# TECHNOLOGICAL PRINCIPLES AND MAPPING APPLICATIONS OF WEB GIS

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***Abstract***
*The rapid development of the modern technologies all over the world requires new strategies for planning the best solutions in web mapping. Before this progress to be accomplished, manually drawn maps were upgraded to computer generated once using Geographic Information Systems. Eventually GIS maps started moving from the desktop part to the World Wide Web and big GIS vendors started making the first frameworks for online maps. It can be claimed that computers are the key to evolution in all application fields in our society, especially as a turning tool in "Innovation Cartography". Up-to-date topics about modern mapping include web GIS technological principles about server-side technologies, geospatial standarts, and protocols, along with their implementations. Also, from a scientific perspective, having a powerful knowledge base of how to use map projections and spatial databases, having a long-term experience with gathering, generalizing and visualizing the geospatial data to specific scales, having useful observations of the nicities of placing labels on the map, having a work-based practical experience in setting up a server that will serve the map, and many others, are of great importance. Web GIS applications are widely usable and helpful in many areas like the military defense, environment conservation, tourism development, disaster management, educational purposes, and so on. This paper contributes to the understanding of the web GIS architecture and its main technological principles, describing the characteristics of the proprietry and free software applications, giving the methodological principles for creation of an efficient fast functional web GIS application, and accessing the thematic web GIS content according to the specific needs of users.*

***Keywords**: Web GIS, technological principles, application fields*

## INTRODUCTION

Nowadays, life with Internet-based technologies gives people unlimited access to all types of information in space-time. In turn, Geographic Information Systems are a tool for creating, manipulating, storing, analysing and visualizing geospatial data. Merging WEB and GIS components into one interconnected system provides free and universal access to Big Data from everywhere. This technological progress helps a wide range of users to find solutions that can meet their needs. In fact, WEB GIS is a set of software, hardware, data, procedures and specialists and it is a powerful tool for communication between web-based server and client architectural components. Undeniable advantages of WEB GIS products are the possibilities for visualizing geospatial data in real time, maintaining different operating systems and building cross platform applications. Only the developement of WEB technologies allows GIS to continue growing and developing their potential. Extremely important step in development process is the transition from the traditional exchange of databases on paper or digital media to modern transfer of attribute and spatial information in the Web. If somehow people attempt to separate GIS from WEB, it would undoubtedly cause a lack of stability in functioning of the numerous application fields in our society. As an end result it would be much more difficult for people to keep up with the qualitative symbiosis between them. That is why the application of WEB GIS cannot be assumed to be an unjustifiable and meaningless vagary, but can be thought of as a powerful tool that could help getting through many problems such as social, political, economic and environmental issues.

## BRIEF HISTORY OF WEB MAPPING

For decades, the main access to geographic information has been pursued only through desktop-based personal computers. During this long period of time it hasn't been possible to be easily and efficiently shared information with other people and organizations due to the lack of rational approach and innovative thinking for tackling this problem. With the invasion of the Internet in the mid-90s the idea of sharing maps and other geographic information between computers both within the labor organization and the public space began to grow. Hardware presence of this and each subsequent stage of development preceded the advancement of the newest software technologies and the necessary technical skills of the cartographers-performers. Currently, with the required dose of desire and labor challenges, the detailed graphics, the good resolution and the smooth navigation of the interactive cartographic images can be effectively achieved. More and more, the development of web space turns into an opportunity for exercising new cartographic techniques and tools for making satisfactory attractive maps. This is evidenced by the frequent use of methods for "smart" snapping interactive map objects and immediately highlighting their “origin location”. Here also appears the necessity of using different management approaches according to protrusion and coloring, combined with pop-up windows from the stylishly formatted web page. The highest advantage of WEB technologies from a development perspective occurs at the end of the XX century, when the possibility of accessing maps from mobile devices becomes a reality. The development of the web maps as a current and future process is constantly growing proportion of the introduction and improvement of modern personal computers and portable mobile devices. Without this progress realization, the access to a map content would be significantly more limited, much more difficult and extraordinarily slowed. The transition from GIS to WEB enables an universal access to geospatial information as for both employees and customers of various organizations. In the broad sense, this progress is also useful for ordinary people because it allows them the ability to search some information that could meet their needs freely and easily.

