EVALUATING GEOPORTALS

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ABSTRACT

EVALUATING GEOPORTALS

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The idea of sharing data is the most important element for geographic information infrastructure, data standards and quality. To achieve this; building spatial data infrastructure, sharing and the presentation of the data concepts are available throughout the world. Following the production of data, there are specific standards such as ISO TC/211, INSPIRE and OGC to define rules and procedures of data sharing. Following the production of the data within certain standards, it is important to reach the data through a "door, gate"-like state of the environment. At this point, the portal architecture and technology are essential to respond to this need. It is important that predefined data can be shared through a single interface. Moreover; this sharing environment should have certain standards in order to respond specific needs and to work more efficiently. On the other hand; recent technological developments require improvements in the existing Geoportals and addition of new features. Sustainability of the Geoportal can be achieved by providing the fundamental features, by adapting to technological developments and by consideration of responses to user expectations. In this thesis; Geoportal components are evaluated via a survey by employees in public sector, private sector and academia in Turkey. According to survey results; national and international standards, selection and visualization data on map interfaces are considered to be the most

significant features. In this context, this study aims to define the importance of Geoportal components in line with technical perspectives, analysis of world examples, international approaches on spatial features and users' evaluations.

Keywords: Geoportal, Geoportal Design, Spatial Data Infrastructure, Spatial Metadata, Spatial Based Web Services

ÖZ

COĞRAFİ VERİ PORTALLARININ DEĞERLENDİRİLMESİ

Con, Eren
Yüksek Lisans, Jeodezi ve Coğrafi Bilgi Teknolojileri Bölümü
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Verinin paylaşılması fikri hem Coğrafi Bilgi Sistemleri altyapısı hem de verinin standardı ve kalitesi için önemlidir. Bu yapının sağlanabilmesi için, dünya genelinde kabul görmüş Mekânsal Coğrafi Veri Altyapısı'nın sağlanabilmesi, verilerin paylaşılabilmesi ve bunların sunulması benzeri yaklaşımlar bulunmaktadır. Bu verilerin üretilmesinin ardından, paylaşılması için de yine belirli standartlar olan ISO TC/211, INSPIRE ve OGC Servisleri benzeri uluslararası kurallar ve yaklaşımlar bulunmaktadır. Bunların yanında; bu verilerin belirli standartlar dâhilinde üretilmesinin ardından verilere temel bir "kapı, geçit" benzeri ortamdan ulaşılması durumu önem arz etmektedir. Bu noktada portal mimarisi ve teknolojisi bu duruma cevap verebilecek önemli bir yapıya sahiptir. Tek bir ara yüz üzerinden; tanımlanan verilerin paylaşılması durumu önemlidir. Bu paylaşılan ortamın belirli ihtiyaçlara cevap vermesi ve daha verimli çalışması amacıyla belirli standartta olması gerekliliği bulunmaktadır. Bunun yanında, güncel teknolojik gelişmeler mevcut Coğrafi Veri Portallarının iyileştirilmesi ve yeni özelliklerin eklenmesi ihtiyacını doğurmaktadır. Sürdürülebilir bir Coğrafi Veri Portalı için temel özelliklerin sağlanmasının yanında, teknolojik gelişmelere uyum sağlanması ve kullanıcı ihtiyaçlarına cevap verilmesi gerekmektedir. Bu amaçla Türkiye genelinde kamu sektörüne, özel sektöre ve akademisyenlere yönelik olarak Coğrafi Veri Portalı özelliklerinin değerlendirilmesi

amacıyla anket yapılmıştır. Sonuç olarak; Ulusal ve Uluslarası standartlara uyum, harita üzerinden veri seçimi ve veri görselleştirmesi ortak olarak en önemli unusurlar olarak değerlendirilmiştir. Bu bağlamda, bu çalışmanın amacı Coğrafi Veri Portalı bileşenlerinin önem derecelerinin teknik yaklaşımların yanında, dünya örneklerinin incelenmesi, uluslararası yaklaşımlar ve kullanıcı bakış açısıyla belirlenmesidir.

Anahtar Kelimeler: Coğrafi Veri Portalı, Coğrafi Veri Portalı Tasarımı, Mekânsal Veri Altyapısı, Mekânsal Meta Veri, Mekânsal Özellikli Harita Servisleri

To Spatial Thinking

To My Parents

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CHAPTER 1

INTRODUCTION

Nowadays, information systems define the framework of the processes of data whose quality, accuracy and continuity are the requirements for the efficient operation of these systems. According to Hilbert and Lopez, 1,000,000,000 gigabytes of data was stored between 1986 and 2007 (URL 1). Although large quantities of data continue to be produced with the development of new technologies, only reliable, intelligible and common data can be used in official transactions. In this context, the scope of the data production and its usage become important within this complex structure. In data production stage, the most important factor is the credentials of the data that is metadata. Also, usage of the data is defined within the legal framework such as copyrights perspective. Data user is informed as far as the information given by the data producer. At this point; Portal structure which is an intermediary between the producer and user of the data, becomes essential item to exchange data in a reliable structure.

In this context, data is the most important component in the field of Geographic Information Systems as well as in many other fields. Especially data sharing according to the needs and purposes is an absolute necessity. Spatial based decision makers are in need of accurate data and data producers are responsible for producing data used in decision making process. Not only establishment of the Geoportal is sufficient, but it should have a comprehensive framework and respond to the user needs.

Around the world, countries or organizations design Geoportals and implement some properties on it. Although some of these properties resemble each other, they are

differentiated based on the standards, user needs and also future needs of the technological infrastructure.

On the other hand; standards and technological perspective should be compatible with the user's requirements and their expectations from Geoportal. In this point, it can be stated that Geoportals have basic features and additional features can be added depending on the interoperability and in order to get maximum benefit from them.

Along this scope; main aim of this thesis is to determine the present and near future Geoportal components according to the technical requirements and user needs. The other important issue is that the outcomes of this thesis can be used as the basis for establishing the new Geoportals or modifying the existence ones. In this framework; this thesis is composed of the literature review, concepts and approaches to Geoportal, analysis of world examples and comprehensive survey parts.

In literature review part; studies, articles and resources are examined and discussed. The literature review covers topics from the definition of the Geoportal to their implementation of the data themes. The scope of the literature review is not only to provide an overview of the previous studies, but also to support the originality of the dissertation.

In 'Concepts and the Approaches to Geoportal' part, main principles and their relations to Geoportal are examined. Service oriented architecture, spatial data infrastructure, metadata and geographic metadata, data integrity and INSPIRE Directive and the needs of Geoportal and operating principles are defined as the main topics.

Another important point is the analysis of the successful and distinct implementations of Geoportal worldwide. INSPIRE Geoportal, United States Geoportal - GeoPlatform, Group on Earth Observations Geoportal – GEOSS and France Geoportal – Geoportail are examined according to the Geoportal concepts and approaches. The world examples are studied under the headings of accessing data and services, metadata operations, themes, standards and interoperability and spotlights. The analysis also contributed to the survey framework.

In addition to the world examples, the thesis also includes an overview on Geoportal applications in Turkey. First national scale Geoportal application was implemented by the Ministry of Environment and Forestry. Due to negative feedbacks and assessments, this Geoportal was scheduled to be redeveloped. Currently, Ministry of Environment and Urbanization is responsible for developing and managing the National Geoportal. The map visualization side of this Geoportal has been published and the rest of the features still continue to be developed. In addition to that; General Directorate of Mineral Research and Exploration provide the Earth Sciences Geoportal. Although it should present geological data within the Geoportal perspective, this Geoportal can be used only to visualize the provided data.

The key point of the thesis is to define the relation between the technical perspective of the Geoportals and the user needs. It is very important that the convergence of the technical perspective and the user needs about the Geoportal features are mapped. For achieving this issue, a survey is created and conducted on the employees of public institutions, private sector and academics provided that they are the main contributors and decision makers of the Geoportal systems. The scope of the survey is limited to Turkey. In the formation process of the survey; world examples, technical requirements and technological perspective of the future needs are used as the bases of the questions. In this point, the answers are interpreted and overall assessment is given based on sector and experiences.

CHAPTER 2

LITERATURE REVIEW

Geographical Data Portal studies are among the topics mainly discussed in the last 10-years period. Especially, under the principles of geographic data availability and interoperability principles, data sharing from the common interface is necessary for common data users. Although there are some studies performed about Geoportal and its sub-components, these studies are mainly subjects or country specific. Geoportal components which are discussed in an expanded form in the following sections are generally composed of the National Spatial Data Infrastructure, global or regional standardization studies and their outcomes. Even though there are some studies and reference documents provided, the Geoportal implementations change depending on the decision makers approach towards the system. In the following sections some of the recent Geoportal studies and their contents are summarized.

Two important studies provide the general framework about the portal and their classification. Maguire and Longley (2005) and Tang and Selwood (2005) have two main approaches to classify the Geoportals. They are similar with slight differences. Maguire and Longley (2005) build the Geoportals within two basic frameworks. On the other hand Tang and Selwood (2005) classify the Geoportals in three main components. According to the first approach Geoportal is defined with “Catalog” and “Application”. On the other hand, second approach entitle the portals in three different categories; “Catalog”, “Application” and “Enterprise”.

Catalog Portals: Tang and Selwood (2005) explain the catalog portals as the accessible structure depending on the metadata records of data that can be searched by the user. In catalog portals, users can access the data and services that are provided by the authorized data providers.

Application Portals: Tang and Selwood (2005) state that application portals "can be tailored to meet specific needs, and the interface designed to provide efficient access to those data and functional services needed" (p.36). On the other hand Maguire and Longley (2005) explain briefly the application portals as interface that combine the necessary tools for the operations by the users.

Enterprise Portals: Tang and Selwood (2005) explain the enterprise portals as the comprehensive structure that enable quick access in recurring transactions, in enterprise and common used systems. These types of portals are widely used in large companies that automate the sharing processes.

On the other hand; Longueville (2010) defines by addressing the today's technology of Geoportals within the Web 2.0 concept. Longueville (2010) describes Geoportal as an instrument that does not only connect the data and services on web based application but also supports the searching, presenting and data exchange via geospatial infrastructure.

Another approach deals with the importance of the components when setting up Geoportals. Tang and Selwood (2005) set four fundamental principles for the Geoportals. These are composed of the search accuracy, speed, simplicity/ease of use and interoperability and integration. According to them, non-standard base or not fully completed metadata schemas lead to undesired search results and cause users not to be able to directly focus to their target easily. Moreover; ease of use principle is supported with the "what, where and when question and its reflection on to the design of the Geoportal" (p.38).

According to the specific subject, Geoportals are taken as a tool for providing data from the common sharing platform. Berry et al. (2010) emphasize the importance of the Geoportal with socio economic analysis. WISERD (The Wales Institute of Social and Economic Research, Data and Methods) aims to manage socio economic data through the single and easily accessible interface with free and open source infrastructure. They set four main benefits of Geoportals namely, the integration and management of the data, implementation of different methods both in quantity and

quality, production of new policies with the comprehensive data usage and building a guidance and capacity for analysis studies.

Oana et al. (2012) explain the benefits of the Geoportal in evaluation and monitoring systems. They set the relation between the European Habitats Directive; INSPIRE Directive and their implementation framework on the Geoportal. In their study; they use the Romanian Natura2000 Areas, which is the European Union's natural conservation area and their establishments through the Geoportal. Their Natural Conservation based Geoportal bases some standards such as ISO 19115 and ISO 19119 for metadata standards and INSPIRE Annex I for data models. This Geoportal implementation aims to provide base datasets such as administrative units and transportation data themes, monitoring the natural habitats and the wild species to the decision makers, analyst and data beneficiaries.

Hoarau (2012) sets a general framework for presenting the remotely sensed data and map visualization via Geoportal in the case of France Geoportal. This study is not only focused on the presentation of the data but it also tries to set the convenient use of the Geoportal. In this study, different types of image provision are used such as superposition or the transparency settings.

Sakkopoulos et al. (2012) discuss the importance of accessing data through Geoportals with the data standardization focusing on spatial planning. They stress the importance of making the European wide data access and use them for supporting decision makers to give sustainable spatial planning decisions. They focus on data access and metadata generation principles based on INSPIRE Directive that support the European wide data solidarity.

Sladıć et al. (2012) study the use of Geoportal in landslide monitoring and risk assessment procedures. They handle not only Geoportal as data management and sharing tool but also alert users in land slide activities. Besides, Geoportal and its real time connection within the instant access data framework importance are evaluated and its implementation is taken into account.

Moreover; Koshkareva et al. (2008) establish the relation between Spatial Data Infrastructure and Geoportal. They set the benefits of the Geoportal when creating consistent and interoperable data in establishing up a national spatial data infrastructure.

Shaon and Woolf (2011) conduct a study by creating a relationship between the Geoportal and metadata. They provide ideas about long term availability of the metadata with models and some principles such as sustaining the healthy structure of the geospatial data storages, web service oriented infrastructure, standardization in metadata and user friendly applications. They consider Geoportal as the connection point between the user, spatial data and its storage.

Granell et al. (2010) describe and set general framework that show the importance of service oriented architecture approach and web services within the environmental model perspective. This study stresses the importance of the data accessibility, reuse of web services and more efficient utilization of the services. Their aim is to create reusable services architecture that meet the common needs of services or data users. Their works also include INSPIRE and Open Geospatial Consortium (OGC) web services and other standard base approaches.

Crompvoets et al. (2004) conducted a survey with 20 countries and 65 coordinators in 2003 in different parts of Europe that focused on the necessity and benefits of the European-Wide based Geoportal usage in accordance with the INSPIRE Geoportal. Impact assessment of the INSPIRE Geoportal Document was created for evaluating the economic, social, and environmental impacts of the INSPIRE Geoportal based on this survey.

According to Crompvoets et al. (2004), main benefits of the INSPIRE Geoportal are explained as “better data availability (90% of geo-portal coordinators), spatial data awareness (70%), and improved cross-border policy making (60%)”. On the other hand; language (45 %), institutional problems (45 %), and national laws protection (40 %) are considered for improvement. In addition to that; users indicate that new data themes should be created and these should include the administrative boundaries (90 %), transport networks (80 %), geographic names (70 %) and land cover (70 %).

The topics discussed in relation to economic factors include two perspectives. First is the consumption of spatial data and second is the avoidance of spatial data duplication. Survey indicates that the data consumption increases and data replication decreases with the increased use of Geoportal.

As the survey shows; INSPIRE Geoportal has positive effects on perception of spatial data and national or international interoperability that are considered as the Social Indicators. In addition to this, environmental indicator is seen as the consistency of information supply to environmental policy. It is stated that INSPIRE Geoportal promotes the environmental conservation and strengthens its own policies (Crompvoets et al., 2004).

This study produces results about the regional impact assessments in four different parts of Europe namely North, East, West and South Europe. Although European Regions show similar approaches, their priorities change depending on their needs and policies. It is seen from the results that North Europe does not consider the avoidance of data replication as much as the other parts of the Europe. East Europe identifies the positive effects of the INSPIRE Geoportal reducing the costs and increasing the quality of geo information perspective. West Europe emphasizes the EU participation and “cross border policy- making”.

CHAPTER 3

BASIC CONCEPTS AND APPROACHES OF GEOPORTAL

Geoportal, in general, provides the general framework required to access geographic information and accessibility criteria via both intra and internet. According to the Open Geospatial Consortium (OGC, 2004), Geoportal is "a human interface to a collection of online geospatial information resources, including data sets and services" (p. 1). Maguire and Longley (2005) explain the Geoportal as "gateways to geographic content and capabilities" (p.2).

Geoportals are designed by combining the perspective of geography, data and the information system and it enriches these concepts by harmonizing them. This harmony can be explained with two points of views; the first is accessing spatial data, second is the increase in the information technology usage in the user-defined context.

Geoportals provide a single media for presenting a different combination of data or systems. Geoportal works on a web based platform and runs on both intranet and internet infrastructure. This situation leads to the necessity of using certain technological approaches. In this scope, Service-Oriented Architecture (SOA) stands out as an essential tool for the solution of working stable systems.

According to the Geographic Information System concept, information infrastructure is important for accessing the desired result. However user interaction, meeting the requirements of the users and the perception of the geographic entities are essential as much as the information infrastructure. In line with this, Human Oriented Architecture (HOA) approach studies direct relations between service providers and the users.

3.1 Service Oriented Architecture (SOA)

The purpose of Service Oriented Architecture (SOA) is to collect applications written for different purposes and with different software processes under one roof ensuring to serve for one purpose. SOA is a service architecture approach that allows using one service's data or functions by other services in accordance with specific standards. According to the Newcomer and Lomow (2004), service oriented architecture is defined as a "composition of services across disparate pieces of software, whether old or new; departmental, enterprise-wide, or inter-enterprise; mainframe, mid-tier, PC, or mobile device, to streamline IT processes and eliminate barriers to IT environment improvements" (p.1).

Considering the relationship between the SOA and Geoportal, the topic of web service stands out as an important issue. Web services structure supports the nature of the Geoportal due to its network based structure and independency from software elements. In section 3.1.1, web service approach is presented and the spatial based web services are explained separately.

3.1.1 Web Services

World Wide Web Consortium (W3C), which sets the standards for development of web applications, describes the web services as "a software system designed to support interoperable machine-to-machine interaction over a network" (URL 2). Moreover, interaction among web services is explained as "a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other web-related standards." (URL 2)

In Figure 1, W3C's SOA and Web Services schematic representation is presented. Web services allow transactions within the service cycle in a network base environment. They are responsible of interaction, publishing and finding services between the requestor, provider and discover structure.

Figure 1. W3C's SOA and Web Services Schematization (URL 3)

When considered from Geographic Information Area and Geoportal perspective; data, information and services are produced or gathered and viewed, manipulated or analyzed with different software tools. In this respect, SOA provide data and service sharing by many providers and it offers appropriate solutions which are developed under different development roots. When the above structure is transferred to the Geoportal structure; service requestor represents the clients who find the desired data or directly use the service providers' abilities in service description rules. While the service provider creates an infrastructure for the Geoportal operations, the discovery agencies represent the metadata that can be published via service providers or requested by the service requestor.

3.1.2 Spatial Based Web Services

Web service concept is essential for Geoportals to achieve their objectives. One of the basic principles of the Geoportals is the accessibility of data independently by the authorized users within the certain protocols and common interfaces. In the spatial concept perspective; geographically defined data can be presented as a web service in line with the spatial feature context. These services contain different purposes and contents. The users of the spatial web map services can use these services according

to their aims or scope of the data presentation. This service relation needs to use standards to operate in the pre-defined structure to avoid mismatch of the different service producer schema. Open Geospatial Consortium (OGC) provides web based spatial map service standards in order to solve this complexity and it is worldwide accepted.

In this study; Web Map Service, Web Map Tile Service, Web Coverage Service, Web Feature/Transactional Service, Web Processing Service and Catalog Service for the Web are discussed depending on OGC standards. All of these services have different functionalities and these properties are explained below according to Geoportal framework.

Web Map Service (WMS)

WMSs are basically used for publishing data from the network based services like image files that can be viewed and whose attributes can be queried depending on the provided framework. OGC defines Web Map Service as "a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases (returned as JPEG, PNG, etc.) that can be displayed in a browser application" (URL 4). Although web based map services can be provided in different structures, the standard based service provision is accepted as the mature level that creates the main philosophy of the web map services. Moreover, Geoportal also needs the standard base services to harmonize and provide data in a single infrastructure.

