Recently, the need for desktop applications has almost been displaced by improved web technologies. Another important development has been web services. Companies, institutions and government agencies have implemented web services to expose data resources or functionalities over the web and have usually made it accessible through application programming interfaces (API). This has enabled resources to become accessible through the web and has made it a data rich environment.

Aforementioned developments have also improved and enlarged the role of geographic information online. Many organizations and government agencies come together to create different levels of spatial data infrastructures (SDI) to make geoinformation more accessible, interoperable and harmonized through open geographic web service standards (e.g., WMS, WFS), technologies (e.g. OSGeo) and policies (e.g. INSPIRE).

Since more open geospatial services are available and the web is a common platform for development, it is possible to provide web applications which extensively utilize these national and international spatial data infrastructures. In Finland, Oskari provides user experience for open geospatial web services. Data sources are utilized in Oskari to create e.g. thematic maps. Even though the Oskari platform is important for the GIS community, the thematic maps feature integrates only Sotkanet with choropleth maps. There are, however, many statistical data sources – both Finnish and global – available from different organizations through Open PX Web APIs. Different types of graphs types can also be implemented. The integration of even one of these resources with differ-

Augmenting the Thematic Maps with Data Driven Graphics by Integrating Open APIs and Mapping Platforms

Pictures show the visualization samples based on the user selections of Sotkanet and PX Web API.
ent types of graphs into the Oskari service integration platform could bring benefits for the whole GIS community and amplify the exploratory analysis with ready visualizations for the area of interest.

Based on these facts, my thesis work focused on augmenting the thematic maps of Oskari by transforming the current thematic mapping feature into a multiple view statistical exploration platform and by integrating PX Web API into the platform. The aim was to allow users to explore enriched visualized data based on the graphs, data tables and choropleth maps in a unified window with multiple data sources. In this highly interactive multiple view system, users would be able to ask more questions and also find answers easier. At its core, the system is implemented using open source technologies, server side integration technique (mashup) and utilized cutting edge data visualization technologies. To create choropleth maps, system used WMS layers, queried the data from PX Web API and styled it using SLD (Styled Layer Descriptor). Graphs are created using well known data visualization library (D3.js).

After the implementation, the platform consists of three types of graphs and choropleth maps – data for each administrative division are shown in choropleth maps, graphs and data tables. To create a more intuitive user experience, visualization seeking mantra (overview, zoom and filter, detailed queries) and the design principles of multiple view systems are applied. As a result, users first get to see the entire data set with sets of visualizations, they can then zoom into to see what they want and filter out what they do not want, and also check details on demand. Moreover, highlighting, sorting and view relationship features have been implemented. With additional features, the graphs sorts the values in ascending order. Users can compare values for different data tables and when they select an element in a graph, the element is highlighted.

The resulting multiple view system allows users more efficient comparison, information search, pattern recognition and change detection. Users are able to find answers easier to questions such as, "Which regions have similar values? How has the situation changed over the years? How does one variable affect another?"

The thesis work addressed how the service integration platforms could be further enhanced by implementing correctly designed multiple view system and by using open APIs. System benefited open source technologies, spatial data infrastructures, open standards and APIs as well as user interface design principles of visualization seeking mantra and multiple view systems. The map application platform now includes more statistical data sources, choropleth maps and graphs and it is ready for its user to analyze them.

It is good to remind ourselves that data itself is meaningless if it does not bring information, knowledge or wisdom with the help of tools and processes. With development in web technologies, just like people harness natural resources to create electricity and light up every house, the GIS community has more chance to harness data sources from the web as a way of enlightening people and decision makers with the help of visualizations.