## MAIN TECHNOLOGICAL PRINCIPLES AND MAPPING APPLICATIONS OF WEB GIS

There are two broad kinds of web mapping applications – static and interactive. Stattic maps consist of only one function that is connected with visualizing the cartographic image. That’s why their functionality can be defined as primitive. Web GIS applications in turn, includes a lot of information structured as cartographic layers and a number of tools which are supporting the possibilities for interaction with the map. Interactive maps allow users not only to view the precise map content which is the object of attention, but also to take part in the communicaton between themselves as clients-consumers of information and the middle-tier server parts that interact with the pre-created GIS data saved on the file server, or more preferably on the database server, so as to respond to the clients requests. On one hand, the middle-tier server side architecture includes web server part, but on the other it also requires geospatial server part or so called web mapping server part where a certain GIS content is stored. A web server (e.g. Apache) is needed to handle the high-level communications between the end user (who is using a Web Browser to access provider’s mapping site) and the underlying web mapping services on provider’s computer. It represents a web page containing maps and map-related tools to the end user. The content of the web page consists of Hyper Text Markup Language (HTML) that entirely represents the web page content, Cascading Style Sheets (CSS) that effectively stylizes the web page content and Java Script (JS) that dynamically manipulates the web page content. The web mapping server, or so called web mapping program, is the engine behind the maps that users see on the web page and it needs to be configured to communicate between the web server and the database server (PostgreSQL/PostGIS). The final step before exporting the GIS content to the WEB is getting through a server-side map rendering engine for publishing, stylizing, sharing and editing geospatial data (e.g. GeoServer), along with a server software solution for caching and rendering the geospatial information (e.g. GeoWebCache) and a client-side framework for visualizing and analyzing the geospatial information (e.g. JavaScript Libraries as OpenLayers/ExtJS/GeoExt), which are used for a better visualization, flexible functionality and high-speed performance. The management of the underlying map data is performed on the first level of the web mapping process scilicet working with the personal chosen desktop part application (e.g. QuantumGIS). Mapping data can also come from web mapping servers when custom geospatial information in real time is needed. Mapping metadata is data about data and it describes where the mapping data came from, how it can be used, what it contains and who to contact with questions. There are 4 transition steps to the final geospatial data serving on the Web (Figure 1).