Web Map Tile Service (WMTS)

WMTS provides pre-cashed images which are spatially defined depending on the references system, where providers use these services for keeping their system stable with the large scale data. OGC defines the WMTS as more advanced use of WMS that "improve performance, instead of creating a new image for each request, WMTS returns small pre-generated images (e.g. PNG or JPEG) or reuses identical previous requests that follow a discrete set of tile matrices" (URL 7).

According to the WMTS and the Geoportal relation perspective; Geoportal is used by many different users who need to scan many of the raster data and examine them. In addition to that, cache mechanism of this service supports the sustainable usage of Geoportal. Cache mechanism provides high resolution base maps with the tile structure that separates the images within different levels of detail presentation.

Web Coverage Service (WCS)

WCS is explained as "retrieval of geospatial data as 'coverages' – that is, digital geospatial information representing space/time-varying phenomena". OGC (2010) explains the coverage as "feature that acts as a function to return values from its range for any direct position within its spatiotemporal domain" (pp. viii-2). In Geoportal perspective; web coverage service is suitable for responding to different requirements of portal stakeholders from single data. Users can extract data and its properties fully or partially according to coverage properties via portal infrastructure and the standard web services. OGC says that "WCS allows clients to choose portions of a server's information holdings based on spatial constraints and other query criteria" (URL 5).

Additionally, in terms of human oriented service provision, this technical infrastructure enables users to communicate with the data to receive the desired results. In this point; OGC explains the interaction between the coverage services and the users as "this service provides access to coverage data in forms that are useful for client-side rendering, as input into scientific models, and for other clients" (URL 5).

Web Feature Service and Web Feature Transactional Service (WFS/WFS-T)

WFS provides an interface that enables users to get information about the spatial feature of the data and to make operations with the data via network enable infrastructure. OGC (2005) explains the WFS as "the operations support insert, update, delete, lock, query and discovery operations on geographic features using HTTP as the distributed computing platform" (p.1). In WFS, clients use the Geography Markup Language (GML) which is known as the spatial featured xml

standard by OGC. WFS contains the geographic information format that client and server communicates and it resembles users' works on vector data.

On the other hand; WFS and WFS-T can be differentiated on some functionality. While WFS provides basic queries on served data, WFS-T allows opportunities for making changes in the physical properties of data. WFS data provides more detailed information about the data and users can edit or make changes on the data with the transactional property of the WFS. According to the needs of data sharing, data can be provided via WFS-T and users can edit via Geoportal. If there are no arrangements requested, then data can be provided in WFS.

Web Processing Service (WPS)

WPS provides spatial analysis features on data through which users can make spatial analysis via web service based data and functions. OGC defines the WPS and its standards as "rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay" (URL 6). Types of analysis to be performed with the help of WPS can be provided as tools for users and "the data required by the WPS can be delivered across a network or they can be available at the server" (URL 6).

According to the Geoportal perspective, WPS provides spatial based analyst operations on provided data. In some situations, this service is very useful to get desired results from the data owner such as creating a buffer from wetlands. In this situation, users do not reach the whole data provided by the data provider but only get the analysis results.

Catalog Service for the Web (CSW)

Data or service sharing and searching is very important for accessibility of the data from the network associated processes especially for the Geoportal. Data is submitted with its credential that is the metadata and clients search their data needs via this predefined features. On the other hand; data providers can publish their data

in many different types of structure. This situation causes undesired results for accessing the correct services or data for the clients.

In this framework, Catalog Service for the Web is defined by the OGC (2007) as the "key technology for locating, managing and maintaining distributed geo-resources (i.e. geospatial data, applications and services)" (p.19). Moreover, in order to resolve the complexity of the data provision, OGC provides a standard for the Catalog service and states that "client applications are capable of searching for geo-resources in a standardized way (i.e. through standardized interfaces and operations)" (p.19).

The administration side of CSW should control the conformance and clients should be addressed in a meaningful structure with metadata standards. Core functionalities of the main structure of the metadata are given below.

- Data and service discovery
- Discovery of metadata management
- Definition of data and service types and its features
- Structure of the data searching words
- Thematization
- Matching request to the data or services
- Create indexing (Lieberman, 2008).

According to the Geoportal perspective; the catalog service is located in the hearth of the system operations and this service not only controls the exchange between the requests and results by the users but it also supports the consistency of the user and Geoportal interaction. According to the INSPIRE (2010), CSW controls the circulation of the data within the system and connects the clients via the CSW features and its operations. In Figure 2, the connections between the clients and system dynamics via the control of the CSW are given. Clients can search their desired data and get the request via CSW. And then CSW gets the result and deliver them to the clients.

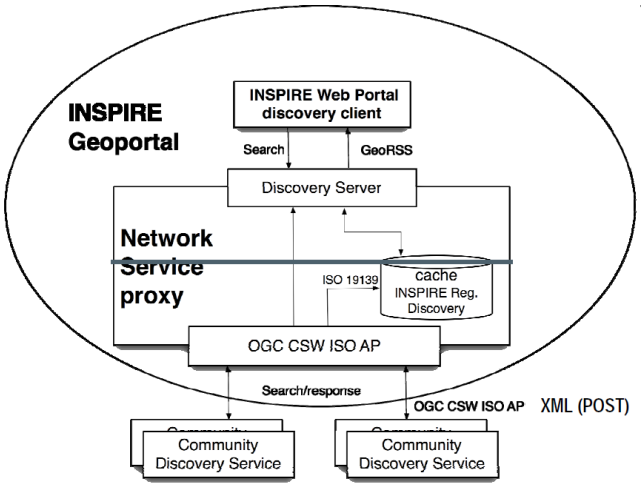

Figure 2. Connection schema of the Clients and the System via CSW (CSW EC (INSPIRE, 2010))

3.2 Human Oriented Architecture

HOA is an approach that brings together the user needs and the technical infrastructure of the systems. HOA combines the features of SOA and takes it further by adding value to its features. It values also the requirements of the user, graphical user interfaces and technological perspective of the applications. Luke Hoffman, who is the author of Journey of the Software Professional: A Sociology of Software Development, explains the interaction between the system and user needs as "matching architecture to human needs is matching roles and responsibilities of the people building a system to the appropriate parts of the architecture" (as cited in Venner, 2004). Jim Kobelius also explains the importance of HOA. He indicates that while SOA directly deals with the resource usage, HOA adds to it and deals with the user contribution or means for enabling contribution to the systems (McKendrick, 2007).

According to the Geoportal perspective; interaction of the Geoportal with the user, technological perspective such as mobile application software version and requirements of the system itself can be considered within the HOA approach. The

most important feature of geographic data is that its user creates a perceptual and visual interaction. Besides, users of the Geoportal not only use the services but also they provide metadata information to the system, make spatial based queries and analyses. In addition to that; type of spatial based web services, which are provided to the clients of the Geoportal, can be determined in this context.

3.3 Spatial Data Infrastructure and Geoportal Relation

Data should be produced or shared in an adopted and understandable way for the community in each country. According to Nebert (2004) "Spatial Data Infrastructure (SDI) provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, and academia and by citizens in general" (p.8). Moreover for achieving this; Global Spatial Data Infrastructure Association (GSDI) emphasizes the necessity of standardization for sustainable and reliable data access, and also its usage in spatial based data and services (Nebert, 2004).

Countries around the world try to establish their own consistent and accessible spatial infrastructure, which is defined as National Spatial Data Infrastructure (NSDI). For example, United States developed three principles consisting of identification, achieving and sharing quantitative data in standards, which access the metadata online via the logic of exchange network, and the creation of datasets that surrounds whole country (URL 8). The USA explains the necessity of consistent spatial data infrastructure that the government agencies or organizations need during important times such as disasters, security situations or environmental indicator monitoring. Moreover; importance of accurate and up to date data is highlighted in terms of cost effectiveness and efficiency (U.S. FGDC, 2005).

On the other hand; India emphasis the importance of the SDI and sets a vision for organized spatial data and their accessibility. They plan to use the sustainable data infrastructure in "crime management, business development, flood mitigation, environmental restoration, community land use assessments and disaster recovery" (GSDI Technical Working Group, 2008, p.1). Their political objective in designing a

national spatial data infrastructure is managing the data in different levels of administrative structure namely Community, Local, State, Regional and National Levels (URL 9).

In addition to that, an institution's or a country's national spatial data infrastructure should be considered in accordance with specific standards. There are some organizations operating in this field worldwide and they set some standards and policies for creating a comprehensive standard framework.

GSDI Association is one of the organizations that set a rule to "promote international cooperation and collaboration in support of local, national and international spatial data infrastructure developments that will allow nations to better address social, economic, and environmental issues of pressing importance" (URL 10).

GSDI has revealed certain principles that aim to raise awareness towards standards in the world. On the basis of these principles, GSDI explains the importance of setting standards. The purpose of these studies promoting compliance with the international standards is to freely access data across the country or around the world (URL 10). Mainly the standardization is a way to access the well desired data in most accurate way. In the process of being established, SDI and GSDI state that Geoportal providers should think "about the data content standards geographic, location gazetteer, geodetic reference systems, and feature type catalogs, national information profiles of international standards, data policies and laws." (Nebert, 2003).

According to the GSDI; SDI should comply with recommendations of the International Organization of Standards (ISO TC 211, TC 204, and JTC-1), World Wide Web Consortium (W3C), Open Geospatial Consortium (OGC) and National Standards Organizations. Moreover; it is expressed that when designing a national SDI, regional SDIs and SDIs of other countries should also be considered (Nebert, 2004).

Infrastructure for Spatial Information in Europe (INSPIRE) is also an important organization dealing with SDI. INSPIRE tries to establish European wide available and compatible spatial based data in terms of common needs of SDI across the EU Countries. It explains the SDI as "a framework of policies, institutional arrangements, technologies, data and people which enables the sharing and effective usage of geographic information" (Tonchovska, 2010).

In addition to this; INSPIRE explains the goals of the SDI as to provide different levels of data to different users with collaboration of the different sectors in the country. The most important aim is expressed by the INSPIRE as the decrease of duplication of data while increasing its use and quality (Tonchovska, 2010). In Figure 3, INSPIRE sets SDI elements as standards, metadata, thematization of the data, reference data, services and networks.

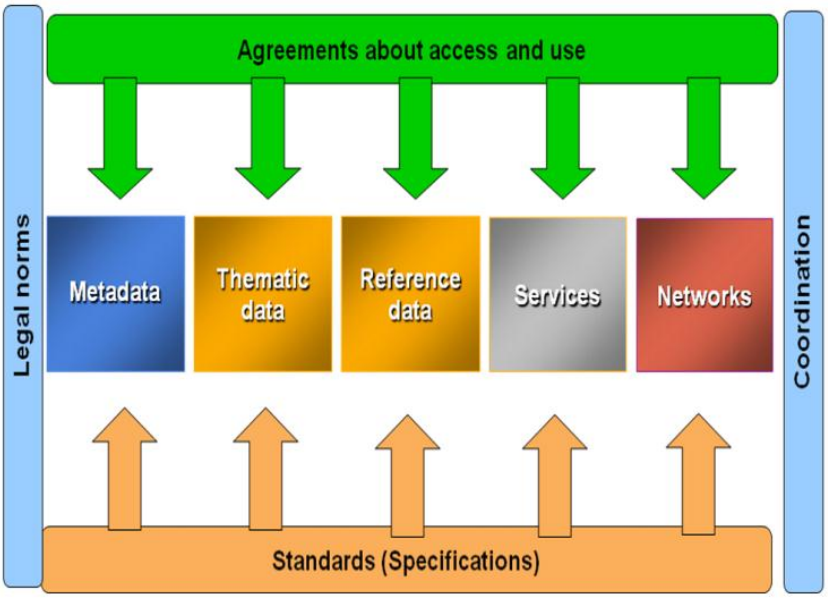

Figure 3. SDI Components (Tonchovska, 2010)

In this context; presenting the SDI through a single entry point as a Geoportal is suitable to achieve and promote the goals of SDI approach. INSPIRE states the immediate priority for the SDI as: to provide data such as orthophotos, vector and

raster data within the defined and common coordinate system (Tonchovska, 2010). On the other hand; it is stated in the Europe and Central Asia Knowledge Brief about the spatial data infrastructure that; compliance with standards and strategic objectives are the important elements during the design phase of SDI (Tonchovska et.al. 2012).

Moreover; GSDI states that the Geoportal builds a top framework for creating a national wide SDI. Geoportal is a tool that links and promotes the standardization, common data sharing and geo infrastructure (Nebert, 2003). In technical details of the Geoportal; web based map services provide and present data in pre-defined standards. These are participation, public review about the data theme accepted by the authorities and usage of the data via Geoportal infrastructure.

3.4 Metadata and Geographic Metadata

Metadata is shortly defined as "data about data". FGDC explains that metadata provides information about the characteristics of the data and it represents "who, what, when, where, why and how of the resource" (URL 11). In addition to that; National Information Standards Organization (NISO) (2004) explains the metadata as "structured information that describes, explains, locates, or otherwise makes easier to retrieve, use, or manage an information resource" (NISO, 2004, p.1). Metadata generally includes the information about the data provider, time of data creation and explanations about them.

The overall structure of metadata is discussed under three main headings; descriptive metadata, structural metadata, administrative metadata. In descriptive metadata; general information is given such as its scope or its owner. In structural metadata; technical details about the data is set and users can understand the internal layout of the data. In administrative metadata; management framework is designed and the accessibility, right management and preservative information depending on the legal instruments are given (NISO, 2004).

When metadata is considered as spatial and geographic data; it includes the spatial based information in addition to standard metadata features. FGDC explains that "geospatial metadata commonly document geographic digital data such as GIS files,

geospatial databases, and earth imagery but can also be used to document geospatial resources including data catalogs, mapping applications, data models and related websites" (URL 11). Information about spatial metadata also includes boundary, reference system and its attributes (URL 11).

Moreover, identification of the metadata based on standards is the important point for sustainable use of data. International Organization for Standardization (ISO), which is the standards organization accepted all around the World, sets international standards for the geographic based data under the ISO/TC 211 committee.
This committee provides ISO documents which start with the No.19, documenting for the GIS area. Metadata related documents of the ISO series used in the Geoportal and their explanations are given below;

- **ISO 19115:2003 Geographic Information – Metadata- Part1 - Fundamentals:** "defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data" (URL 12).
- **ISO 19115 – 2: Geographic Information - Metadata - Part 2 - Extensions for Imagery and gridded data:** "extends the existing geographic metadata standard by defining the schema required for describing imagery and gridded data. It provides information about the properties of the measuring equipment used to acquire the data, the geometry of the measuring process employed by the equipment, and the production process used to digitize the raw data." (URL 13).
- **ISO/TS 19139:2007: Geographic information -- Metadata -- XML Schema Implementation: "**defines Geographic Metadata XML, imagery and gridded data (gmi) encoding an XML Schema implementation derived from ISO 19115-1, 19115-2" (URL 14).
- **ISO 19110: Geographic information – Methodology for Feature Cataloging:** "An affiliate standard that supports the detailed description of

feature types (roads, rivers, classes, rankings, measurements, etc.) in a manner similar to the CSDGM Entity/Attribute Section. The standard can be used in conjunction with ISO 19115 to document geospatial data set feature types or independently to document data models or other feature class representations" (URL 15).

- **ISO 19119: Geographic information - Services - Amendment 1:** "Extensions of the service metadata model. An affiliate standard that supports the detailed description of digital geospatial services including geospatial data portals, web mapping applications, data models and online data processing services. The standard can be used in conjunction with ISO 19115 to document services associated with a specific data set/series or independently to document a service" (URL 15).

Metadata is produced to understand the content of data and its features for data users or systems. Within system perspective, Geoportal not only presents the metadata but also creates and publishes the metadata via defined interfaces provided by the system dynamics. According to the Giuliani and Peduzzi (2011), it is stated that data interoperability and the publishing, searching and discovery of metadata via pre-defined and standard base interface is very important to reach the desired data. Moreover; it can be said that the Geoportal provides an additional contribution to the production of metadata in standard base via pre-defined interfaces. In the same article it is said that "reaching such level of agreement has allowed to ease the quality check both for completeness and accuracy, to update and harmonize input data sets (and create their metadata)" and "to ensure that all data producers use the same norms" (Giuliani and Peduzzi, 2011, p.57).

Geoportal internal dynamics works on the technological infrastructure that is responsible for fulfilling the needs of portal users. In this context; metadata has an important role in data or service publishing, and it is managed via the data services. Lemajić and Rašić (2008) state that "Geoportal offers a metadata-driven catalogue-service for publish-and-find functionality" (p.148).

On the other hand; Geoportal ensures the interoperability principles and availability of the data. According to Stutte et al. (2012) INSPIRE perspective tries to create a European based spatial data infrastructure via Geoportal discovery tools as "support queries on metadata catalogues provided in the 23 official languages, the INSPIRE Geoportal catalogue builds up a search index and that unifies the catalogues of the member states under one single roof" (p.1).

3.5 Data Integrity and Geoportal: Infrastructure for Spatial Information in the European Community- INSPIRE

Besides establishing the national spatial data infrastructure and creating metadata to manage the spatial data, INSPIRE Directive tries to achieve the integrity of spatial data. In the fourth paragraph of the Directive, the superior aim is explained as follows "the infrastructure should assist policy-making in relation to policies and activities that may have a direct or indirect impact on the environment" (INSPIRE Directive, 2007, p.1). On the other hand; managing and gathering information from different parts of the European Union with a pre-defined standard as a spatial basis is a necessity for the continuity of its structure. In fifth paragraph, creation of the spatial data with common standards and checking its compatibility are expressed as duties of member states. (INSPIRE Directive, 2007).

In the third paragraph; some problems according to "availability, quality, organization, accessibility and sharing of spatial information" is introduced and public authority regulations are shown as a controlling mechanisms, thus INSPIRE Directive states that overarching mechanism for different data user is needed for achieving the European wide desired data structures (INSPIRE Directive, 2007,p.1).

INSPIRE sets some principles for partners of the EU States to work together under the framework of five statements. These are defined as common principles and are given below;

- "Data should be collected only once and kept where it can be maintained most effectively.

- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications.
- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for through investigations, general for strategic purposes.
- Geographic information needed for good governance at all levels should be readily and transparently available.
- Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used" (URL 16).

According to these principles; it is understood that data should be stored and maintained by its producer. In the Geoportal perspective; this situation requires technical and the workflow processes. Additionally, a metadata operation such as metadata validation helps these principles work successfully.

In order to provide INSPIRE compatible Geoportals; countries should follow its requirements. INSPIRE requirements are expressed within five headings: Metadata, Data Specifications, Network Services, Data and Service Sharing and Monitoring and Reporting.

INSPIRE Metadata Implementing Rules Document describes the requirements of metadata framework with reference to the INSPIRE Directives' third article that states data should have credentials to be accessed easily (EC JRC, 2013). In addition; INSPIRE metadata services are interrelated and compatible with ISO 19115 "Geographic Information – Metadata". Although in some points they are differentiated, in general these two standards set the core requirements of metadata.

INSPIRE intents to achieve through its data specification requirements that data structure is accessible to everyone and is up to date. According to the Guidelines for the Encoding of Spatial Data "spatial information in the Member States will be designed to ensure that spatial data are stored, made available and maintained at the most appropriate level" (INSPIRE Drafting Team Data Specifications, 2008, p.12).

INSPIRE sets thematic working groups in order to categorize and define the thematizaiton of data within the specification requirements framework. These themes are differentiated in three Annexes and practically they are demanded from the stakeholders. In Table 1, the Annexes and their contained themes are provided.

INSPIRE indicates that establishment and maintenance of the technological infrastructure is under the responsibility of member states. Commission Regulation about the Network Services states that stakeholders are responsible for maintaining sustainability of the network services and providing metadata (INSPIRE, 2009).