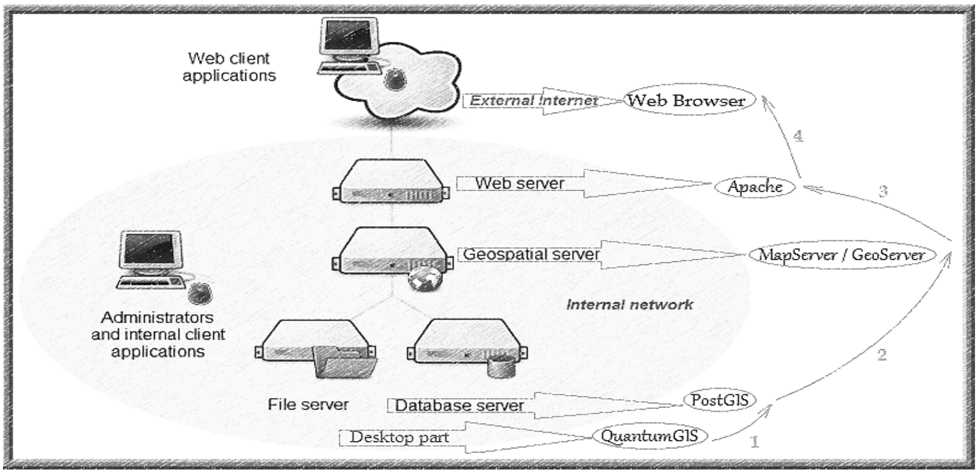


*Figure 1. Example of a system architecture for Web GIS application.*

## Rich Internet Applications

In recent years there has been a great proliferation of web-based mapping applications. While Geographic Infromation Systems (GIS) were traditionally used mainly by a relatively small group of experts, the general public has now been introduced to WEB GIS applications by the increasing number of free web-based mapping applications that use a set of different technologies popularly referred to as a Rich Internet Application (RIA) technologies. A Rich Internet Application (RIA) is a web application that has many of the characteristics of desktop application software, typically delivered by way of a site-specific browser, a browser plug-in, an independent sandbox, extensive use of Java Script, or a virtual machine (Johansson, 2010). Traditionally, WEB GIS applications have used technologies and techniques such as Java Script and AJAX (Asynchronous Java Script And XML) to create advanced web mapping features. Asynchronous calling of remote procedures, intelligent caching, image tiling and advanced user interface construction has enabled developers to create rich, interactive mapping applications (Johansson, 2010). Java Script (JS) and Asynchronous Java Script And XML (AJAX) applications run in the Web Browser environment and exhibit RIA characteristics such as rich user experience, asynchronous background client-server communication, interactivity and transmission of computing and processing complexity from server to client-side.

Java Script (JS) is a dialect of the scripting language ECMAScript (ES) which is officially managed by the Mozilla Foundation. A scripting language is a programming language that controls the behavior of an existing application or system. That means that there is a core application that hosts the script and provides the Core Functionality and the Document Object Model (DOM). Script code is often interpreted from the source code, or bytecode, instead of being pre-compiled as many traditional programming languages. That’s the main reason such programming languages to be called interpreted languages. As there are many different Web Browsers that support Java Script, each one of them is a different host environment for the Java Script Code. The Web Browser contains a Java Script Engine that interprets and executes the Java Script Code and the Document Object Model (DOM). Java Script Code is contained within the Hyper Text Markup Language (HTML) and reacts to user interactions in an event-driven manner. The Web Browser provides functionality for the embedded Java Script Code, such as Objects exposed by the DOM API, and represents windows, menus, pop-ups, dialogue and other user interface components. The hosting Web Browser also provides event propagation and handles attachment of Java Script Code by so called event-listeners/event-handlers to the different events. Events could be triggered by user interactions (such as mouse-clicks) or by document state changes (such as completion of loading a document component).

Most Web Browsers use the Document Object Model (DOM) for Objects Representation and Event Management. XML or HTML documents are represented in the DOM as a tree of nodes (parent, child, and sibling nodes). Any subnode of a given node is called a child node, and the given node, in turn, is the child’s parent. Sibling nodes are nodes on the same hierarchical level under the same parent node. Nodes higher than a given node in the same lineage are ancestors and those below it are descendants. Each of these nodes is represented in the DOM as Objects which can be manipulated by Script Code such as Java Script via the DOM API. In recent years, a standardization of the DOM API has been developed by the World Wide Web Consortium (W3C) to increase interoperability and to strive towards platform and programming language independency. However, different Web Browsers have still different support for the DOM.

Asynchronous Java Script and XML (AJAX) applications, in turn, use the XMLHttpRequest Object in the Web Browser to retrieve data from a server/service asunchronously. This means that the data can be loaded into a web application in the background, without interfering with the user interactions within the application. This enables a web application to represent the new information to the user by partially updating the screen without having to reload the web page or load a new one. AJAX is traditionally thought of being paradigm for updating information on a web page because it increases the dynamic and interactive behavior of the web pages and can enrich the user experience. Lately, the AJAX technique has become very popular because of some “killer applications” such as Google Maps.