According to the INSPIRE, Network Services are gathered under the headings of Discovery Services, View Services, Download Services, Transformation Services and Invoke Spatial Data Services. Discovery Services are responsible for "making it possible to search for spatial data sets and services on the basis of the content of the corresponding metadata and to display the content of the metadata." (INSPIRE, 2008, p.9). This service directly deals with the metadata schemas because the discovery framework is designed depending on accessibility of data and services.

View services are created to connect the clients and the data via INSPIRE infrastructure depending on the basic principle of the INSPIRE Directive. It is explained in INSPIRE Directive (2007), network services are responsible for "display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata" (p.7).

In INSPIRE Directive (2007), Download Services are explained according to the service frame as "enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly" (p.7). Moreover; INSPIRE (2008) intends that datasets should be fully accessible or benefit from services like web map services or gazetteer services.

INSPIRE Directive (2007) sets the Transformation Services logical frame in order to provide data for different parts of the community. It sets principles that "enabling spatial data sets to be transformed with a view to achieving interoperability" (p. 7). This service is mainly focused on the reference system transformation and its

consistency. It is used in order to combine different reference systems and to present them in a common reference system.

Table 1. INSPIRE Themes (URL 17)

Annex 1	Annex 2	Annex 3
Coordinate reference systems, Geographical grid systems, Geographical names, Administrative units, Addresses, Cadastral parcels, Transport networks, Hydrography, Protected sites	Elevation, Land cover, Orthoimagery, Geology	Statistical Units, Buildings, Soil, Land use, Human health and safety, Utility and governmental services, Environmental monitoring Facilities , Production and industrial facilities, Agricultural and aquaculture facilities, Population distribution and demography, Area management/restriction/ regulation zones & reporting units, Natural risk zones, Atmospheric conditions, Meteorological geographical features, Oceanographic geographical features, Sea regions, Bio-geographical regions, Habitats and biotopes, 19 Species distribution, Energy Resources, Mineral Resources

Invoke Spatial Data Services are explained as “service allows defining both the data inputs and data outputs expected by the spatial service and define a workflow or service chain combining multiple services“ (INSPIRE, 2008, p.11). In this context, it provides the control mechanism that manages and orchestrates the services or requests from the sources of the data.

In the context of managing the spatial data and producing results around the EU Member States, there should be a controlling mechanism and the means for healthy functioning of the system. For achieving the desired condition, INSPIRE provides its own Geoportal to set defined properties. Luraschi (2010) explains the scope of the Geoportal to promote an “interoperability assessment through use of INSPIRE Network Services” (p.5). On the other hand Geoportal serves “to provide an operational platform to satisfy the requirements of the Directive, regulation” (p.3). Moreover, Bernard et al. (2005) explain the EU Geoportal vision as to “allow users to discover, understand, view, access, and query geographic information of their choice from the local level to the global level, for a variety of uses” (p.1).

INSPIRE Geoportal shows the importance of NSDI, metadata, service oriented architecture, conformance of standards and interoperability. In addition to that; it is vital for the system to get feedbacks and to make improvements. INSPIRE structure and its Geoportal application is a role model for European Union member countries, those are responsible for setting their INSPIRE compliant Geoportal.

3.6 Analysis of Geoportal Features and Different Approaches to Achieve the Most Efficient Outcome

Main task of the Geoportal can be considered as to organize data search functions coming from different directories, data and data services, applications, content and services in different platforms. Geoportals offer the opportunity of online access to data and services via metadata storing. For achieving these functions, Geoportal needs to work on a pre-defined infrastructure. This infrastructure is examined in the Operating Principles in Part 3.6.1.

3.6.1 The Needs of Geoportal and Operating Principles

Users access the Geoportal and publish their data or services with the predefined and required metadata schema. On the technical perspective, Geoportal Services function

via main website, geospatial data and services maintained on the database of metadata. Users can access services or the data from the main website, and search from the background information of data which is stored in the metadata catalog.

Geoportals basically work according to triple framework composed of Geoportal Core Services, Data Providers and Geoportal Clients. Geoportal Core Services provide sustainable internal service flow that links data, spatial service and metadata providers to Geoportal clients. Data, spatial service and metadata providers are responsible for working in accordance with NSDI components, metadata standards and sustainable data provision. Clients are responsible to consume the provided services and requests.

In Figure 4, OGC (2004) defines the Geoportal infrastructure in three categories as broker, provider and requestor. In figure below; broker represents the Geoportal services, requestor defines the users of the Geoportal and providers are the data and service providers.

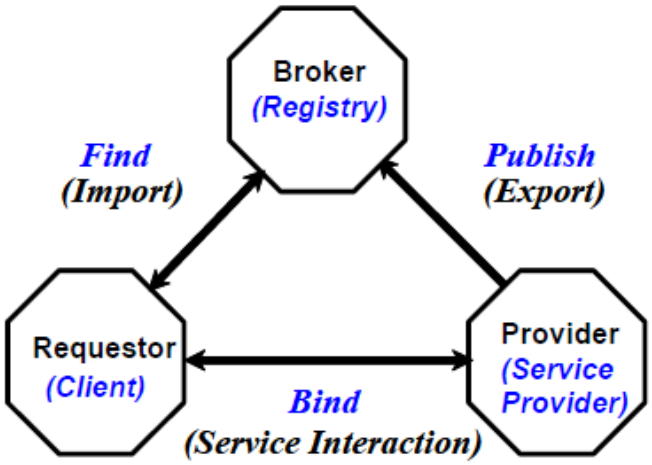

Figure 4. OGC's Geospatial Portal Reference Architecture (OGC, 2004, p.6)

Geoportals are inherently engines that connect the multi data source, services and users and they allow them to communicate with each other through the common infrastructure. In order to provide communication flow in this infrastructure, World Wide Web (www), Hypertext Transmission Protocol (http) and eXtensible Markup Language (xml) stand out as important components.

World Wide Web Consortium, which sets the international standards for www, explains it as "a communication tool intended to allow anyone, anywhere to share information" (URL 18). It works on the internet based platforms working with the hypertext standard that many of the data such as text or images are transmitted via this infrastructure (URL 19).

World Wide Web holds the computers, networks, and services together through HTTP (Hypertext Transmission Protocol). HTTP is defined as "an application-level protocol for distributed, collaborative, hypermedia information systems" (URL 20). Briefly, it is a network protocol to ensure the flow of information through internet infrastructure.

From the perspective of Geoportal, Geoportal services are maintained within a main website and there is communication between the metadata database about geospatial data and services with the information flow infrastructure. Basically; services within this structure is transferred by encoding over HTTP as a web service messages with eXtensible Markup Language (xml). Xml defines a format which allows the data exchange between different systems according to the defined perspective that enables to exchange large scale of data on Web (URL 21).

Users can access the services consistently via Geoportal infrastructure depending on the today's needs. In Geoportal, technical infrastructure is set in order to maintain system harmonization and communication of services with each other. Open Geospatial Consortium (OGC) provides Geospatial Portal Reference Architecture and organizations can use it to guide their Geoportal establishment procedures. OGC (2004) defines the main aim of creating reference architecture as creating geospatial standards for fast and inexpensive portal application

According to Tait, Geoportal architecture is composed of three main layers: web portal, web service and data management. Web portal layer composes of the web interfaces, environments and their functions; web service layer operates as mediator between the users, system functions and data content; data management components consist of data storage as relational database framework and operations via SQL functions (Tait, 2004).

According to the Maguire and Longley (2005) in Figure 5, Geoportal Architecture structure is composed of metadata management, mapping, data download and linking functions working on the spatial mapping server. In addition to that; relational database management systems support the accessibility of the demanded data on Geoportal that many users can access via different modes of data queries or displays.

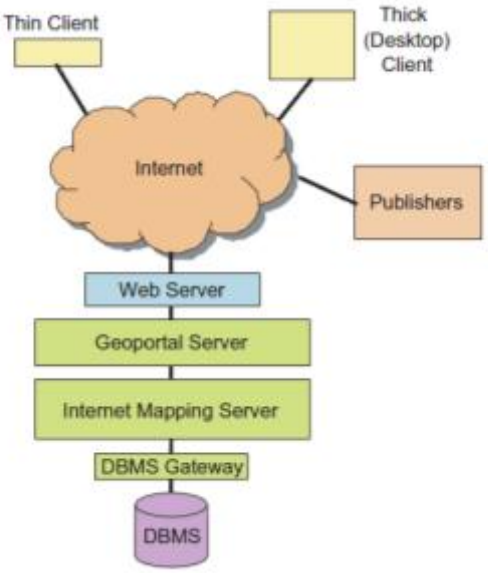

Figure 5. System Architecture for Geoportal (Maguire and Longley, 2005, p.10)

Although different service providers or approaches put forward different reference architectures; basically their functionalities work in the same way. As long as there is available technology, OGC allows unconstraint service structure. This thesis takes the scope of the OGC Reference Architecture as its technical base.

According to the OGC Reference Architecture in Figure 6, core structures of the Geoportals are composed of four components that are responsible for different procedure performances via internet infrastructure. These are; Portal Services, Portrayal Services, Catalog Services and Data Services.

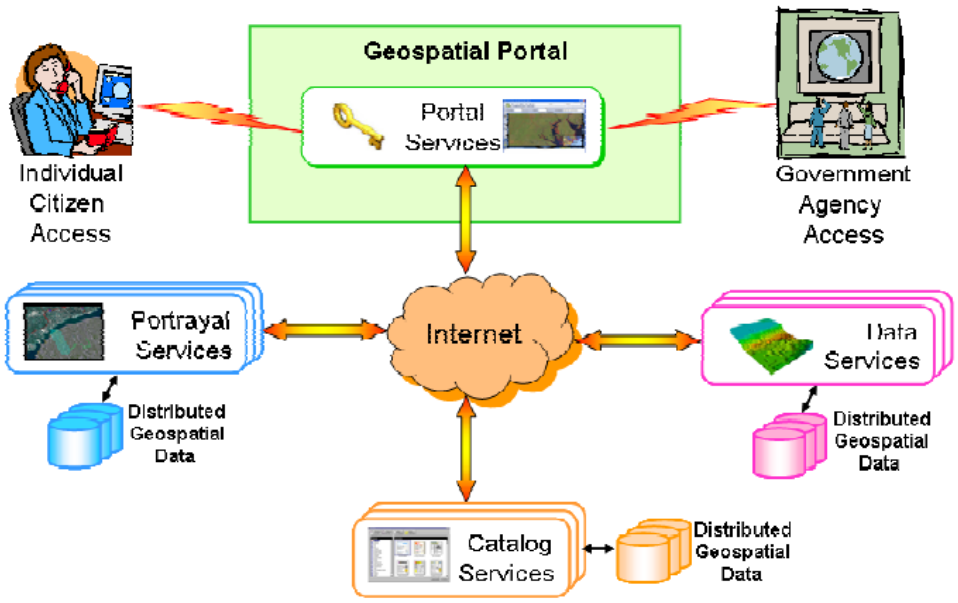

Figure 6. OGC Portal Service Architecture and Service Components (OGC, 2004, p.3)

Portal Services are defined as the bridge between the user and Geoportal infrastructure. They are located above the other three services. Users can access the Geoportal components via portal services with user interfaces (OGC, 2004).

Portrayal Services submit the available data and services in accordance with the specific characteristics of the user's requests. This service is the visualization infrastructure side of the Geoportal (OGC, 2004).

Catalog services are used for searching and finding the intended data or services from the published data on Geoportal. OGC defines the catalog service as a hierarchical structure that enables access data on Geoportal (OGC, 2004).

Geospatial data is stored in the databases and data services can access these services in pre-defined conditions. According to the OGC, data should be referenced in line with their distinguished features. According to the system needs, data can be indexed by the system (OGC, 2004).

CHAPTER 4

ANALYSIS OF WORLD EXAMPLES

Besides the technical and theoretical framework, government organizations or research bodies create and publish their own Geoportals depending on their needs. Although these Geoportals have similarities, they also differ and provide their own particular features.

Main aim of analyzing the world examples is to understand how the existing Geoportals are designed and operated based on their capabilities, technical infrastructure or perspective. In this framework; Geoportals are examined in terms of their feature properties or spotlights.

In this part; INSPIRE Geoportal, United States Geoportal (GeoPlatform), Group on Earth Observations Portal (GEOSS Portal) and France Geoportal (Geoportail) are analyzed according to the above explanations. They are categorized by Accessing Data and Services, Metadata Operations, Themes, Standards and Interoperability, and their Spotlights.

4.1 INSPIRE Geoportal

INSPIRE Geoportal provides basic features meeting the European Union Member State needs in full compliance with INSPIRE Directive. The development and its functioning in a healthy way are under the responsibility of the European Commission. On the technical side, it sets discovery, view, download, transformation; invoke services with the service orchestration perspective.

European Commission INSPIRE Geoportal Team expresses the scope of INSPIRE Geoportal as promoting the interoperability of the service, setting up an architecture

for the successful usage of the INSPIRE Services, testing the requirements of the rules developed by the Directive, getting feedback from the users and performance testing of the Geoportal (Luraschi, 2010).

INSPIRE Geoportal is designed in order to focus on finding and viewing services and metadata management. On the other hand, this portal is capable of working with harmony with the Network Services. As discussed above; although the technical side of the system is important to achieve a healthy working service; user interaction, ease of use, the scope and requirements of the business processes and Geoportal properties are the other important issues for the design of the Geoportal.

INSPIRE Geoportal is designed considering both the technical side and the user interaction. Users can access the Discovery/Viewer, Metadata Validator and Metadata Editor features of Geoportal with the main router screen. This interface is comfortable to use and to cover directly targeted operations.

4.1.1 Accessing Data and Services

INSPIRE combines the data search functions and their visualization on the maps through the web based application. Data search operations can be performed through datasets, series, services, layers, and download service. Results can be filtered by relevance, resource title, origin, and date of creation, date of last revision, resource and service types. Moreover, advance search can be applied according to origin, metadata language, spatial data theme, and topic category and service type.

Additionally, users can select area from the map and the data search function interrelates with this selection. This function is an important tool to follow up the data availability in working regions. After the selection procedure, metadata is provided to the users to examine the content of the data.

In Figure 7 and 8; from the INSPIRE Geoportal “Saline and Sodic Soils Map for Europe” is provided and users can access the WMS services based on the metadata content. This map service can be visualized and users can use this service as a base map for their applications.

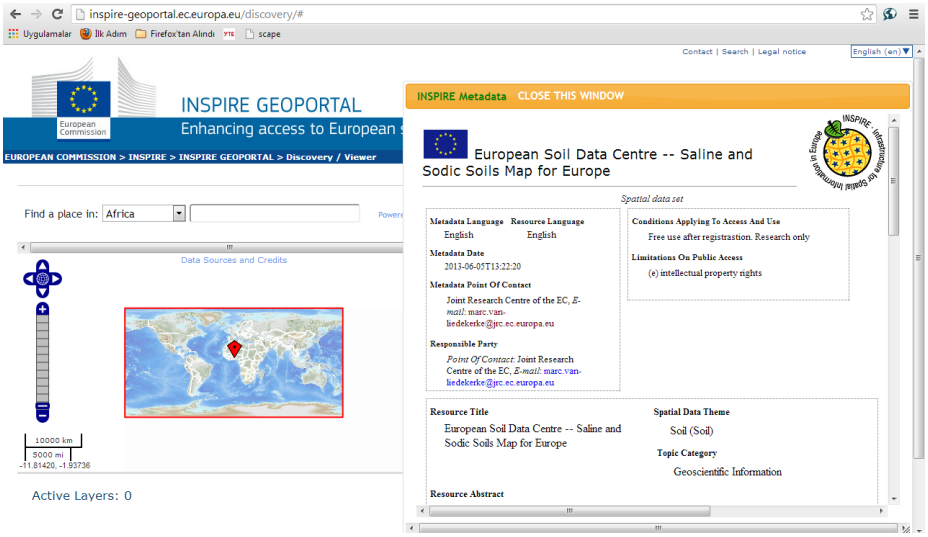

Figure 7. Metadata Visualization for Saline and Sodic Soils Map for Europe on INSPIRE Geoportal

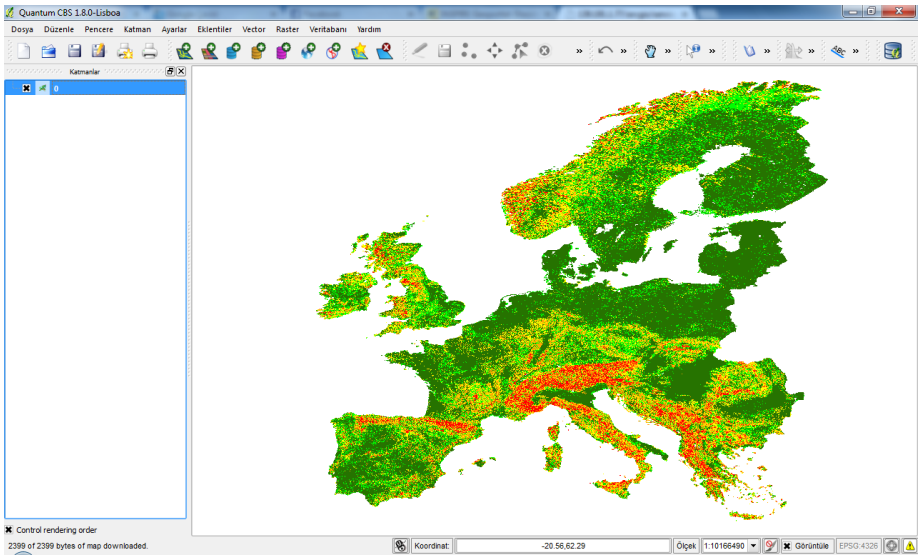

Figure 8. Visualizing the Saline and Sodic Soils Map for Europe WMS on Quantum GIS

4.1.2 Metadata Operations

Metadata management is a major component for using Geoportals in an effective and efficient manner. In order to successfully manage standard metadata features,

INSPIRE Geoportal sets a metadata validation infrastructure and interface. INSPIRE Geoportal explains the "purpose of the INSPIRE Metadata Validator to test the compliance of INSPIRE metadata with the INSPIRE Metadata Regulation" (URL 22). In Figure 9, Metadata validation user interface can be observed.

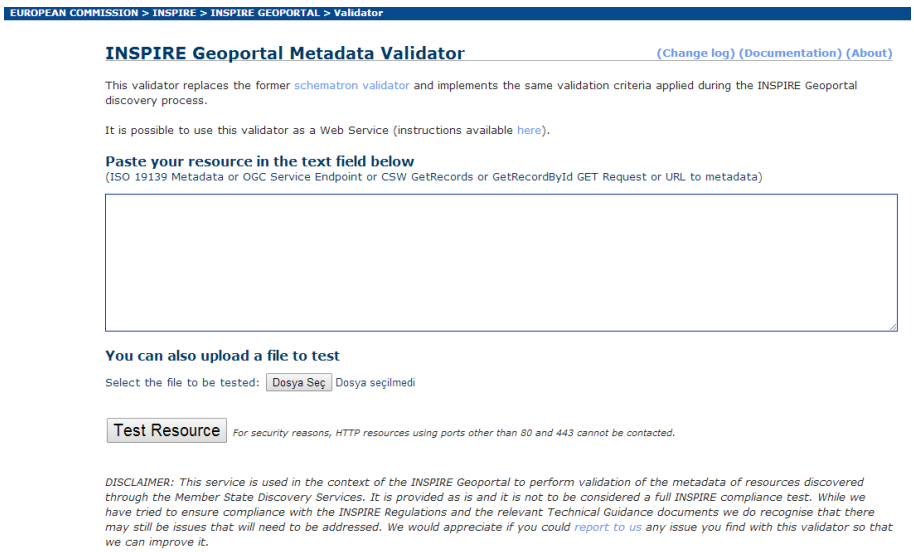

Figure 9. Metadata Validation User Interface in INSPIRE Geoportal (URL 23)

4.1.3 Themes

INSPIRE Geoportal Service thematic consideration is shaped based on the INSPIRE Directives' Data Specifications Annex I-II-III. These themes are explained previously in this thesis in section 3.5 called "Data Integrity and Geoportal: Infrastructure for Spatial Information in the European Community- INSPIRE". Thematic groups are used as the search criteria and it can be refined according to the origin, metadata language, spatial data theme, topic category and service types.

4.1.4 Standards and Interoperability

INSPIRE Geoportal is designed based on the INSPIRE Directive Rules which contains the standards indicated when forming this Directive. As a result of the work

done by Bartha and Kocsis; in international level ISO/TC 211, OGC, W3C, OMG and OASIS standards, in European Level CEN TC/ 287 standards are taken as a base for designing INSPIRE Geoportal (Bartha and Kocsis, 2011). INSPIRE Directive is planned to be implemented at the end of 2020.

Compliance to the standards of INSPIRE Geoportal are developed based on the ISO 19100 which is composed of 42 headings. Bartha and Kocsis (2011) group these standards as technical infrastructure, data models and services management functions.

Within this perspective; ISO 19115 sets the metadata standards and its supporting standard ISO 19139 which explains metadata encoding. ISO 19119 standards is used for data services. Moreover; ISO 19128 is used for the service based implementations for map server interfaces (for WMS standards).

4.1.5 Spotlights

INSPIRE Geoportal has an important role to sustain interoperability in data management activities. First of all; it sets the standard base themes for data presentation on European Level through which countries can reach and understand the same common data infrastructure. INSPIRE sets services such as WMS as standard and expects INSPIRE based Geoportals to conform them.

It is stated that INSPIRE Geoportal supports the European Interoperability Framework (EIF) bases and the e-government integration (Taylor, 2008). In parallel to this, it also supports the Geo Rights Management (GeoRM) that identifies the management of data usage rights.

4.2 United States Geoportal – GeoPlatform

GeoPlatform, which is the abbreviation of the Geospatial Platform, is the governmental organization that aims to present data via Geoportal. GeoPlatform is managed by the Federal Geographic Data Committee (FGDC) which is responsible for the coordination of “development, use, sharing, and dissemination of geospatial data on a national basis” (URL 24). GeoPlatform was started to be developed in 2010

and its improvements still continue. The development time line of the GeoPlatform is presented in Figure 10.

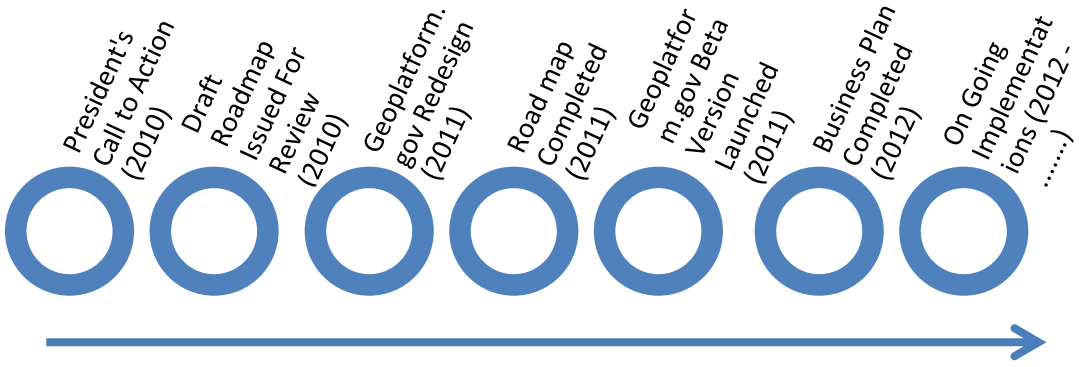

Figure 10. Development Timeline of the GeoPlatform (URL 25)

GeoPlatform is designed to search and access the desired spatial data under the responsibility of different institutions. Its operations are explained as "an Internet-based capability providing shared and trusted geospatial data, services, and applications for use by the public and by government agencies and partners to meet their mission needs" (URL 26).

The main screen of GeoPlatform is designed to access desired services and data quickly with user friendly interfaces. Users can access the data catalog, published maps, data marketplace, data publishing services, development environment and most used services or datasets. Moreover, there is a direct data search function and recent information about the spatial data is given in order to inform portal users.

4.2.1 Accessing Data and Services

GeoPlatform provides accessing tools to data and service with direct keyword search function, data selection interfaces, functional and thematic maps and marketplace. The clients can use keywords to access the data or services via the pre-defined filter

operations with the search function. In data selection interface; users can search data services via different scenarios.

First of all; users can search via tags, formats, organization types, organizations, community categories and map selection functions. In tags heading, data or services are provided with concept words such as temperature or water depth. In format headings, users can access the data with zip, xml, kml, wms, wfs, csv, xls, json, gml, QGIS, ArcGIS Online Map, Access and tiff formats. In corporate based search; data is classified according to Federal Government, State Government, Local Government, Non-Profit Organizations, Cooperative Commercial and Universities. According to the responsible organization based search; data is classified such as National Oceanic and Atmospheric Administration, National States Geographic Information Council, U.S. Geological Survey, Earth Data Analysis Center, U.S. Department of Commerce, US Census Bureau. In community categories based search; data is classified as elevation and bathymetry, physical and oceanographic, biology and habitat, atmospheric and natural hazards.

Users can search locations via web map based location search functions. Results are presented with a particular specification depending on the above mentioned framework and data are provided with the organization type label, explanations and data formats. In Figure 11, Forest data search result is given as an example.

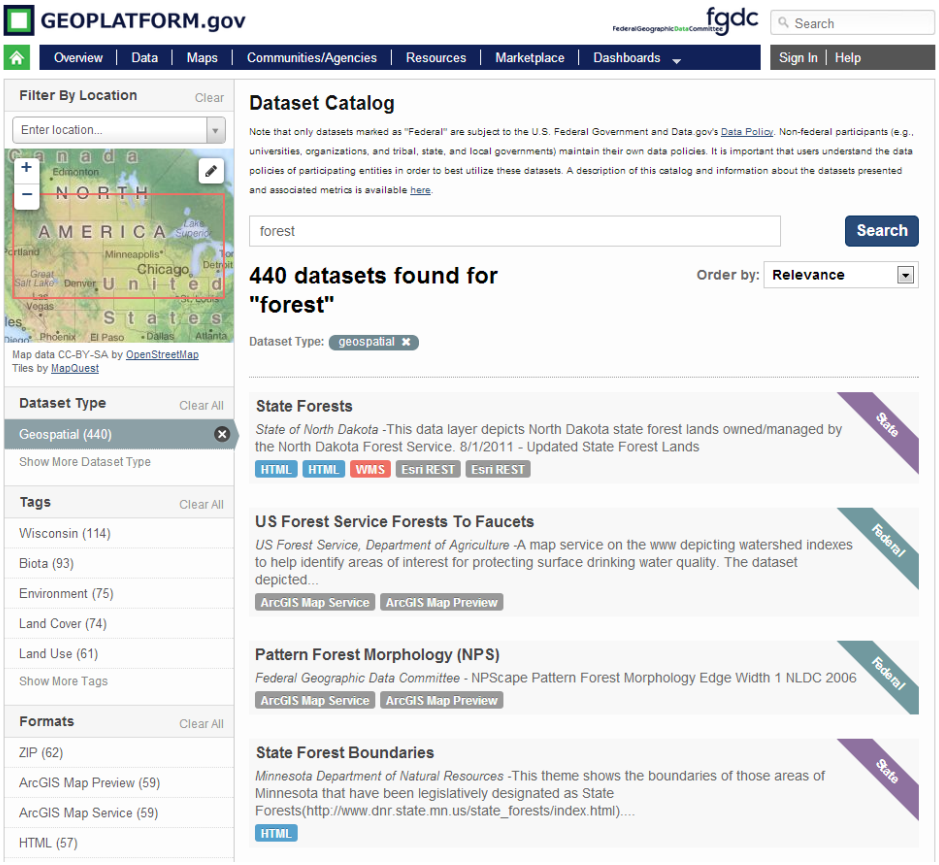

Figure 11. Forest Data Search Results on GeoPlatform

4.2.2 Themes

GeoPlatform categorizes data in thematic groups that users can access via this thematizaiton. Thematic consideration of the portal is designed according to data groups and community categories. This categorization is done under the Coordination of Geographic Information and Related Spatial Data Activities Circular No. A - 16. (FGDC, 2013). Circular No A-16 Themes is given in Table 2.

Table 2. Circular No A-16 Themes (URL 36)

Circular No. A-16 that is Coordination of Geographic Information and Related Spatial Data Activities			
Biota	Cadastre	Climate and Weather	Cultural Resources
Elevation	Geodetic Control	Geology	Governmental Units
Imagery	Land Use – Land Cover	Real Property	Soils
Transportation	Utilities	Water – Inland	Water – Oceans and Coasts

In this perspective; GeoPlatform classifies the data by considering these themes indicated in Circular No. A-16. In this context; natural disaster data, energy availability data, water quality and watershed management data are examples of the themes provided.

4.2.3 Standards and Interoperability

GeoPlatform is shaped under the Federal Geographic Data Committee (FGDC) that controls the geospatial data management processes and sharing. For achieving data management and sharing principles; FGDC works on the interoperability issues both in national and international level.

Like other Geoportals, GeoPlatform also use metadata standards in line with ISO 19115, ISO 19119 and ISO 19139. When complying to the international standards and also taking into consideration the national implementation framework principles; GeoPlatform implements The North American Profile (NAP) of the ISO 19115 and Content Standard for Digital Geospatial Metadata, Extensions for Remote Sensing Metadata, Biological Data Profile of the Content Standard for Digital Geospatial Metadata and Metadata Profile for Shoreline Data. Moreover; OGC Catalog Service

for the Web (CSW) protocol is used for finding metadata on internet based processes.

GeoPlatform standard studies are done by the Geospatial Intelligence Standards Working Group. One of their most important works is implementation of ISO 3166 on GeoPlatform. It codes representation of country names and their subdivisions.

4.2.4 Spotlights

GeoPlatform is designed to consider the main standards widely used in the spatial information area. GeoPlatform has been designed for public needs and takes in consideration the transformation to e- governance.

Although GeoPlatform has different unique properties; Marketplace is the one important feature that separates from the other Geoportals. Marketplace term is used as a common information pool that users or providers can follow the instant data production process and they can also communicate with the owner of the data via GeoPlatform. Johnston explains the goals of the marketplace as avoiding reproduction of data, creating partnerships and arranging the deals with the data providers and users (Johnston, 2013).

4.3 Group on Earth Observations Geoportal – GEOSS Portal

The Group on Earth Observations, which is abbreviated as GEO, "is a voluntary partnership of governments and international organizations, that coordinates efforts to build a Global Earth Observation System of Systems, or GEOSS" (URL 10). It aims to provide data from different sources to be accessed through a single interface. GEO is established in 2002 by the G8 (Group of Eight) countries and it aims to focus on a "Societal Benefit Areas" that are "disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity". It is declared that 90 Governments, European Commission, 67 Intergovernmental Organizations contribute to the system to work efficiently (URL 27).

GEOSS Portal main screen is composed of search functions, web map viewer and themes, geographic areas to be used in common usage scenarios. It is designed with a

simple interface and basic functions, through which users can easily search access, download the data and services. This main screen is designed both for expert or non-expert users that can use the map functions and selection alternatives. Moreover; with the same interface, users can examine the desired results and they can access these services through the main management screen. In Figure 12, main management screen of GEOSS Portal is given.

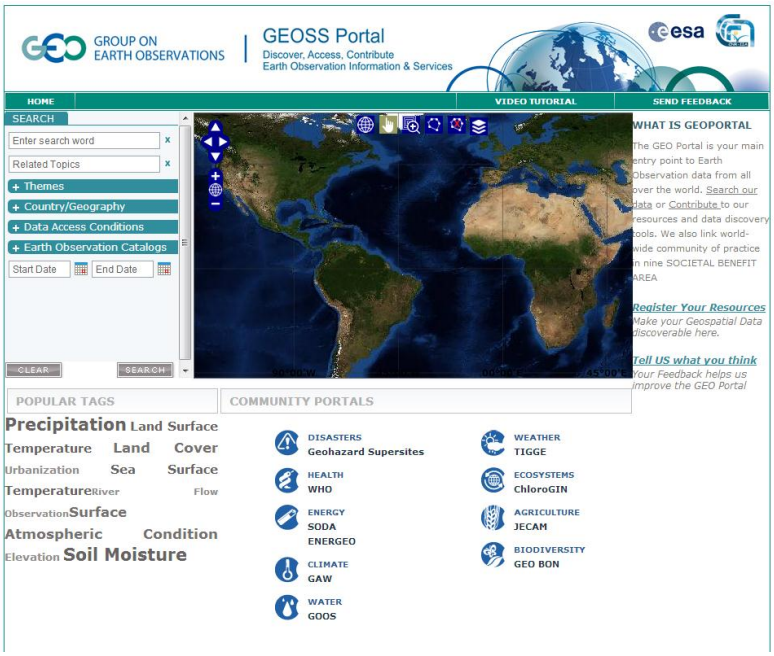

Figure 12. GEOSS Portal Main Management Screen (URL 28)

4.3.1 Accessing Data and Services

GEOSS Portal provides data and service access through basic search functions, themes, geography search, data access conditions, earth observation catalogs and geographic area of interest. In basic search function, users can search via "search word" or "related topics" categories.

Results can be refined under specified search criteria and they can be sorted in a list and this list contains the information according to the legend descriptions. This legend is classified under Monitoring and Observation Systems, Computational Model, Initiatives, Websites and Documents, Analysis and Visualization, Alerts, RSS, and Information Feeds, Catalogues, Inventories and Metadata Collections, Software and Applications basis (URL 28). Moreover; map service types such as WMS (Web Map Service) are also presented in results. After selecting the desired data, users can get the metadata information and if it is applicable, they can see it in the map interface. WMS data usage in GEOSS is given in Figure 13.

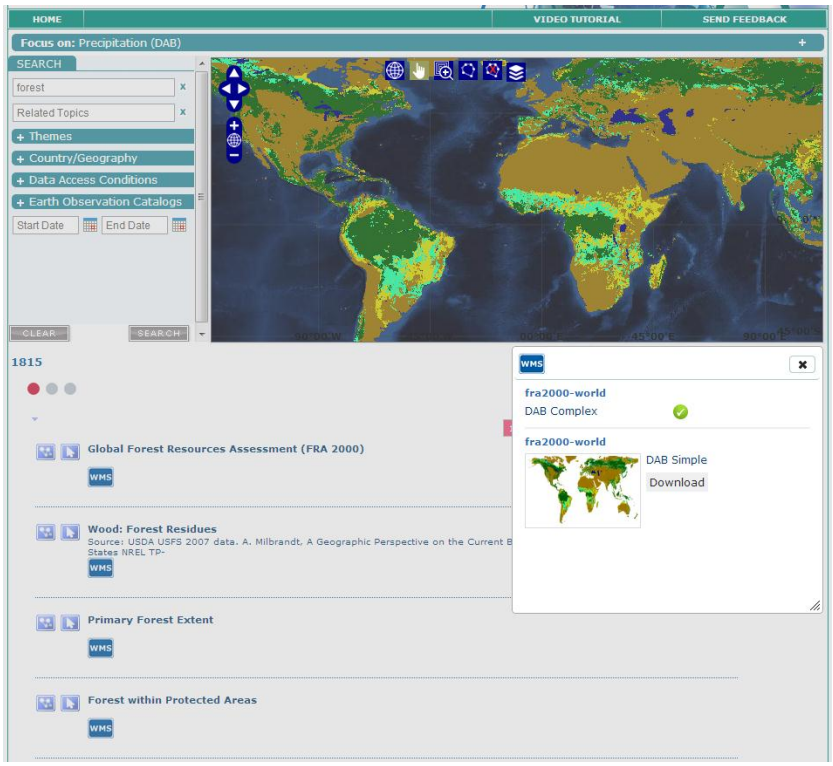

Figure 13. Global Forest Resources Assessment (FRA 2000) WMS Data on GEOSS Portal (URL 29)

4.3.2 Themes

GEOSS declares its data management strategic target as "promotion of a coordinated, life-cycle data management process to support improved simulation,

modeling, and prediction capabilities for each Societal Benefit Area and across multiple Societal Benefit Areas" (URL 30). GEOSS classifies the themes according to their strategic targets and provides detailed explanation about the scope and the data. According to this point of view, themes are grouped under 9 themes. These are given in Figure 14.

Figure 14. Societal Benefit Area and Themes (URL 31)

In disaster theme; it is stated that its aim is risk management and monitoring of disasters from global to local level. This theme includes earthquakes, fires, floods, volcanic activities and tsunami. On the other hand; in health theme; data is classified according to the topics that directly affect human life such as water quality, infectious diseases, and vector-borne diseases. In energy theme; the accessibility of the energy resource, new alternative energy studies and energy management facilities are presented. In climate data theme; International Institution's studies on climatic observation such as precipitation, seasonal forecasts and carbon datasets are provided in the system.

In water theme; water quality parameters are accessible through remote sensing tools and sensor based monitoring. In this theme, European Union studies, Asian Water

Cycle Initiative and Global Groundwater Information System provide the data. In addition to that; ecosystem datasets are provided and the framework is associated with the "ecosystem datasets" and "near real time" data monitoring. This theme presents human and ecology interaction datasets, monitoring ecosystems and its consequences.

In agriculture theme; Global Agricultural Monitoring, Community of Practice and Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) are provided. In this theme; "fisheries, aquaculture, forestry and land cover mapping" are presented and "proposal for improving crop monitoring over the world" type approaches are implemented. In biodiversity theme; data is coordinated by the Group on Earth Observations Biodiversity Observation Network (GEO BON) that provides the "status, trends, services, risks, and conservation about the ecosystems, species, and genes" (URL 32).

4.3.3 Standards and Interoperability

GEOSS Portal provides data and services throughout the world and it is designed to provide according to the needs of this comprehensive structure. GEOSS has 90 member countries, 77 participating organization and 6 observer organizations, 2 observer countries. In order to sustain this multi-partner structure working together; GEOSS Standards and Interoperability Forum (SIF) is founded under the roof of Institute of Electrical and Electronics Engineers (IEEE). In addition to considering the technical infrastructure, GEOSS also improves the concepts that are common to GEOSS Portal users. Khalsa et al. (2008) explain this issue by exemplifying the SIF tasks as; "identifying organizations and individuals that can play a bridging function among GEOSS components and Societal Benefit Areas" that must be easily accessible and vital in disasters and hazard times" (p.1760).

Geospatial standards are evaluated based on the Standards and Interoperability Forum. In current situation; Web Map Server Interface (WMS 1.3), CSW 2.0.2 HTTP Binding and Web Accessible Folder are accepted. On the other hand; some important standards are in pending position such as OGC Web Feature Service 1.0;

ISO 19115:2006 Geographic information --Metadata (Corrigendum 1), ISO 19112:2003 Geographic information -- Spatial referencing by geographic identifiers.