## Open Geospatial Web Services and Standarts

Later on, open standarts which are protocols for communication between applications are of great importance because they refer to the ability of a program to share data or functions with another program or so called interoperability. There are proprietary and open-source software working possibilities. The first mentioned includes one main barrier for customers and that is the cost price. On the other hand, open-source software refers to a type of software product that has the programming source code available which means that it is free to use. There is also one more mixed opportunity between these two aforementioned options and that is betting on paid improvements to the open-source code when extra functionality or additional patching is needed. In this case another barrier in exporting geospatial data to the Web might be the lack of technical know-how professional skills. Here must be mentioned the last common used fourth additional option connected with free software application usage, whereupon the whole program is downloaded for free, but the program source code is invisible to the user. Regardless of the aforementioned advantages and disadvantages of analysed in future software products, the final decision taken by the service providers always must come from defining the specific customer needs. This may be given the thought of a rule number one in the WEB GIS industry. Entering the depths, there should also be removed one common mistake connected with showing in details mostly the general geographic information without paying attention to the necessity of presence of comprehensive personal information, that could help the map content to being thought as pragmatic along with intriguing. Another critical component of any WEB GIS application is the used map projecton – whether for a hardcopy printout or an interactive web map. The map projection itself depends on the heterogeneous nature of spatial datasets. Heterogeniety can be result of data collection methods, analysis methods, file formats, or the software used to create, store, and make the datasets available online. Differences in heterogeneity can pose a major problem in spatial data sharing and data interoperability, as well as in the functionality (Zhang et al., 2010; Lassoued et al., 2010). However, the creation of open-source geospatial web services and standarts provide the framework for the incorporation and exchange of heterogeneous spatial datasets and overcoming interoperability and data-sharing problems (Zhang and Li, 2005; Moses, 2011). The rapid development and adoption of open-source services and standarts provides a stable foundation for the development, growth, and use of web services (Zhang and Li, 2005). The enabler of open-source geospatial web services is the Open Geospatial Consortium (OGC). The three most common used OGC standarts, namely Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS), are designed for geospatial information visualizing but they vary based on their inputs, outputs, and inherent client functionality. The comparison between these three popular OGS Web Services is shown in Table 1.

*Table 1. Comparison of the most common used OGC Web Services.*

| **Service Interface Standart** | **Inputs** | **Outputs** | **Client Functionality** |
|---|---|---|---|
| Web Map Service (WMS) | Maps (created from vector and/or raster datasets) | Image (GIF, JPEG, etc.) | Request |
| Web Feature Service (WFS) | Vector datasets (points, lines, polygons) | Extensible Markup Language (XML) data that is both human-readable and machine-readable such as Geography Markup Language (GML) data and Scalable Vector Graphics (SVG) data that includes geospatial and attributive information along with metadata | Request, Query, and Manipulate |
| Web Coverage Service (WCS) | Raster datasets (pixel-based or feature bounded in space) | Encoded binary images (GeoTIFF, Network Common Data Form or so called NetCDF, etc.) | Request and Query |

From controlling reality to manipulating possibilities, there are 5 different types of tools used in digital mapping and its related disciplines:

1. ***Geospatial data Mapping and Viewing***;

2. ***Geospatial data Analysis*** as data classification, spatial proximity calculations, statistical summary. Analysis tends to summarize information temporarily, in cases where manipulating data is changing in time or new data creation is needed;

3. ***Geospatial data Creating and Manipulating*** by using proprietary or open-source desktop GIS products;

4. ***Geospatial data Conversion*** by using conversion tools and data access libraries, in cases where source data isn't in the format required by viewing or manipulating the WEB GIS application. Historically viewed, in the commercial world more and more vendors supported their own proprietary formats with marginal support for others. This use of proprietary data formats has led to a historic dependency upon a vendor's product. Fortunatelly, recent advances in geomatics software have led to cross-application support for more competitor formats. This, in turn, has led to interoperable vendor-neutral standards through cooperative organizations such as the ***Open Geospatial Consortium (OGC).***

5. ***Geospatial data and Web maps Sharing*** from one side by sharing static or interactive maps through the WEB GIS application and from the other side by using web service specifications for sharing geospatial data between the used applications of the provider. The use of ***Open Geospatial Consortium Web Services Srandarts (OWS)*** allows different WEB GIS applications to share geospatial data both with each other and also with other applications. OWS is an open standart for sharing and accessing information. Therefore organizations are no longer tied to a particular vendor's data format. That means that the softwares used in the WEB GIS application processing needs only to support OWS.

There is a number of 8 Open Web Services Standards authorized by the Open Geospatial Consortium, which characteristics are shown in Table 2.