4.3.4 Spotlights

GEOSS Portal is a world-wide Geoportal that combines and present data. GEOSS mainly focuses on comprehensive data that can be monitored in different time periods. One of the most important aims of the GEOSS Portal is to provide data that will help protect human life and sustain environment. GEOSS Portal does not provide data directly but facilitates data themes through a single interface.

4.4 France Geoportal – Geoportail

Geoportail is the France Geoportal that provides spatial based data access infrastructure worldwide but specifically to French citizens. Citizens, institutions and professionals can reach the services via Geoportail. Main aim of the Geoportal is to provide an open and interoperable data logic structure that is regularly updated and checked via the common and standardized metadata schemas (URL 33).

Main principle is explained by the Chamuet (2010) as a "co-visualization of geographic or geo located data from various producers on a common website". Geoportail services are provided by the government organizations those are responsible for management functions. Geoportail is also used as e-government transformation processes to conform INSPIRE Directive. In this context; Geoportail is designed with these principles to provide services to the citizens.

Geoportal is presented with directly accessible main screen with well-known and most commonly used services. Main screen is designed for both non-specialized and expert users. Map interfaces, data themes or catalog, commonly used services are available through the main screen. Users can access them via this user friendly interface. Geoportail main management screen can be seen in Figure 15.

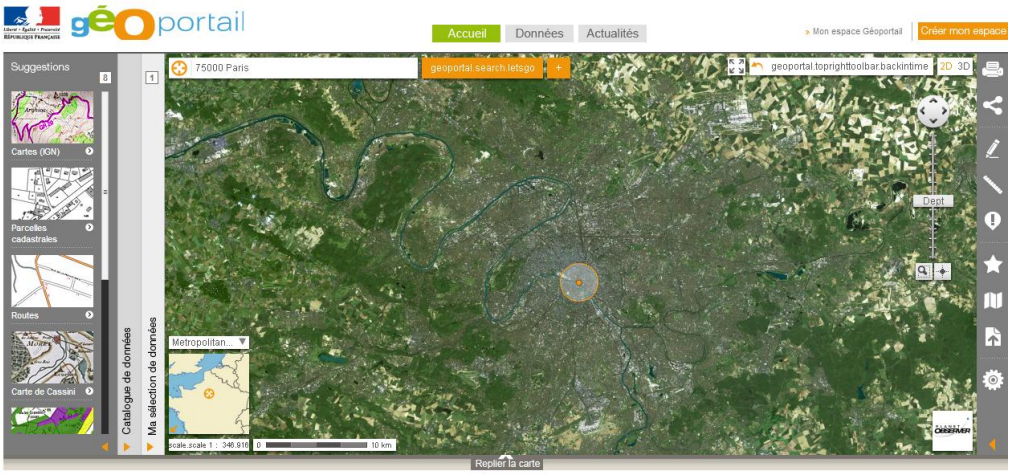

Figure 15. Geoportail Main Management Screen (URL 34)

4.4.1 Accessing Data and Services

Data or services can be accessed via basic lets-go and detailed search functions, theme shortcuts with the sophisticated geo catalog searches. In basic lets-go search functions, users can use the Geoportal for finding a location with address, coordinate and places. On the other hand, users can access commonly used services through the themes and visualize them through the web map interface.

Besides providing easily accessible services, Geoportail offers detailed data management functions for achieving the continuity and interoperability of services. These functions are gathered under the geo catalog scope and they are separated as search and advanced search. In search function, requests are received under what and where questions. In what question concept, search function can be restricted with Web Map Services, Web Feature Services and downloadable data. On the other hand; with the where question search function, location based search can be done with the support of the simple map interface.

In advanced search function; requests are widened to make more precise search. Although standard base tools such as title and keywords base search functions exist, more search tools responding to different needs such as year based, free or restricted

data and services are provided. In addition to that search functions are available within the geographic area where the limits are based on territory, region, and government agency and municipality. Search and Standards Function on Geoportail is exemplified in Figure 16.

The concepts of interoperability of data services and international and regional compliance standards are defined in Geoportail. This definition is composed of the ISO, OGC, CAT and downloadable or transactional services. In Figure 17, forest data is requested from the system; and results are given with the standards legends and data can be previewed with the web map interface.

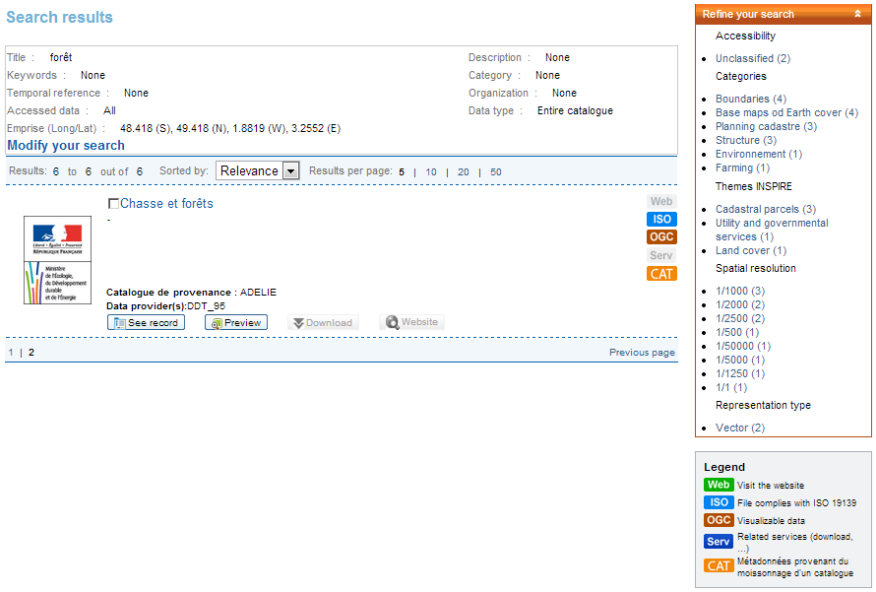

Figure 16. Search and Standards Function on Geoportail (URL 35)

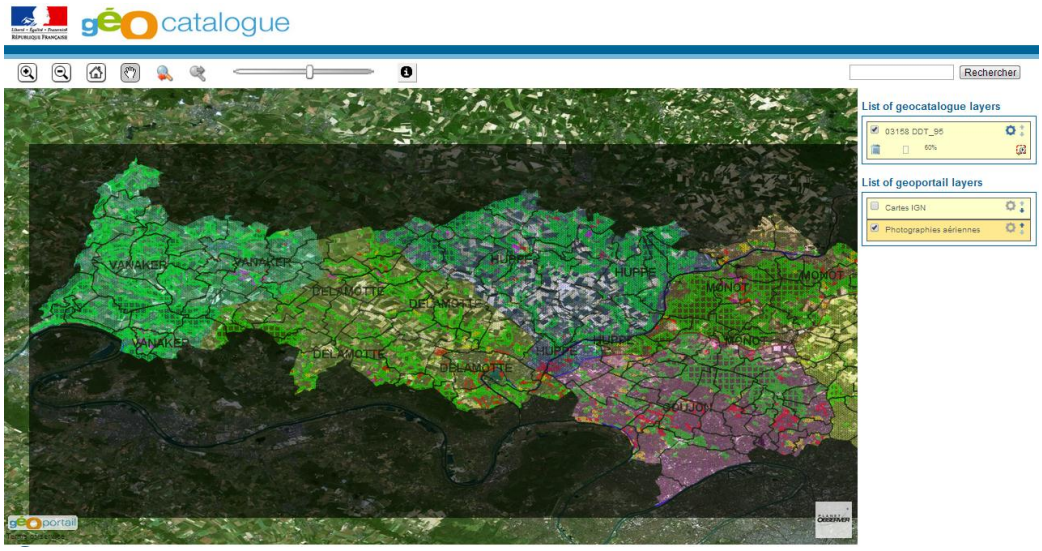

Figure 17. Forest Theme Result (URL 35)

4.4.2 Themes

Geoportals merges the geospatial data under specific themes to provide data from the different data sources associated with each other. Geoportail defines these themes in two ways; Geoportail's own classification and INSPIRE. In Geoportail's own classification; data are gathered in 15 data themes that are agriculture buildings,maps

historical maps, culture and heritage, ecology, energy, hydrography, coastline, land tenure, cadastral parcels, photographs, road network, networks (other), geodetic sites, railways, administrative units, risk areas, management areas and various. In INSPIRE compatible data, themes are classified according to altitude buildings, weather, geographical names, geology, hydrography, land tenure, ortho imagery, cadastral parcels, coordinate reference systems, maritime regions, transport networks, utilities and public services, protected sites, energy sources, administrative units, statistical units, land use, natural risk zones, management areas, restriction or regulation zones and reporting units (URL 34).

4.4.3 Standards and Interoperability

Geoportail is specifically designed for France Government Organizations and Citizens to access geographic features. Chamuet explains the main principles of France Geoportal as e-government transformation and interoperability to the INSPIRE Directives (Chamuet, 2010).

Geoportail creates the geo catalog for managing the data, metadata and services that are the core structure of Geoportal to provide data homogeneity. Richard and Robida explain the geo catalog and interoperability issue with compliance to the ISO 19000 Standards, OGC and INSPIRE metadata and services (Richard and Robida, 2010). The French Geoportal: linking discovery and view network services. In this standardization process; Geoportail tries to implement the 19115, 19119, 19110, 19139 and OGC CSW standards.

4.4.4 Spotlights

Geoportail is designed to manage and share governmental data of France in national and international level. Geoportail provides many features of the Geoportals and it conforms many standards and INSPIRE Directives; it provides unique features separating it from other Geoportals.

First of all; Geoportail is the most users interactive Geoportal among the examined samples that enable users to create their workspace. Moreover, Geoportail provides location and address search features that users can navigate through the web map view. Geoportail also allows users to visualize 3 Dimensional data via client software. In addition to that; one of the most important features of the Geoportal is to provide Application Programming Interface. Through this interface, developers can use the features and base maps of the Geoportail within their codes.

Apart from the examples above, Turkish Ministry of Environment and Forestry Geoportal is included in below table in terms of Geoportal features availability. Even though features are provided, their contents are not sufficient enough to perform the intended transactions. In the near future, Turkey Geoportal features availability can

be updated with the completion of the official Geoportal developed by Ministry of Environment and Urbanization.

Comparison of Geoportal feature of World Examples is given in Table 3.

Table 3. Comparison of Geoportal Components of the World Examples

Subjects	INSPIRE Geoportal	Geo Platform	GEOSS Portal	Geo Portail	Turkey Geoportal
Main Management Screen	✓	✓	✓	✓	✓
Metadata Editing and Validation Interface	✓	✓	✓	o	o
Data Download	✓	✓	✓	✓	✓
Support Different Data Format	✓	✓	✓	✓	✓
Standardization in Data and Services	✓	✓	✓	✓	✗
Data Grouping According to Themes	✓	✓	✓	✓	✓
Data view with Web Map Viewer	✓	✓	✓	✓	✓
Search Data with Area Selection	✓	✓	✓	o	o
Support Spatial Based Web Services	o	o	o	o	o
Catalog Service Support	✓	✓	✓	✓	✗
Print and Printing Layout Design	✗	✗	✗	o	o

Table 3 (continued)

3-Dimensional Data Visualization	✖	✖	✖	✓	✖
Mobile Application Support	✖	✖	✖	✓	✖
Account and Group Management	✓	✓	✓	✓	✓
User Data Store	✓	✓	✓	✓	✖
API Support	✖	✓	✖	✓	✖
Geo Rights Management	✓	o	✓	✓	✖
E-Government Integration	o	o	✖	o	✖
Online E-Commerce Marketplace	✖	✓	✖	✖	✖

(✓ = Available, **o** = Not Fully Available**,** ✖ = Not Available)

CHAPTER 5

SURVEY

In the survey part; questions are prepared in line with the above indicated literature review, analysis of world examples, projected components and recent technological developments. Main aim of this survey is to question the consistency of components of Geoportal with the user needs. In order to achieve this, it is important to receive the opinion of users working in different sectors. Users from various disciplines can reflect their experiences and needs based on their point of views. It is also important to reach more people from different areas of expertise in order to sustain consistent results. It is essential to obtain user opinions and combine them with standards and best practices for efficient use of Geoportals.

According to the Houston; survey "is a systematic method of collecting information from a selected group of people by asking a series of questions" (Houston, 2014). On the other hand; Houston expresses the purpose of the survey under four headings and they are composed of defining user requirements, determining the current situation, identifying areas that need to be improved and understanding the success of the current implementation (Houston, 2014). At this point, conducting a survey is a practical method to collect users' opinions about the Geoportal components.

5.1 Survey Framework and Methodology

The purpose of this survey is to identify the Geoportal components to be used in new Geoportals or to develop already existing ones. Survey is conducted via web based survey application Survey Monkey (https://www.surveymonkey.com/s/38WSLV6) and results are gathered and managed from this application. This web link is shared via e-mail and participants are directed to the survey page. Survey questions are

composed of recommendations that are designed as short questions to avoid distraction of the participants.

In order to ensure the reliability of the survey, survey questions were sent to people particularly specialized in this subject. In public sector, information systems professionals who work in Geoportal projects or information technology areas; in private sector, technical people in the field of information systems; in academics those working within the Geographic Information Science are targeted.

In this framework; this survey was sent to the relevant divisions of 19 universities, 28 private companies, information technology departments or departments which have done Geoportal oriented works. Survey was also shared in social networks LinkedIn and Facebook. Survey began on March 17, 2014 and stayed open until it reaches 100 participants. It took nearly 3 weeks and it was completed on April 3, 2014.

Survey starts with general questions aiming to understand the knowledge level of the participant, their sectors and their experiences on Geoportal studies. General questions are as follows;

1) How many years have you been working in the field of Geographic Information Systems?
    a) 1-3
    b) 3-5
    c) 5-10
    d) More than 10

2) Which sector do you work at?
    a) Public Institution
    b) Private Sector
    c) Academics
    d) Freelance

3) Have you ever make research or projects about Geoportals?
    a) Only Research
    b) Only Projects
    c) Both of Them
    d) No

5.2 General Survey Questions and Results

36 people from public institutions, 25 people from the private sector, 37 people from the academia, 1 person from the freelance labor and 1 person from the non-governmental organizations have participated in the survey and evaluated the questions. Freelance labor and the non-governmental organization participants are excluded from the study because the participant number does not enable common assessment. Thus survey evaluations are done based on the feedbacks of 98 people from public institutions, private sector and academia. Answers of different sectors can be seen in Appendix B.

General Questions are the important indicators for getting reliable and sustainable results. Implementation of the survey on experienced users, professionals and people who are interested in this area enables more robust evaluation of the results.

The first question is asked to determine experience of the participants in the field of Geographic Information Systems. According to the survey results, in Figure 18; 10.20% of the respondents have 1-3 years of experience, 13.27% have 3-5 years of experience, 27.55% have 5-10 years and 48.98% have more than 10 years of experience in the field of GIS.

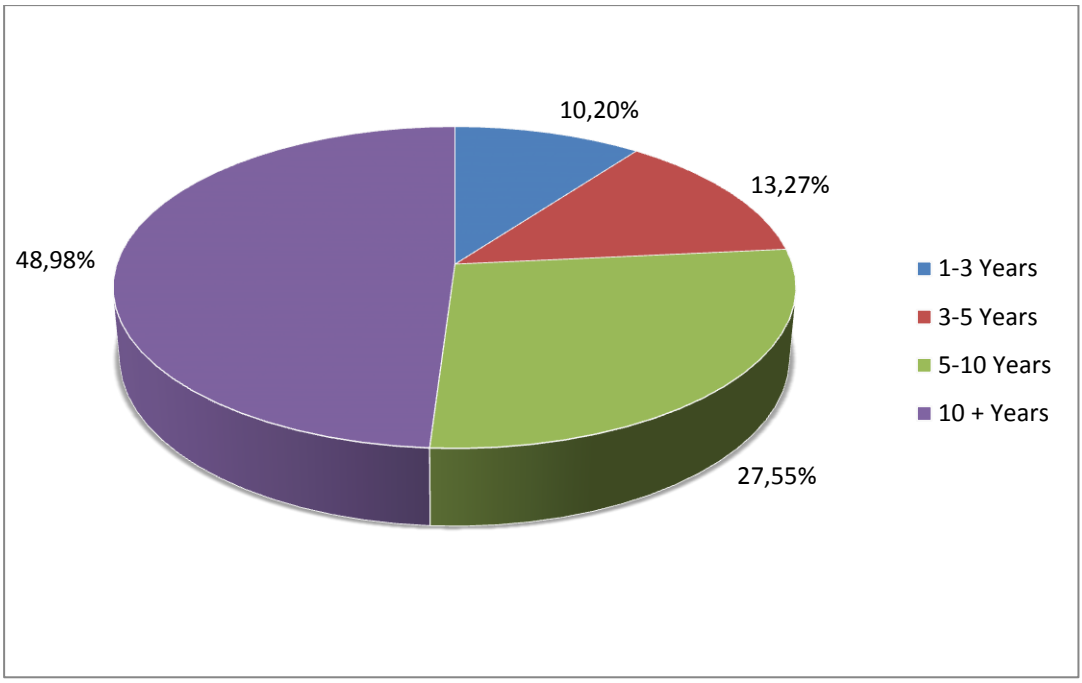

Figure 18. Participants Experience in the Field of GIS

Due to the nature of the subject, it is important to reach the experienced users in GIS. According to these results; 48.98% of survey participants have more than 10 years of experience and 76.53% of survey participants have more than 5 years of experience in the field of GIS.

In the second question, sectors they are working in are asked in order to determine the participant's sector distribution. It is important that especially the public sector, private sector and academia are represented in the survey results. Public sector is both users and the decision maker of Geoportal. Private sector generally provides the technical infrastructure and also may be the user of the Geoportal. On the other hand Academia provides their academic perspective. The survey results show that 37.76 % of participants are academicians, 36.73% work in public institutions and 25.51% work in private sector. In survey logic; recommendations are prepared mainly depending on the decision makers and the academic perspective.

Third question aims to understand previous Geoportal experience of the participants. Survey result in the Figure 19 shows that 25.51% of the participants do only research

10.20% only project, 32.65% both project and research and 31.63% of the user do not have a direct relationship with Geoportal. According to survey results; 68.36% of the participants have direct relationship with Geoportal.

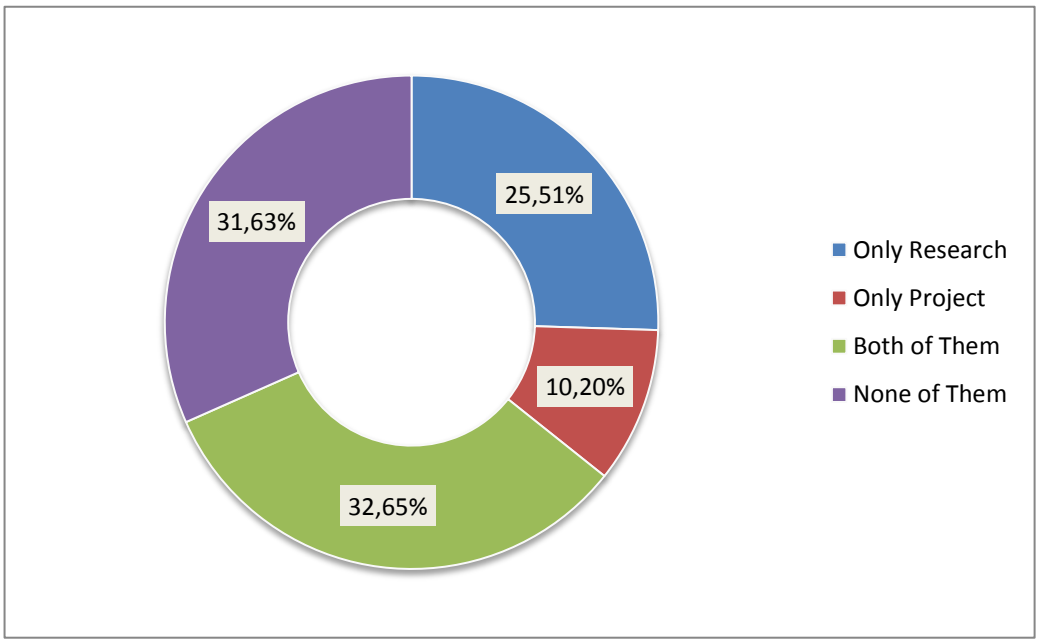

Figure 19. Users Relation about the Geoportal

On the other hand, apart from the 98 participants, 23 participants have not completed technical questions. It is understood that they are not sure about the importance of the questions because they initially answered the general questions then they left in the technical part. This situation is better for survey results so that people who do not have opinion about the Geoportal do not answer the questions. All of these results show us that; most of the users have direct relation to Geoportal and others who completed the survey have strong opinion about the Geoportal. These 23 participants, who did not complete the technical survey questions, are excluded from the survey assessment. All 98 evaluated surveys were fully completed in all sections by the participants.

5.3 Technical Survey Questions and Results

In the second section, 26 questions were asked about the technical details of the Geoportal to the participants who filled the first three questions. Each question aims to identify importance given to each recommendation by the participants in line with their opinions. Questions are graded in 1-5 point intervals and if the participations do not have idea about the question, they can choose the "No Idea" option. 1 point represents the "least important" alternative and 5 points represent the "most important" alternative.

Average value for 26 questions is 4.02 out of 5. Maximum value belongs to the third question, which is "Geoportal should have Standardization in Data Themes both National and International Level (e.g. INSPIRE)" with a score of 4.72. In addition to that; minimum value belongs to the "Geoportal should have 3-Dimensional Data Provision and Visualization" with a score of 3.36.

Average value of each question according to survey results can be seen in Table 4.

Table 4. Survey Questions and the Average Values

No	Survey Questions	Average Score
1	Geoportal should have "Data Download Ability"	**4.54**
2	Geoportal should have "Data Download Ability in Different Formats (for raster, vector, database)"	**4.39**
3	Geoportal should have "Standardization in Data Themes both National and International Level (e.g. INSPIRE)"	**4.72**
4	Geoportal should present Metadata Information	**4.57**
5	Geoportal should have "Interactive Data View within the Web Map Viewer"	**4.60**
6	Geoportal should have ability to "Search Data with Selecting Area from Map"	**4.63**

Table 4 (continued)

7	Geoportal should have support “Thematic Mapping and Analytics on Data”	**4.09**
8	Geoportal should support “Print and Printing Layout Design ”	**3.61**
9	Geoportal should display “External Web Map Services (WMS)”	**4.26**
10	Geoportal should provide “Web Map Tile Services (WMTS) Support”	**3.78**
11	Geoportal should provide “Web Coverage Services (WCS) Support”	**3.64**
12	Geoportal should provide “Web Feature Services (WFS) Support”	**4.00**
13	Geoportal should provide “Transactional Web Feature Services (WFS-T) Support”	**3.51**
14	Geoportal should provide “Web Processing Services (WPS) Support”	**3.57**
15	Geoportal should provide “Catalog Service for the Web (CSW) Support”	**3.70**
16	Geoportal should have “GeoRSS Support”	**3.95**
17	Geoportal should have “3-Dimensional Data Provision and Visualization”	**3.36**
18	Geoportal should have “Mobile Application Software Version”	**3.87**
19	Geoportal should provide “Accounts and Groups Management Support”	**3.66**
20	Geoportal should have ability to “Store User Data”	**3.74**
21	Geoportal should provide “Application Programming Interface”	**3.58**
22	Geoportal should be accessible to “Non-Governmental Organizations or Associations”	**4.15**

Table 4 (continued)

23	Geoportal should be accessible to "Private Sector"	**4.13**
24	Geoportal should provide "Online E-Commerce Marketplace for Data Selling Support"	**4.02**
25	Geoportal should provide "Geo-Rights Management Perspective "	**4.17**
26	Geoportal should support "E- Government Integration"	**4.39**

In the following part, each question is explained one by one in terms of content, expectations from the question and then participant's responses are evaluated.

I. Geoportal should have "Data Download Ability"

Geoportal is a mediator between data producers and data users that provides an infrastructure for data exchange. Download ability is very important for Geoportals. INSPIRE forces the use of spatial data comprehensively and through its download services data should be presented to the authorized users of the INSPIRE Community (INSPIRE, 2012). In this perspective, download service is mandatory in order to comply with INSPIRE Directive.

Due to lack of data accuracy and precision, download services cannot be provided in certain situations. Italian Geoportal which is "Geoportale Nazionale"; explains that some organizations cannot "guarantee the completeness and accuracy of the data even if it wants to give an updated, adequate and full service." (URL 37). The country policies about the data sharing or cyber security concerns also affect the data download feature availability. Canadian Geoportal defends this issue with the Canada Geoportal Security perspective indicating that this protects the sustainability of the Geoportal operability (URL 38).

The purpose of this question is to understand the experts' and users' opinion about the ability to download data via Geoportal. It is expected that the majority of users give high score to this question. Depending on the survey results; average score is 4.54 and 71.43 % of participants give highest score to it. Only 5.10% users give a

score below the average to this question. Survey results show us that most of the users find this feature very important for the Geoportal.

II. Geoportal should have "Data Download Ability in Different Formats (for raster, vector, database)"

Both in international or national level, countries use different software or different data structures to manage their spatial data. While data users of the Geoportal might be working with the data in one format, producer of the data may produce in a different format. Framework of the data provision generally emerges with the user's needs and data can be provided in different formats depending on the technical infrastructure.

As an example; Halleman who is the Director of the France Geoportal tells that France Geoportal provides a vector base shapefile format as basic offering and then they expands their data formats to others such as MapInfo specific data format. On the other hand; they provide a raster data format transformation such as TIFF to ECW and they plan to provide JPEG2000 to ECW and TIFF format changes. Moreover; PostGIS database format is also planned to be presented in their Geoportal (Halleman, 2014).

According to the survey results; 61.22 % participants give the highest score and the average score is 4.39. It is remarkable that 53.85 % of the private sector participants give the highest score to this question. On the other hand; 71.05 % of the academics give highest score to it. 93.88 % of the users give a score higher than average and this feature is important for the participants.

III. Geoportal should have "Standardization in Data Themes both National and International Level (e.g. INSPIRE)"

Standardization in data themes is very important in spatial based studies in order to sustain the interoperability between the data producer and data users and to provide easy access to data on a common path. INSPIRE which is an International Geoportal provides a data specification perspective and a consistent and understandable data content for their partners. On the other hand; United States provides a Circular to

sustain collaboration in national level among organizations to provide a reliable and consistent data.

In this perspective, according to the survey results; average score is 4.72 and 77.55 % participants give the highest score to this question. It is important that none of the participants give below than average. Although, it is expected that the public sector should give more importance to this question, they give 75 % while academicians give higher importance with 81.58 %.

IV. Geoportal should present "Metadata Information"

Metadata is important to define data content that can be understood from the users easily. Metadata information ensures data reliability and this way data is proven by its producer. It is important to provide the credentials of data since data sharing is located in the hearth of the Geoportal. In addition to the presence of the data, its compliance to the standardization is also important for the presentation of data on Geoportals. All analyzed samples provide metadata information and they also provide a standard based metadata framework.

It is expected that the survey participants would give a high score to the metadata information because metadata is the most important component in a Geoportal. According to the survey results, average score is 4.57 and 70.10% of the participants give the highest score. In addition to that, 25.77 % give the score 4 to this question and it means that 95.87 % give importance to this question.

V. Geoportal should have "Interactive Data View within the Web Map Viewer"

Geoportal can be defined as an interface between the user and spatial data which users can interact with and understand the features. In this perspective, users can interactively use data that is accessible through Geoportal. On the other hand; if the end user is sure about the typed context, they can directly search and make operations in line with their aims without interacting with the map. All Geoportals, which are analyzed above, provide a data view on the map viewer.

In addition to the interactive data view through a map, different features of the visualizing techniques can be used. In these instances; both spatial and its related attribute features can be presented through pop-up windows.

According to the survey results, the average score for this question is 4.60 and 68.37 % participants gives the highest score. On the other hand; only 1 participant gives a score below than average to this question and results are in line with expectations.

VI. Geoportal should have ability to "Search Data with Selecting Area from Map."

One of the most important features of the Geoportal is to access data and its features with different methods. Although Geoportal is necessary to provide "word" based search, map based search functions are also essential to reach the data in more interactive and convenient manner. On the other hand; location based search function covers the gap to reach spatial data belonging to a specific region if the word based search cannot be sufficient in search process.

According to the survey results; average score of the question is 4.63 and 70.41 % of the participants give the highest score. On the other hand; it takes the second place among 26 options in importance. This result shows us that participants prefer to operate interactively by using visual and spatial based features.

VII. Geoportal should have support "Thematic Mapping and Analytics on Data"

Interpretation of the data is an important factor for the user to get the most desired results after accessing the data through Geoportal. In this point; thematic mapping or making analytics on the data can provide more efficient results and it can also increase the use of the Geoportal. Users can obtain a better understanding of attributes of the spatial data via Geoportal thematic mapping features. On the other hand; making the analytics which enables the basic logical inferences, enables user to get generalized results through data.

None of the Geoportal Examples examined above provides a thematic mapping or analytics on data. They provide data as a predefined content and user can use the default properties of the system. Considering further integration of Geoportal such as data exchange, these properties become important in this structure.

According to the survey results, 44.90 % of participants give the highest score and 48.57 % of the participants give 3 or 4 points to this question. The average result of this question is 4.63. It is understood that the user does not strongly support the thematic mapping and analytics on data and they prefer to use these features through Geoportal.

VIII. Geoportal should support "Print and Printing Layout Design "

Responding to different user needs is a key element for Geoportal to ensure more user friendly structure. While some users of Geoportal need to obtain digital based data, others need both digital and hard copy of the sources. In this process; Geoportal enables to design the print out framework and transforms it through a structure that can be printed. Only the French Geoportal has printing functionality depending on the predefined structure with the title and the explanations.

According to the survey results; 31.63 % of participants give 4 points to these questions and 13.26 % give a score below than average. 62.24 %. of the participants select 3 or 4 points in this question. This question takes 3.61 as an average score and this question is among the lowest rated. It is understood that the users have less need for print or printing layout design in Geoportal.

IX. Geoportal should display "External Web Map Services (WMS)"

Geoportal combines and presents the data that can be obtained from different resources. Depending on the technological infrastructure and the decision mechanisms, data is provided through mode of data provision. In some situations data may not be available or may be excluded from the Geoportal according to the Geoportal perspective. Even though national based Geoportals provide data in national level, it is needed for the global based data to be presented.

In this framework; some external resources are needed that are in web map services (WMS) structure and only their basic features can be used as raster based data. These data can be named as the external WMS services and users can find these services and add them momentarily.

According to the survey results; 46.94 % of participants give the highest score to this question and 94.90 % give a score above the average. Average score of this question is 4.26 and it is located in upper parts among the survey questions. Depending on this result, it is concluded that user needs to integrate external WMS services to the Geoportal.

X. Geoportal should provide "Web Map Tile Services (WMTS) Support"

Geoportal provides different types of data used in official transactions. Due to the difficulties in the investigation of high amount of data; system might slow down and become useless. A quick accessible structure should be provided as a base map through Geoportal. Moreover, the purpose of using data as a base map or image like Google Earth through Geoportal needs to be accessible by many people intensively. At this point, WMTS supports the needs of raster data provision and it is suitable to be used through the web based infrastructure. All the Geoportals examined above support the WMTS.

According to the survey results; 40.82 % participants give 4 points to this question and average score of the question is 3.78. It is important that 11.22 % of the users select the "No Idea" and only 1 answer remained below average. On the other hand; results show us that 87.75% of the users regard that it is moderately important for the Geoportal.

XI. Geoportal should provide "Web Coverage Services (WCS) Support"

Geoportal provides a data access infrastructure that users can interact with and get desired results. WCS is an important data service that users can reach the parts of the provided data. Based on the users need, this service can provide a raster based regulated data which users can define depending on their aims. This service is regarded as useful because Geoportal is used by different groups with different

requirements. All the examples provide the WCS and users can select the provided data services.

According to the survey results; 34.69 % of the participants give the highest score and another 34.69 % give the second highest score to this question. As in the previous question, 11.22 % select the "No Idea" option. This question takes 3.64 average score from the participants and 5.10 % of the participants give a score below the average. Depending on the survey result, it can be understood that participants prefer WCS properties to be provided but this is not a mandatory feature for them.

XII. Geoportal should provide "Web Feature Services (WFS) Support"

Geoportal aims to provide detailed information about data that is accessed by the users. WFS provide detailed information about vector based data and users can get information both spatially and attribute based. Comparing to the WMS services, WFS is not preferred by the data providers because license status of data usage is not certain if not defined in the Geoportal. In addition to that, WFS consumes the system resources intensively. Geoportal examples examined above support WFS.

Survey results show that 42.86% of the participants give the highest score to this question and 89.8 % gives a score above the average. This question takes 4 average score from users and it is located in the middle row among questions. 4.08% of the users give below than average score and 6.12% select the "No Idea" option. Depending on the survey result, WFS is not strongly preferred by the participants.

XIII. Geoportal should provide "Transactional Web Feature Services (WFS-T) Support"

Although Geoportal aims to provide data via web based infrastructure, in some points its functionality can go further. Geoportal can enable users to make some arrangements through the WFS-T. It can be used as a common platform through which many data contributors can process on the data and commit to the server. WFS-T is used rarely because transactional operations require more memory capacity to process efficiently.

On the other hand; scope of the WFS operations is an important issue and it should be decided by the decision makers of the Geoportal. From Geoportal perspective, the system resources are used widely and transactional services cannot perform well. At this point; today's technologies such as distributed systems and cloud services can respond to these needs. On the other hand; none of them from the examined world examples provide WFS-T support.

According to the survey results; 35.71 % of participants give the second highest score to this question. 77.61% of the users give a score above the average and average score is 3.51 for this question. Same as the other map services, 11.22 % participant do not have opinion about this question and only 8.16 % of the users give below than average score. It can be understood from the result that participants do not strongly prefer WFS-T features or support intervention to data via Geoportal.

XIV. Geoportal should provide "Web Processing Services (WPS) Support"

Geoportal offers a flexible structure that responds to different needs of users. In this context, different user groups need make spatial analyses depending on their aims from Geoportal. Geo processing operations via web based applications provide many advantages for user to interact and get result from the system linked to the analysis framework. While Geo processing services are generally expensive for the ones who rarely use spatial analysis and use it through the commercial desktop software, WPS provide a cost efficient option for these users. In addition to that; results gathered with WPS through Geoportal are formal and can be used as official results. Unlike these advantages, providing and maintaining these services and variety of them need to be considered comprehensively. The examples discussed above do not provide a WPS.

According to the survey results; 36.73 % of participants give the second highest score to this question. On the other hand; 31.63 % of participants give a score close to the average point and average score is 3.57. Depending on the results, it is located at the bottom among the 26 questions. Although the results show us that participants do not directly want to use spatial based analysis via web services base, they do not find it insignificant.

XV. Geoportal should provide "Catalog Service for the Web (CSW) Support"

Interaction between the clients and the data is controlled by the services that organize the hierarchy of the components by the internal structure of the Geoportal. Data are provided or gathered from the system and they should be reached quickly and easily within hierarchy. CSW provides this logic by controlling the metadata records and

this service works on their structural records. In this perspective; CSW is not only used for searching data from the system, but also used for publishing this service to sustain proper working of Geoportal functions. In addition to that, INSPIRE compatible Geoportals should provide CSW under the discover services approach. The entire examples that are examined above provide a CSW for efficient use of data and services.

According to survey results; 33.67 % of the participants give the highest score to this question. Other 33.67 % also gives 4 points. The average score for this question is 3.70. On the other hand; 8.16 % of users do not have an idea about this question and it is not expected that the users do not give it the most important score. In Geoportal studies, users of the system should be informed about the catalog services and their properties.

XVI. Geoportal should provide "Spatial Based Data Update Information (GeoRSS) Support"

Geoportal is dynamic and constantly maintains the flow of information. Many users connect to the system and publish or discover data through Geoportal. In this context, System user should be aware of the recent development about the essential information such as data updates. Moreover, spatial based information flow is essential for the user to easily follow the recent developments about data. At this point, Geo RSS service standard can be used for informing users in spatial bases from different sources. All examples provide GeoRSS services infrastructure but they do not provide these services directly.

According to the survey results; 40.82 % of participants give the highest score, 90.82 % of the user give above the average point to this question and the average score is

3.95. On the other hand; 4.08 % of participants give a score below the average and 5.10 % do not have an idea about this question. Depending on the survey results, participants prefer to be informed about the recent updates as GeoRSS about the data as spatial based in Geoportal.

XVII. Geoportal should have "3-Dimensional Data Provision and Visualization"

The importance of three-dimensional data is constantly being increased. In addition to terrain models; many spatially defined objects are used by many users. Like other data; 3 dimensional data is also associated with responsible organizations and it can be provided through Geoportal. France Geoportal provides three dimensional data via client application.

According to survey results; 28.57 % of participants give the second and third highest score to this question. Moreover, 23.47 % of the participants give below than average score and only 19.39 % of the users give the highest score to this question. Average score is 3.36 that is the lowest average among 26 questions. Participants do not consider it as a priority among the recommendations.

XVIII. Geoportal should have a "Mobile Application Software"

In addition to providing data; Geoportal should meet the needs by means of different access tools. Geographic Information System is used in many different areas and they demand different instruments like at field studies. On the other hand; today's technology is on the way of mobilization and instant access is important. All these require accessing and using Geoportal in mobile devices. For using the Geoportal in mobile devices efficiently, they should have a Mobile Application Software. In the studied examples; only the France Geoportal provides mobile application software and it is available only in the Google Play Store that is suitable for the Android Operating System.

According to the survey results; 36.73 % of participants give the highest score to this question and average score is 3.87. Although, 13.26 % of the users give points below the average, 86.73 % of the participants give above the average points. Depending

on the survey results; participants do not strongly prefer the mobile usage of the Geoportal. In terms of sector distribution, academics' average is 4.03, private sector is 3.81 and public sector is more interested in the application with a score of 4.78.

XIX. Geoportal should provide "Account and Group Management Support"

Users of the Geoportal benefit from Geoportal at different levels. These users can be groups which have similar activities in Geoportal. Depending on the defined framework; accounts and groups can be authorized and some services are available to them. In addition to that, new developments on the system, adding new features and their usage can be regulated with account and group management support. This situation provides not only easy management of the group operations but also supports the security of the system by linking to the authorization process. All examined Geoportals provide account and group management functions.

According to the survey results; 35.05 % of participants give the highest score to this question and average score is 3.66. 83.50 % of the users give points above the average but 7.22 % do not have an idea about this question. Depending on the survey results, participants do not strongly prefer the account and group management support in Geoportal and it is located at the bottom part of the question list.

XX. Geoportal should have ability to "Store User Data"

Users of the Geoportal make transactions in the system frequently based on their needs. Depending on the features of the Geoportal, users can form their accounts and store it for future. At a different time, user can log again into the system in which previous works are stored. On the other hand; users may add external data for instant use, they can store the data and remember how they made operations on the system with the login process. All the Geoportal expressed above provides functions to store user data.