*Table 2. Open Web Services provided by Open Geospatial Consortium.*

| | |
|---|---|
| **Web Coverage Processing Service** | The Web Coverage Processing Service Specification (WCPS) defines a protocol-independent language for the extraction, processing, and analysis of multi-dimensional gridded coverages representing sensor, image, or statistics data. |
| **Web Coverage Service** | This Web Coverage Service Specification (WCS) offers multi-dimensional coverage data for access over the Internet. |
| **Web Feature Service** | The Web Feature Service Specification (WFS) represents a change in the way geographic information is created, modified and exchanged on the Internet. Rather than sharing geographic information at the file level using File Transfer Protocol (FTP), for example, the WFS offers direct fine-grained access to geographic information at the feature and feature property level. Web Feature Services allow clients to only retrieve or modify the data they are seeking, rather than retrieving a file that contains the data they are seeking and possibly much more. That data can then be used for a wide variety of purposes, including purposes other than their producers' intended ones. WFS is primarily a Feature Access Service but also includes elements of a Feature Type Service, a Coordinate Conversion/Transformation Service and Geographic Format Conversion Service. |
| **Web Map Context** | The Web Map Context Specification (WMC) states how a specific grouping of one or more maps from one or more map servers can be described in a portable, platform-independent format for storage in a repository or for transmission between clients. |

| | |
|---|---|
| **Web Map Service** | The Web Map Service Interface Standard (WMS) provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not. |
| **Web Map Tile Service** | The Web Map Tile Service Implementation Standard (WMTS) provides a standard based solution to serve digital maps using predefined image tiles that are available in each layer (i.e. each type of content), in each graphical representation style, in each format, in each coordinate reference system, at each scale, and over each geographic fragment of the total covered area. The Service Metadata Document declares the communication protocols and encodings through which clients can interact with the server. The clients can interpret the Service Metadata document to request specific tiles. |
| **Web Processing Service** | The Web Processing Service Interface Standard (WPS) provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services overlay. The standard also defines how a client can request the execution of a process, and how the output from the process is handled. It defines an interface that facilitates the publishing of geospatial processes and clients' discovery of and binding to those processes. The data required by the WPS can be delivered across a network or they can be available at the server. |
| **Web Service Common** | The Web Service Common Specification (WSC) includes common aspects according to the Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS) which includes operation request and response contents, parameters included in operation requests and responses, and encoding of operation requests and responses. |

## Open Geospatial and Web Servers

If Open Web Services are the communication language, then Open Web Mapping Servers are the partial body of the middle-tier system architecture of WEB GIS. Therefore here is provided an information, shown in Table 3 below, about the made comparison of the two most common used open-source Web Mapping Servers – MapServer and Geoserver. None of them is better or worse – it depends on the development objectives that better fits the developer's needs.

*Table 3. Advantages and disadvantages of MapServer and GeoServer according to specific indicators.*

| **Traits** | **MapServer** | **GeoServer** |
|---|---|---|
| Open Web Services – WMS/WFS | Better dealing with Web Map Service (WMS) that serves georeferenced map images and has very simple quering of data. | Better dealing with Web Feature Service (WFS) that allows powerful querying and retrieval of features. |
| WFS/WFS-T | Supports only the basic Web Feature Service (WFS). Doesn't support the additional Transactional Web Feature Service (WFS-T). | Supports both Web Feature Service (WFS) and Transactional Web Feature Service (WFS-T) that allows creation, deletion, and updating of features. |
| Common Gateway Interface/ Servlet | Works with Common Gateway Interface (CGI) that is the very first attempt at providing users with dynamic content. It allows users to execute a program that resides in the server to process data and even access databases in order to produce the relevant content. Since these are programs, they are written in the native operating system and then | Works with Servlet that is called J2EE. A servlet is is an implementation of Java that aims to provide the same service as Common Gateway Interface (CGI) does, but instead of programs compiled in the native operating system, it compiles into the Java bytecode which is then run in the Java virtual machine. |

| | | |
|---|---|---|
| | stored in a specific directory. One of the CGI disadvantages is the platform dependence. With CGI, switching operating system is a difficult and laborious process as programs recompilation in the new operating system would be needed. Since independent programs in CGI are being run, they create their own process when they are executed, something that does not happen with servlets as they just share the memory space of the Java Virtual Machine (JVM). This can lead to problems relating to overhead, especially when the number of users exponentially increases. It also creates vulnerability issues as the program is not controlled in any way once it is run on the server. Later on, the more common method when using CGI is via scripts. This, in turn, has a positive effect because it reduces the time needed in creating programs and it is generally more secured. | Though Java programs can be compiled into the native code, they still prefer to compile in the Java bytecode. One of the Servlets advantages is the platform independence. That's because Servlets can run on any operating system just as long as a Java Virtual Machine (JVM) is installed, which means that there would not be any problem even if operating systems are chosen to be switched. Servlets saves executing processes time and assures control safety. With CGI, scripts can be run right away, while servlets, the script has to being translated into Java and then being compiled into a servlet which adds a little bit to the loading time. The summary of the aforementioned facts may entail to some advantage to GeoServer, since some companies don't want to work with CGI. |
| Configuration | A little bit hard to configurate | Has a Web Tool Administration that eases the configuration |
| Software Interface | Command line or separately installed Graphical User Interface (GUI) | Graphical User Interface (GUI) |
| Visualization | Has without any doubt a very powerfull cartographic system, providing data under dynamic vectors with high quality | Has a satisfactory and good enough geospatial data visualization |
| Release | A more mature project – 1996 | A bit more recent project – 2003 |

The other upgradeable part of the body of the middle-tier system architecture of WEB GIS is the presence of Web Server. Undoubtedly, more than 20 years already undisputed world leader in the ranking of Web Servers is the open-source Apache followed by the proprietary Microsoft IIS. Its main advantage is that it is free-to-use application without license taxes and fees. It can be installed not only under Windows, unlike Microsoft IIS Web Server, but also under Linux, Unix, Mac OS. It is also flexible because of its capability for users to choose between different modules. In addition, it allows for certain more safety and security, which could obviously be expected, assuming that Windows-based computer operating system is more often attacted by hackers. Last, but not at least advantage of Apache is that it is still being used with the widest support from the user community.

## Open Desktop GIS Software Platforms

After all, looking back at the beginning of the whole web mapping process, there is expected that the most important thing is the data itself. Without it, there could not be talked about any possible start pointing at all. So firstly, it is needed for the developer a desktop GIS web mapping solution for creation, managing, analyzing and displaying the underlying data sets where it's necessary. Examples of this kind of software platforms may be the proprietary ArcGIS or the open-source QuantumGIS. In accordance with their widespread use, their main characteristics are represented in Table 4 below. The made comparison could be of any help in cases where there's a doubt which one of the two most common used softwares is more appropriately to be used according to the specific user needs and experiences, along with program limitations and extra functionalities.

*Table 4. Comparison of the two main used desktop GIS software platforms – ArcGIS and QuantumGIS.*

| **Characteristics** | **ArcGIS** | **QuantumGIS** |
|---|---|---|
| Software | Commercial | Open-source |
| Functionality | Much more developed with an advanced complex set of editing tools and analytical functionalities | A basic set of the most common used geospatial processing tools together with continuous development of free plug-ins. It could include a powerful analytical functionality through integration with the oldest and largest available open-source GIS software, to wit GRASS GIS, which, in turn, is used around the world in academic and commercial settings as well as by many governmental agencies and environmental consulting companies. |
| Data Consuming | Not so efficient conversion and reciprocality | GDAL/OGR library maintenance and PostgreSQL/PostGIS interaction |
| Speed | Wasting time in license validating | Less processing time |
| Labelling | Better annotation placement properties | Better label styles |
| 3D mapping | Much better performance using the 3D Analyst Extention (such as extruding objects with amazing vertical exaggeration or performing fly-throughs) | Lack of decent 3D support |
| Print | Better option for beautiful cartographic masterpieces creation | Not so appropriate choice |
| Results | More reliable results (especially in cases where Automatic/Manual Interactive Topology Fixing is used) | Verifiable results (e.g. Topology checking) |
| Documentation | Superb in-depth documentation provisioning on how to use different tools for getting hands-on experience | Informative, well-written and practical documentation |
| Release | A more mature project – 1999 | A bit more recent project – 2002 |