According to the survey results; 32.65 % of the participants give the highest score, another 32.65% also give the second highest score to this question and average score is 3.74 and it is located on below the middle row. 13.26% of the user gives a score below the average to this question and users do not strongly prefer this feature.

XXI. Geoportal should provide "Application Programming Interface"

Geoportal does not only provide a data accessible interface but also provides use of its properties in other applications via application programming interfaces (API). Many functions of the Geoportal can be operated and service providers can use spatial features with them. Moreover; depending on the development of API for different software languages; it provides many applications that code in different software languages with this Geoportal functions can be used.

In addition to these properties, countries want to provide base maps and spatial features under their control rather than using global mapping services such as Google Maps or Bing Maps. Geo Platform and the France Geoportal provide an API for different software languages.

According to the survey results; 32.65 % of the participants give the highest score to this question and average score is 3.58. 81.63 % of the user gives a score above the average but 7.14 % do not have an idea about this question. Depending on the survey results, participants do not strongly prefer API support of Geoportal and this feature is located towards the bottom levels of the question list.

XXII. Geoportal should be accessible to "Non-Governmental Organizations or Associations"

Geoportal is used by different institutions and organizations. One of the important organizational bodies is the non-governmental organizations that are working with the provided data in the Geoportal. In addition to that these bodies do not only use the available data, they also produce data that can be used by other organizations. Accessibility of this context is handled with the authorization, account management and metadata concept.

According to the survey results; 42.88% of users give the highest score and average score is 4.15. Only 4.08 % of the participants give below the average score and 95.97 % give above the average to this question. The participants support the access of Non-Governmental Organizations or Associations and it is located in the upper sections of the recommendations.

XXIII. Geoportal should be accessible to "Private Sector"

Although Geoportal is directly linked to the Public based organizations, it also benefits from the private sector through indirect means. When the private sector does their projects, they need to use the approved data of the public institutions. Geoportal can be used as the intermediate connecting the private and public sector during the data exchange process. In terms of the world examples given above, private sector can access the data and services of Geo Platform, GEOSS and France Geoportal.

According to the survey results; 45.36 % of participants give the highest score and average score is 4.13 for this question. 93.82 % of the participants give points above the average. On the other hand; average score is 3.94 for the public sector, 4.03 for academics and 4.54 for private sector. The survey results show that participants support the integration of the private sector to Geoportal.

XXIV. Geoportal should provide "Online E-Commerce Marketplace for Data Selling Support"

Geoportals visualize the available data in line with their existing structures and presentation frameworks. Data is provided as open or restricted depending on its importance, security measures or public needs. Many organizations or institutions purchase or make agreements with other institutions to use their data. On the other hand; the scope of the exchange should be defined by the control mechanism of the Geoportal. Moreover; the type of exchange structure, which is also important, is designed through e-commerce or marketplace. None of the World examples examined above provides data exchange through Geoportal.

According to the survey results; 44.90% of the participants give the highest score and average score is 4.02. 7.14 % of the participants give below the average score and 90.82 % gives above the average to this question. It is located in the mid-level among the 26 questions and participants do not strongly support online e-commerce marketplace for data selling.

XXV. Geoportal should provide “Geo-Rights Management Perspective ”

In the process of the data offered through Geoportal, using data within a given framework is very important. After accessing through the Geoportal, users are responsible to use the data in the defined metadata context and within defined rights. With the Geo Rights Management function, data owners or decision makers decide the scope of sharing and with whom it will be shared. Although some data has open data specifications, others may have a monetary value that can be sold that gives it a high degree of importance. In this approach; providers of the data can get this exchange value via other modes of exchange such as protocols.

INSPIRE Geoportal has Rights Management perspective in its network service and this is implemented in the INSPIRE Geoportal. On the other hand; France Geoportal and GEOSS Portal also provide rights management but in Geo Platform rights management about spatial data is not implemented wholly.

According to the survey results; 54.08 % of the participants give the highest score and average score is 4.17 for this question. 91.83 % of the participants give points above the average and only 4.08% of users give a score below the average. Remarkable result is gathered from different sectors; the average of academics is 3.95, public is 4.22 and the private sector is 4.46 for this question.

XXVI. Geoportal should support “E- Government Integration”

E- Government subject is a current topic that has the same nature with the Geoportal in terms of digital application via network enable platforms. Geoportal processes work on digital platforms and their outcomes can be used in formal transactions. Integration of the e-government with the Geoportal also eliminates many procedures connected with the government.

E-Government situation should be considered with the security, authorization, legal dependencies and technological perspective of the countries in mind. INSPIRE Geoportal does not directly provide E-Government integration but some examples in Europe provides it based on the INSPIRE Directive. Only GEOSS Portal does not provide E-Government integration.

According to the survey results; 64.95 % of the participants give the highest score and average score is 4.39 for this question. 4.12 % of the users give a score below the average and 94.85 % of the participants give above the average score to this question. The average score for Public sector is 4.74, 4.13 for academics and 4.08 for private sector. Especially public sector strongly supports the E-Government integration on Geoportal.

5.4 Prominent in the Evaluation of Technical Question

After an assessment of each question, prominent results are evaluated in the following section. First of all; average ranking of the questions is given below and they are separated according to three different categories. These results are categorized as; first degree of importance if between 4.50-5 point interval, second degree of importance if between 4.50-4 point interval and third degree of importance if below the 4 points. Average rankings of each question can be seen in Table 5.

Table 5. The Average Ranking of the Questions

Question No	**Ranking No**	**Survey Questions**	**Average Score (High to Low)**
3	1	Geoportal should have "Standardization in Data Themes both National and International Level (e.g. INSPIRE)"	**4.72**
6	2	Geoportal should have ability to "Search Data with Selecting Area from Map"	**4.63**
5	3	Geoportal should have "Interactive Data View within the Web Map Viewer"	**4.6**
4	4	Geoportal should present "Metadata Information"	**4.57**

Table 5 (continued)

1	5	Geoportal should have “Data Download Ability”	**4.54**
2	6	Geoportal should have “Data Download Ability in Different Formats (for raster, vector, database)”	**4.39**
26	7	Geoportal should support “E- Government Integration”	**4.39**
9	8	Geoportal should display “External Web Map Services (WMS)”	**4.26**
25	9	Geoportal should provide “Geo-Rights Management Perspective ”	**4.17**
22	10	Geoportal should be accessible to “Non-Governmental Organizations or Associations”	**4.15**
23	11	Geoportal should be accessible to “Private Sector”	**4.13**
7	12	Geoportal should have support “Thematic Mapping and Analytics on Data”	**4.09**
24	13	Geoportal should provide “Online E-Commerce Marketplace for Data Selling Support”	**4.02**
12	14	Geoportal should provide “Web Feature Services (WFS) Support”	**4**
16	15	Geoportal should have “GeoRSS Support”	**3.95**
18	16	Geoportal should have “Mobile Application Software Version”	**3.87**

Table 5 (continued)

10	17	Geoportal should provide “Web Map Tile Services (WMTS) Support”	**3.78**
20	18	Geoportal should have ability to “Store User Data”	**3.74**
15	19	Geoportal should provide “Catalog Service for the Web (CSW) Support”	**3.7**
19	20	Geoportal should provide “Accounts and Groups Management Support”	**3.66**
11	21	Geoportal should provide “Web Coverage Services (WCS) Support”	**3.64**
8	22	Geoportal should support “Print and Printing Layout Design ”	**3.61**
21	23	Geoportal should provide “Application Programming Interface”	**3.58**
14	24	Geoportal should provide “Web Processing Services (WPS) Support”	**3.57**
13	25	Geoportal should provide “Transactional Web Feature Services (WFS-T) Support”	**3.51**
17	26	Geoportal should have “3-Dimensional Data Provision and Visualization”	**3.36**

According to the survey results; the most important recommendation is conformance to “Standardization in Data Themes both National and International Level”. In addition to that; “Search Data with Selecting Area from Map”, “Interactive Data View within the Web Map Viewer”, “Metadata Information” and “Data Download Ability” are other very important issues for the participants. Metadata question was asked to ensure reliable survey results because metadata is a prerequisite feature of

Geoportals. It can be seen that participants also consider it indispensible by ranking it 4th among 26 questions.

On the other hand; even though web service support of the Geoportal is another important issue, it takes low ratings from the users especially Catalog Service for the Web (CSW). This may be caused by two reasons; users do not have a deep understanding about the web map services or they may want to use these services directly. As users were selected from experienced ones, the first explanation can be declared as invalid. This shows us that users are more familiar with using data through traditional methods such as downloading to their locals.

Moreover; it can be seen in Table 6 that users give average or near average scores to new or unheeded concepts.

Table 6. New or Unheeded Approaches Results

Ranking No	**Survey Questions**	**Average Score (High to Low)**
7	Geoportal should support "E- Government Integration"	**Above Average (4.39)**
9	Geoportal should provide "Geo-Rights Management Perspective "	**Above Average (4.17)**
13	Geoportal should provide "Online E-Commerce Marketplace for Data Selling Support"	**Average (4.02)**
15	Geoportal should have "GeoRSS Support"	**Near Average (3.95)**
16	Geoportal should have "Mobile Application Software Version"	**Below Average (3.87)**
23	Geoportal should provide "Application Programming Interface"	**Below Average (3.58)**

Another important result is the selection of "No Idea" option in certain questions. As seen in the Table 7; participants do not express their ideas especially in the question of the web map services. It is understood that the users prefer to use traditional methods such as using and editing data after downloading. No Idea responses and their distribution are given in Appendix C.

Table 7. No Idea Answer Distribution

Questions	**Ratio**
	Number of People
Geoportal should provide "Web Map Tile Services (WMTS) Support"	**11,22%**
	11
Geoportal should provide "Transactional Web Feature Services (WFS-T) Support"	**11,22%**
	11
Geoportal should provide "Web Coverage Services (WCS) Support"	**11,22%**
	11
Geoportal should provide "Catalog Service for the Web (CSW) Support"	**8,16%**
	8
Geoportal should provide "Accounts and Groups Management Support"	**7,22%**
	7
Geoportal should provide "Application Programming Interface"	**7,14%**
	7

In addition to 26 questions; users also give their suggestions or comments about the Geoportal features in the last question of survey. The user suggestions are given below:

- Edit the data feature can be used for Enterprise portals but editing tool should not be included at the national level Geoportals.

- If public and private sector work together and share data, public sector would benefit the dynamism of private sector.
- According to the purpose of the Geoportal, some of the above features can be restricted.
- Integrated data received from the public for the integration of e-government should be strongly supported. Otherwise, the data already present in public will be regenerated.
- It is a difficult task but 3D objects can be queried.

CHAPTER 6

CONCLUSION

Geoportal provides comprehensive infrastructure that presents the geographic data in a sustainable and consistent manner. According to the technological changes, users require new concepts. In line with this, Geoportals are modified for those who benefit from their system. In this context, the aim of this thesis is to precisely emphasize from an academic perspective the Geoportal components based on user needs. In order to do highlight this aim, the thesis is composed of literature review, concepts and approaches of Geoportal, analysis of world examples and comprehensive survey parts.

As a result of the thesis; the most desired Geoportal features in line with user needs are aimed to be identified. In order to achieve this, survey is conducted with the participation of employees from public, private sector and academics. According to the survey results; instant communication with the data and the standardization in data themes are appreciated as the most important components. On the other hand; arrangement of data in real time via Geoportal and 3 dimensional data needs are indicated as the least important factors.

Analyses of responses coming from different group of users are an important issue for the survey. Different sector groups have different expectations of the Geoportal and thus they would have different attitudes towards the survey questions.

Public Sector mainly focuses on the administrative and the political side of Geoportal. Especially; conformance to the national and international standards and e-government integration questions are located at the top ranks for public sector. On

the other hand; 3-dimensional data provision and visualization, most of the web map services and other current technological trends are located towards the bottom ranks.

Private Sector assesses mainly based on the managing, accessing and searching of the spatial data. According to the survey results; conformance to the national and international standards, metadata information and selection process of data are high rated questions. On the contrary; especially the web map services that are capable of data editing and making spatial analyses and 3-Dimensional data ~~issues~~ are rated towards the bottom of the list.

Academics give the most importance to usage and access of data with download capability. Academics regard the data download and different data format download ability as valuable. On the other hand; some web services, API and account and user management functions are evaluated as the least important features for the Geoportal. It is unexpected that the metadata information is not located at the top of the list and it is located at the 6^{th} rank.

When responses from all sectors are considered all together; "Standardization in Data Themes both National and International Level (e.g. INSPIRE)", "Search Data with Selecting Area from Map" and "Interactive Data View within the Web Map Viewer" abilities are the common features considered as most important for the Geoportal. On the other hand; "Transactional Web Feature Services (WFS-T) Support" and "3-Dimensional Data Provision and Visualization" are evaluated as the least important components for Geoportal by all three different sectors.

From the initial startup phase, the responsible organizations should implement certain features in the Geoportal. Most important issue is the management of the metadata information by the Geoportal. They should provide interface for viewing or publishing the metadata. In addition to this; accessibility of data and service via Geoportal with its map functions through the map view, making basic queries and using thematic functions interactively are essential for effective usage of Geoportal. Providing Geo Rights and data download ability are also important for Geoportals. Moreover; Geoportal accounts and groups management function supports its

management capabilities. These can be considered as the basic features that each Geoportal should have.

On the other hand; some issues stand out to improve the existing Geoportals. First of all; standardization in data themes becomes an important issue for interoperability. Many different GIS data extensions and types are constantly being created. Therefore; support for different data extension and data type is an essential feature in developing the existing Geoportals. In addition to that; print operations via Geoportal can be important when delivering projects within the regulation. Storing the user data and instantaneous spatial information with GeoRSS are critical features to increase the interactive usage of Geoportal.

In recent years, the importance of spatial based web services is increased and they are started to be widely used. Especially; WMS, WFS, WMTS, CSW are supported by many service providers. In addition to that; studies on WCS, WPS, and WFS-T are gaining momentum. Available Geoportals can work on spatial based web services to meet the user needs. Moreover; public institutions, private companies and non-governmental organizations need reliable data for their projects. Thus different sector groups can be supported in Geoportals.

Geographic information is also affected by the technological developments. Thus E-Government Integration, Application Programming Interface Support, 3-Dimensional Data Provision and Visualization, Mobile Application Software Support and Online E-Commerce Marketplace for Data Selling Support are also the highlighted topics. These components can be considered for advanced Geoportals.

The Turkish Geoportal example applications are also evaluated. Some of the Geoportal applications by Public Institutions are implemented and there are others in the development phase. Although, there are certain features that each Geoportal should have as indicated above, the Turkish Geoportals in general only provide the visualization of the data via web map based applications. In the future Turkish Geoportals, not only the visualization feature should be considered as design priority but they should also include basic features of Geoportal explained above. In addition

to this, improving the existing Geoportal components and advanced Geoportal components should also be considered.

The aim of the survey is not only to receive user opinions about Geoportal components but also to inform the users about the Geoportal features that they are not aware of. In addition to this; the research and survey results can be used as a road map in the Geoportal preparation process or to improve the already existing ones.

As a result of this study, Geoportals should be designed considering the following principles;

- It should be in a network base structure (Internet and/or Intranet Base),
- It should manage metadata,
- It should be managed by single and authorized source with up to date information,
- It should protect rights on data
- It should contain interoperability approach
- It should take into account national and international standards
- It should be responsive to user needs, at least contain basic Geoportal Components

Considering the future of Geoportals, it is necessary to monitor that Geoportals are compatible with the new technologies in order to ensure their sustainability. Data is still growing exponentially. In order to handle this huge data, new approaches come out. Big data and cloud computing are outstanding concepts for responding to today's needs. Geoportals working with these technologies can be considered as a future study.

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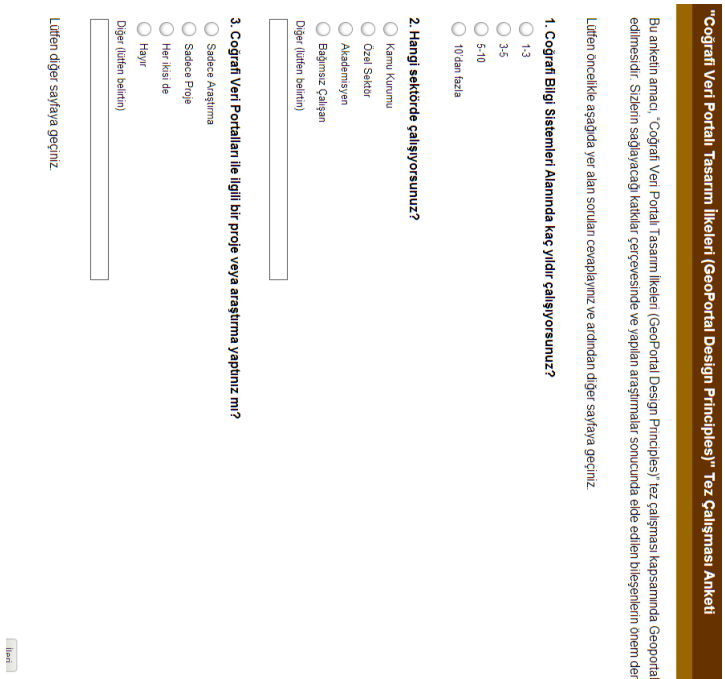
APPENDIX A

QUESTION STRUCTURE ON WEB BASED ENVIRONMENT



"Coğrafi Veri Portalı Tasarım İlkeleri (GeoPortal Design Principles)" Tez Çalışması Anketi

Bu anketin amacı, "Coğrafi Veri Portalı Tasarım İlkeleri (GeoPortal Design Principles)" tez çalışması kapsamında Geoportal kurma veya mevcut Geoportalların geliştirilmesi çalışmalarında ele alınması gereken bileşenlerin tespit edilmesidir. Sizlerin sağlayacağı katkılar çerçevesinde ve yapılan araştırmalar sonucunda elde edilen bileşenlerin önem dereceleri belirlenecektir. Katkılarınız için teşekkür ederim.

Lütfen öncelikle aşağıda yer alan soruları cevaplayınız ve ardından diğer sayfaya geçiniz.