## Open Spatial Databases

One more level higher, in addition to the aforementioned first-level data processing, the mission for creation a Spatial Database which to act as one wholly inseparable system is also needed for gathering, continue manipulating and transfering above the previously collected geographic information. That’s why what’s comming next is the installation of some sort of Spatial Databases such as PostGIS which is an extension to PostgreSQL (developed by a Spatial Database Technology Research Project) that allows GIS objects to be stored into the database. PostGIS spatially enables the popular PostgreSQL Object-Relational Database, allowing it to be used as a back-end database for Geographic Information Systems (GIS) and web mapping applications. PostGIS is stable, fast, standarts compliant, with hundreds of spatial functions and is currently the most widely used open-source Spatial Database. PostGIS is used by diverse organizations from around the world, including risk-averse government agencies and organizations storing terabytes of data serving millions of web requests per day. Database administration is available for the desktop and web via pgAdmin, php PgAdmin, and others. Data import/export can be done by the command line tools (such as shp2pgsql, pgsql2shp, org2org, dxf2postgis) or from the desktop and web GIS clients. These clients can also manipulate and produce PostGIS geospatial data tables. It allows hundreds of geospatial processing functionalities including Buffers, Unions, Overlays, Distance, and many more as well as Atomicity, Consistency, Isolation, and Durability (ACID) transactional integrity, R-Tree Spatial Index, Multi-User Support, and so on. ACID transactional integrity ensures predictable behavior, reinforcing the role of transactions as all-or-none propositions designed to reduce the management loading when there are many variables. PostGIS implements Simple Features Structured Query Language (SFSQL) Open Geospatial Consortium (OGC) Implementation Specification for Geographic Information.

## Metadata

Last, but not at least, a very important characteristic of the final WEB GIS application with regard to users is having a knowledge of where, when, why and how data is available on the Internet. Users must know where provider's geospatial data comes from and answer the question if they can rely on its quality and reliability. Metadata, or data about data, provides necessary information for users about the data, including information about collection and analysis methods, sources of error, spatial reference systems, and contact information. Metadata components might be hierarchically constructed at various levels according to the listed information about geospatial data because the amounts of metadata included with spatial data vary, from none to full documented metadata that meets a metadata standart. Example of kind of this structure is shown in Table 5.

*Table 5. Metadata components according to the listed information about the provided geospatial data.*

| **Listed Information** | **Metadata Components** |
|---|---|
| No Metadata | Basic information generated directly from data, such as data sources and information about the attributes (names and data formats) |
| Basic Metadata | File name, keywords, summary, description, spatial reference system, basic attribute information, credits, and access and use limitations for the data |
| Mandatory Metadata | All mandatory fields including basic information (e.g. abstract, keywords, supplementary information, data citation, contact information) and information about data quality, data organization, spatial reference system, attributes, and its distribution |
| Full Metadata | All mandatory and optional fields including basic information (e.g. abstract, keywords, supplementary information, data citation, contact information) and information about data quality, data organization, spatial reference system, attributes, and its distribution |

Utilization of web-based GIS can provide managers, decision-makers,and scientists access to uo-to-date and accurate information from multiple sources, including the government and academia, and across multiple spatial scales that are essential to informed decision-making (Bauer, 2012). A key point in this process is the presence of an efficient access to up-to-date information by using data portals or searchable data catalogues that could benefit managers, decision-makers, and scientists by providing access to spatial decision support tools, assisting with spatial planning, and serving as an educational resource (Wright et al., 2011). Once Web Services are published, or made accessible, they can be called and invoked by other applications, like web sites, and then combined with other services can create larger, more comprehensive services and/or applications (Anderson and Moreno-Sanchez, 2003).

## CONCLUSIONS

There are many new principle technologies and mapping applications in WEB GIS field that are rapidly and constantly changing it. On the technology side, such examples include the technical evolutions and predictable trends in web GIS server-side and client-side capabilities, Cloud GIS, Mobile GIS, Online Spatial Analytics, Web 3D and Big Data. On the application side, the main future development purpose is WEB GIS applications to include complex functionalities so as to be showcased in public information services, citizen engagement events, and operational decision support. Increasingly, the new trends in WEB GIS filed are undoubtedly having a positive effect on the society as a whole, according to the deep thought-provoking and strategically planned experiments in the WEB GIS industry.

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