1. Coğrafi Bilgi Sistemleri Alanında kaç yıldır çalışıyorsunuz?
- 1-3
- 3-5
- 5-10
- 10'dan fazla

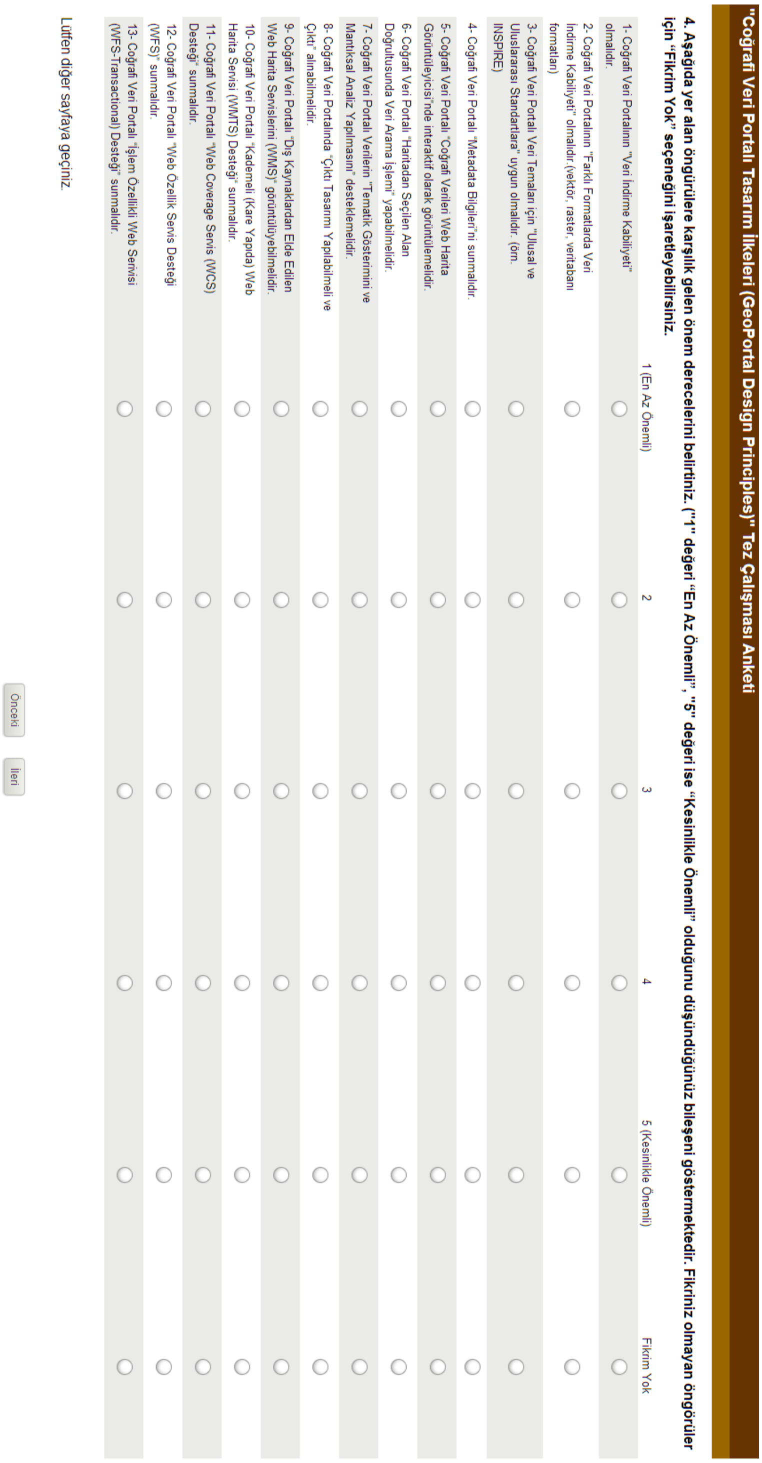
2. Hangi sektörde çalışıyorsunuz?
- Kamu Kurumu
- Özel Sektör
- Akademisyen
- Bağımsız Çalışan
- Diğer (lütfen belirtin)

3. Coğrafi Veri Portalları ile ilgili bir proje veya araştırma yaptınız mı?
- Sadece Araştırma
- Sadece Proje
- Her ikisi de
- Hayır
- Diğer (lütfen belirtin)

Lütfen diğer sayfaya geçiniz.

İleri

Figure 20. The First Page of Survey Questions



"Coğrafi Veri Portalı Tasarım İlkeleri (GeoPortal Design Principles)" Tez Çalışması Anketi

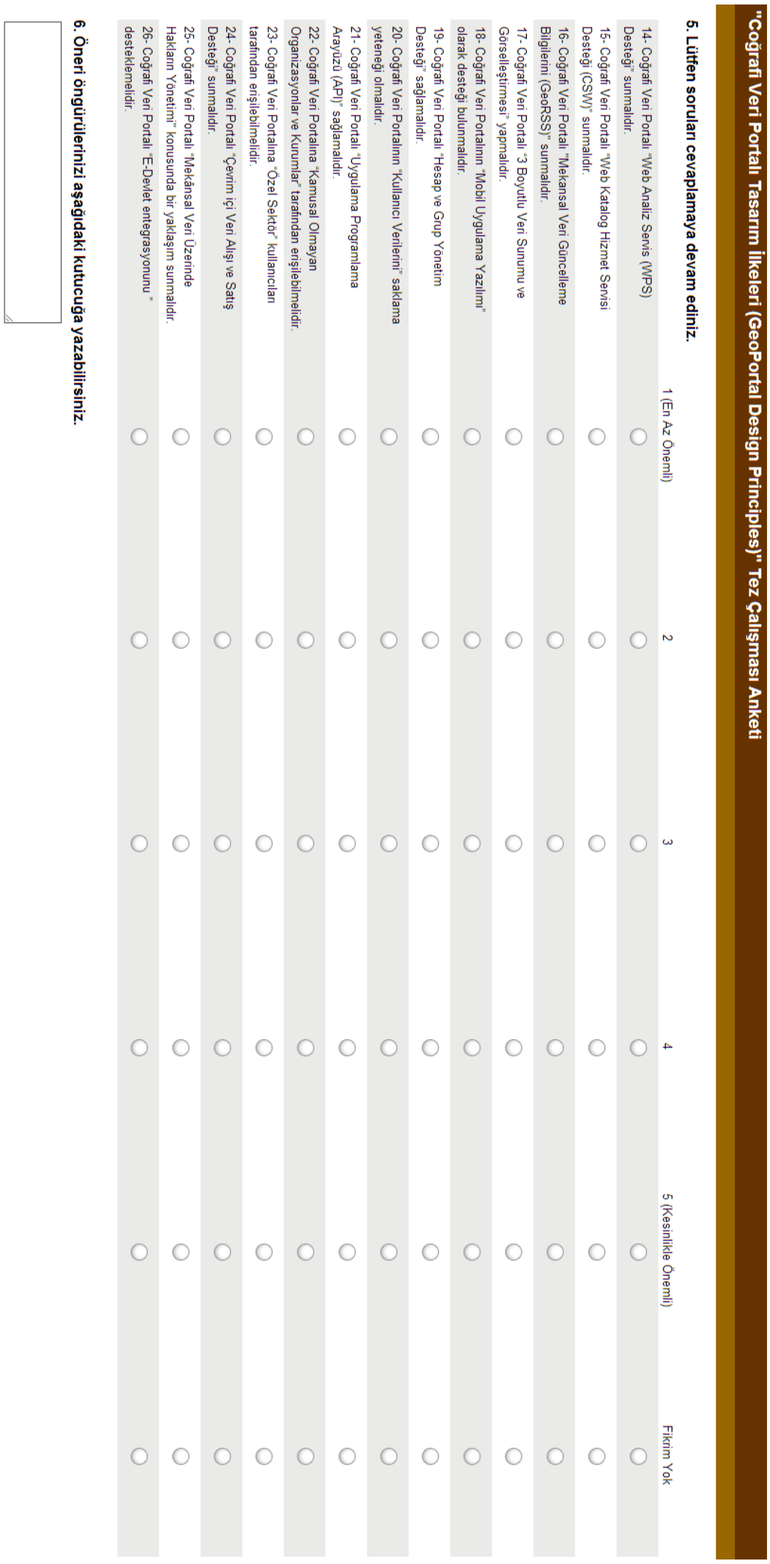
4. Aşağıda yer alan öngürülere karşılık gelen önem derecelerini belirtiniz. ("1" değeri "En Az Önemli", "5" değeri ise "Kesinlikle Önemli" olduğunu düşündüğünüz bileşeni göstermektedir. Fikriniz olmayan öngörüler için "Fikrim Yok" seçeneğini işaretleyebilirsiniz.

	1 (En Az Önemli)	2	3	4	5 (Kesinlikle Önemli)	Fikrim Yok
1- Coğrafi Veri Portalının "Veri İndirme Kabiliyeti" olmalıdır.	○	○	○	○	○	○
2- Coğrafi Veri Portalının "Farklı Formatlarda Veri İndirme Kabiliyeti" olmalıdır.(vektör, raster, veritabanı formatları)	○	○	○	○	○	○
3- Coğrafi Veri Portalı Veri Temaları için "Ulusal ve Uluslararası Standartlara" uygun olmalıdır. (örn. INSPIRE)	○	○	○	○	○	○
4- Coğrafi Veri Portalı "Metadata Bilgileri"ni sunmalıdır.	○	○	○	○	○	○
5- Coğrafi Veri Portalı "Coğrafi Verileri Web Harita Görüntüleyicisi"nde interaktif olarak görüntülemelidir.	○	○	○	○	○	○
6- Coğrafi Veri Portalı "Haritadan Seçilen Alan Doğrultusunda Veri Arama İşlemi" yapabilmelidir.	○	○	○	○	○	○
7- Coğrafi Veri Portalı Verilerin "Tematik Gösterimini ve Mantıksal Analiz Yapılmasını" desteklemelidir.	○	○	○	○	○	○
8- Coğrafi Veri Portalında "Çıktı Tasarımı Yapılabilmeli ve Çıktı" alınabilmelidir.	○	○	○	○	○	○
9- Coğrafi Veri Portalı "Dış Kaynaklardan Elde Edilen Web Harita Servislerini (WMS)" görüntülüyebilmelidir.	○	○	○	○	○	○
10- Coğrafi Veri Portalı "Kademeli (Kare Yapıda) Web Harita Servisi (WMTS) Desteği" sunmalıdır.	○	○	○	○	○	○
11- Coğrafi Veri Portalı "Web Coverage Servis (WCS) Desteği" sunmalıdır.	○	○	○	○	○	○
12- Coğrafi Veri Portalı "Web Özellik Servis Desteği (WFS)" sunmalıdır.	○	○	○	○	○	○
13- Coğrafi Veri Portalı "İşlem Özellikli Web Serivisi (WFS-Transactional) Desteği" sunmalıdır.	○	○	○	○	○	○

Lütfen diğer sayfaya geçiniz.

Önceki İleri

Figure 21. Second Page of Survey Questions



"Coğrafi Veri Portalı Tasarım İlkeleri (GeoPortal Design Principles)" Tez Çalışması Anketi

5. Lütfen soruları cevaplamaya devam ediniz.

	1 (En Az Önemli)	2	3	4	5 (Kesinlikle Önemli)	Fikrim Yok
14- Coğrafi Veri Portalı "Web Analiz Servis (WPS) Desteği" sunmalıdır.	○	○	○	○	○	○
15- Coğrafi Veri Portalı "Web Katalog Hizmet Servisi Desteği (CSW)" sunmalıdır.	○	○	○	○	○	○
16- Coğrafi Veri Portalı "Mekansal Veri Güncelleme Bilgilerini (GeoRSS)" sunmalıdır.	○	○	○	○	○	○
17- Coğrafi Veri Portalı "3 Boyutlu Veri Sunumu ve Görselleştirmesi" yapmalıdır.	○	○	○	○	○	○
18- Coğrafi Veri Portalının "Mobil Uygulama Yazılımı" olarak desteği bulunmalıdır.	○	○	○	○	○	○
19- Coğrafi Veri Portalı "Hesap ve Grup Yönetim Desteği" sağlamalıdır.	○	○	○	○	○	○
20- Coğrafi Veri Portalının "Kullanıcı Verilerini" saklama yeteneği olmalıdır.	○	○	○	○	○	○
21- Coğrafi Veri Portalı "Uygulama Programlama Arayüzü (API)" sağlamalıdır.	○	○	○	○	○	○
22- Coğrafi Veri Portalına "Kamusal Olmayan Organizasyonlar ve Kurumlar" tarafından erişilebilmelidir.	○	○	○	○	○	○
23- Coğrafi Veri Portalına "Özel Sektör" kullanıcıları tarafından erişilebilmelidir.	○	○	○	○	○	○
24- Coğrafi Veri Portalı "Çevrim içi Veri Alışı ve Satış Desteği" sunmalıdır.	○	○	○	○	○	○
25- Coğrafi Veri Portalı "Mekânsal Veri Üzerinde Hakların Yönetimi" konusunda bir yaklaşım sunmalıdır.	○	○	○	○	○	○
26- Coğrafi Veri Portalı "E-Devlet entegrasyonunu " desteklemelidir.	○	○	○	○	○	○

6. Öneri öngürülerinizi aşağıdaki kutucuğa yazabilirsiniz.

Figure 22. Third Page of Survey Questions

APPENDIX B

SURVEY RESPONSES BY SECTOR AND AVERAGE SCORES

Table 8. Public Sector Responses and Average Scores

Questions	Average Score
Geoportal should have "Standardization in Data Themes both National and International Level (e.g. INSPIRE)"	**4,75**
Geoportal should support "E- Government Integration"	**4,74**
Geoportal should have ability to "Search Data with Selecting Area from Map"	**4,67**
Geoportal should have "Interactive Data View within the Web Map Viewer"	**4,64**
Geoportal should present Metadata Information	**4,57**
Geoportal should have "Data Download Ability"	**4,28**
Geoportal should have "Data Download Ability in Different Formats (for raster, vector, database)"	**4,28**
Geoportal should display "External Web Map Services (WMS)"	**4,28**
Geoportal should provide "Web Feature Services (WFS) Support"	**4,22**
Geoportal should provide "Geo-Rights Management Perspective"	**4,22**
Geoportal should have support "Thematic Mapping and Analytics on Data"	**4,14**
Geoportal should provide "Online E-Commerce Marketplace for Data Selling Support"	**4,08**

Table 8 (continued)

Geoportal should have “GeoRSS Support”	**4**
Geoportal should be accessible to “Non-Governmental Organizations or Associations”	**4**
Geoportal should be accessible to “Private Sector”	**3,94**
Geoportal should support “Print and Printing Layout Design ”	**3,83**
Geoportal should provide “Catalog Service for the Web (CSW) Support”	**3,81**
Geoportal should provide “Web Map Tile Services (WMTS) Support”	**3,78**
Geoportal should have “Mobile Application Software Version”	**3,78**
Geoportal should have ability to “Store User Data”	**3,78**
Geoportal should provide “Accounts and Groups Management Support”	**3,69**
Geoportal should provide “Web Processing Services (WPS) Support”	**3,61**
Geoportal should provide “Web Coverage Services (WCS) Support”	**3,58**
Geoportal should provide “Transactional Web Feature Services (WFS-T) Support”	**3,58**
Geoportal should provide “Application Programming Interface”	**3,53**
Geoportal should have “3-Dimensional Data Provision and Visualization”	**3,5**

Table 9. Private Sector Responses and Average Scores

Questions	Average Score
Geoportal should have "Standardization in Data Themes both National and International Level (e.g. INSPIRE)"	**4,62**
Geoportal should present Metadata Information	**4,58**
Geoportal should have "Interactive Data View within the Web Map Viewer"	**4,58**
Geoportal should have ability to "Search Data with Selecting Area from Map"	**4,58**
Geoportal should be accessible to "Private Sector"	**4,54**
Geoportal should have "Data Download Ability"	**4,46**
Geoportal should provide "Geo-Rights Management Perspective "	**4,46**
Geoportal should be accessible to "Non-Governmental Organizations or Associations"	**4,42**
Geoportal should display "External Web Map Services (WMS)"	**4,35**
Geoportal should provide "Web Map Tile Services (WMTS) Support"	**4,27**
Geoportal should have "Data Download Ability in Different Formats (for raster, vector, database)"	**4,12**
Geoportal should provide "Online E-Commerce Marketplace for Data Selling Support"	**4,12**
Geoportal should provide "Web Feature Services (WFS) Support"	**4,08**
Geoportal should support "E- Government Integration"	**4,08**
Geoportal should provide "Web Coverage Services (WCS) Support"	**3,96**
Geoportal should provide "Accounts and Groups Management Support"	**3,96**
Geoportal should have support "Thematic Mapping and Analytics on Data"	**3,85**

Table 9 (continued)

Geoportal should have “Mobile Application Software Version”	**3,81**
Geoportal should have ability to “Store User Data”	**3,81**
Geoportal should provide “Application Programming Interface”	**3,77**
Geoportal should provide “Catalog Service for the Web (CSW) Support”	**3,65**
Geoportal should have “GeoRSS Support”	**3,65**
Geoportal should provide “Transactional Web Feature Services (WFS-T) Support”	**3,58**
Geoportal should support “Print and Printing Layout Design ”	**3,27**
Geoportal should provide “Web Processing Services (WPS) Support”	**3,27**
Geoportal should have “3-Dimensional Data Provision and Visualization”	**2,88**

Table 10. Academics Responses and Average Scores

Questions	**Average Score**
Geoportal should have “Data Download Ability”	**4,84**
Geoportal should have “Data Download Ability in Different Formats (for raster ,vector, database)”	**4,68**
Geoportal should have “Standardization in Data Themes both National and International Level (e.g. INSPIRE)”	**4,66**
Geoportal should have ability to “Search Data with Selecting Area from Map”	**4,66**
Geoportal should have “Interactive Data View within the Web Map Viewer”	**4,58**
Geoportal should present Metadata Information	**4,45**
Geoportal should have support “Thematic Mapping and Analytics on Data”	**4,21**

Table 10 (continued)

Geoportal should display “External Web Map Services (WMS)”	**4,16**
Geoportal should support “E- Government Integration”	**4,13**
Geoportal should have “GeoRSS Support”	**4,11**
Geoportal should be accessible to “Non-Governmental Organizations or Associations”	**4,11**
Geoportal should have “Mobile Application Software Version”	**4,03**
Geoportal should be accessible to “Private Sector”	**4,03**
Geoportal should provide “Geo-Rights Management Perspective ”	**3,95**
Geoportal should provide “Online E-Commerce Marketplace for Data Selling Support”	**3,87**
Geoportal should provide “Web Processing Services (WPS) Support”	**3,76**
Geoportal should provide “Web Feature Services (WFS) Support”	**3,74**
Geoportal should support “Print and Printing Layout Design ”	**3,66**
Geoportal should provide “Catalog Service for the Web (CSW) Support”	**3,66**
Geoportal should have ability to “Store User Data”	**3,61**
Geoportal should provide “Web Coverage Services (WCS) Support”	**3,53**
Geoportal should have “3-Dimensional Data Provision and Visualization”	**3,53**
Geoportal should provide “Application Programming Interface”	**3,53**
Geoportal should provide “Web Map Tile Services (WMTS) Support”	**3,47**
Geoportal should provide “Transactional Web Feature Services (WFS-T) Support”	**3,42**
Geoportal should provide “Accounts and Groups Management Support”	**3,38**

APPENDIX C

NO IDEA RESPONSES

Table 11. No Idea Responses And Distributions

Questions	Ratio / Number of People
Geoportal should provide "Web Map Tile Services (WMTS) Support"	**11,22%** / **11**
Geoportal should provide "Transactional Web Feature Services (WFS-T) Support"	**11,22%** / **11**
Geoportal should provide "Web Coverage Services (WCS) Support"	**11,22%** / **11**
Geoportal should provide "Catalog Service for the Web (CSW) Support"	**8,16%** / **8**
Geoportal should provide "Accounts and Groups Management Support"	**7,22%** / **7**
Geoportal should provide "Application Programming Interface"	**7,14%** / **7**
Geoportal should provide "Web Feature Services (WFS) Support"	**6,12%** / **6**
Geoportal should provide "Web Processing Services (WPS) Support"	**6,12%** / **6**
Geoportal should have "GeoRSS Support"	**5,10%** / **5**

Table 11 (continued)

Geoportal should provide “Geo-Rights Management Perspective ”	**4,08%**
	4
Geoportal should have ability to “Store User Data”	**2,04%**
	2
Geoportal should provide “Online E-Commerce Marketplace for Data Selling Support”	**2,04%**
	2
Geoportal should present Metadata Information	**2,06%**
	2
Geoportal should support “E- Government Integration”	**1,03%**
	1
Geoportal should display “External Web Map Services (WMS)”	**1,02%**
	1