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# Multimedia Presentations of Spatial Journalistic Content

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**Master's Thesis**

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# STATEMENT OF AUTHORSHIP

Herewith I declare that I am the sole author of the submitted Master's thesis entitled:

**Multimedia Presentations of Spatial Journalistic Content**

and I have not used any sources other than those listed in the bibliography or identified as references. I further declare that I have not submitted this thesis to any other institution.

Munich 25.11.2017 Zeinab Torabi

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# ABSTRACT

With the increasing popularity of presenting multimedia content in online journalism especially with locational information, this thesis investigates possible approaches in this regard. A number of most prominent features in relation to multimedia presentations in general, web mapping, and the use of spatial data in journalism are presented. The current most commonly used web mapping technologies and platforms for representing spatial journalistic content are highlighted by conducting an online survey with more than fifty participants. Consequently, this research elaborates more in-depth investigations with two qualified web mapping platforms of “CARTO” and “ArcGIS Online”. These two representative platforms are evaluated and compared further in terms of the overall presentation of multimedia capabilities, user-friendly and intuitive user interface, mobile support, license and pricing, etc. In addition, the presentation of web maps based on a predefined sample story is discussed. The implementation of this sample story with both platforms is additionally explained in detail in this thesis. For the final evaluation process, the assessment is conducted based on literature discoveries, user-experience in implementation of the sample story and the expert point of view. The research concludes with defining important criteria of a multimedia presentation with spatial data and ways of its implementation. Furthermore, the strengths and weaknesses of two selected platforms for the multimedia presentation of spatial journalistic content are examined.

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# 1 INTRODUCTION

## 1.1 Cartography in online journalism

Recently with the steady increase of online users, presenting journalistic information through this media has become of a particularly great interest. Statistics show that 56 percent of adults get some kind of local news and information on their mobile devices[1]. Nowadays more and more people read news online, for example, while they are in public transportation. Online platforms are capable of updating the latest news within a few minutes and their users are only a few clicks away from it without any extra cost.

Many journalists in press agencies leverage the unique potential of web technologies to make the news content stand out in online journalism, where available tools are not confined to mere text and pictures on newspapers. Users can depict a story with the most powerful combination of multimedia tools, such as audio slideshows, animated information graphics and maps, news tweets, or live streaming (Wenger et al., 2014). It is important to note that many of these multimedia articles or stories are directly or indirectly linked to location. Therefore, it is crucial to bring the knowledge of cartography to the field of journalism.

For instance, the story about the death of Freddie Gray, a 25-year-old black American man who died, while he was in the custody of the police, was reported online by "*Baltimore Sun*"[2] news press. The story started out as a local story and later evolved into a national story about justice and race. The author of this story has used pictures of the area as a background to give an impression of where this incident has happened. On each page, apart from a short text on narrating the story, there is a map to show the location and a video to display a related interview. For moving forward or backward in the story or displaying the related map or video, the user needs to click different buttons. Satellite images are used as a map base.

[1] http://www.pewinternet.org/2011/03/14/how-mobile-devices-are-changing-community-information-environments/
[2] http://data.baltimoresun.com/freddie-gray

In another example, "*The Washington Post*"[3] has presented the journey of a Syrian family from Aleppo to Austria with a different technique. The story will unfold and the multimedia elements will be exposed to user's attention simply by scrolling down the page. With the help of flow map, the path of the journey and the transitions through different cities are illustrated. Consequently, the reader can follow the line of events that happens in each location much easier in comparison to the previous story.

In a similar way, "Süddeutsche Zeitung"[4] has presented a multimedia story about how the U.S. "War on Terror" is secretly conducted from convert bases in Germany. The story is divided into different sections that can be selected from the top menu and each section is accompanied with a map and a set of markers on the right side. By scrolling down the page, the map would harmonize with the related location in the text. However, during the work on this thesis, the map tiles in the story could not be loaded and presented. Some other multimedia elements such as videos were as well not responding.

## 1.2 Motivation and problem statement

Despite the abundant appearance of spatial data in online journalism, there are not many studies done in this area. Even though multimedia and interactivity are common features in online journalism, many stories with spatial data are not presented properly. For example, the design of the story about the death of Freddie Gray mentioned before requires the user to click several times on different buttons to browse the content. It is proved by journalism organizations[5] that users are not reading a story if several interactions are needed to read through (clickbait stories). Furthermore, the use of a satellite image might confuse the users who are not familiar with understanding and interpreting such images. The spatial platform which was applied to the story of Süddeutsche Zeitung is not properly responding the map tiles. Hence, there is a scientific gap to cover more in-depth investigations in regard to implementation and evaluation of such practices. This thesis aims to

[3] https://www.washingtonpost.com/graphics/world/exodus/black-route/
[4] http://www.geheimerkrieg.de/en/#entry-61-7932-the-us-knows-no-limits
[5] http://www.bbc.com/news/uk-wales-34213693

investigate best approaches for integrating maps and further spatial information to a multimedia presentation or a story.

In relation to digital cartography, there are many mapping platforms that provide different tools and services to embed the map into a website or blog. From Google's Street View to Esri Story Maps platform, people are engaging their geographical imaginations to produce personalized visual representations of spaces that matter to them (Feigenbaum et al., 2016). Likewise, people use RSS feeds and APIs to dynamically draw information from web and social media data sources to create real-time map visualizations and mash-ups (Crampton, 2009).
The decision upon a well-suited framework to address the demands of users is an important factor to be considered in this regard. Therefore, it is necessary to discern the vital requirements that a proper spatially enabled framework should provide in order to best deliver a multimedia presentation. Moreover, differentiating the pros and cons of some of the existed platforms will establish a good overview to enhance the production of web maps in journalism.

## 1.3 Research questions and hypotheses

The focus of this thesis is to establish different possible methods for presenting journalistic content by the means of multimedia tools and web mapping frameworks. In order to guide the relatively broad aim of this study, the following research questions have been developed:

1. What are the criteria of a good framework for multimedia presentation of location based journalistic information?

2. Which platforms are most suitable for creation of the web maps along with different types of multimedia elements?

3. What strengths or weaknesses does each platform have in regard to overall presentation as well as presentation of web maps?

By setting the above-mentioned questions, the study expects to achieve a list of important criteria in regard to selection of a suitable platform. For addressing the last two questions, the thesis should introduce a number of suitable platforms for further evaluation and comparison of the created multimedia presentation of spatial journalistic content.

## 1.4 Thesis structure

The work of this thesis is structured in seven main chapters. After presenting the main objectives and motivations of the thesis in the beginning chapter, in chapter 2, the related literature is investigated and summarized. The areas such as multimodality in journalism, presence of spatial data and maps in news, web mapping, and different digital narrative structures are observed. Chapter 3 introduces the methodology of addressing the proposed research questions and gives an overview of how the workflow of this study is guided. In chapter 4, a web mapping survey is conducted and analyzed. The survey examines the current most commonly used web mapping platforms and technologies within the community of journalism. At the end of chapter 4, two representative platforms are selected based on the concluded requirements form chapter 2 and the results of the web mapping survey. In chapter 5, a sample story is described and implemented by the two selected platforms. The story has a predefined scenario with a number of essential multimedia elements. Subsequently, the results of the created stories are evaluated and compared in chapter 6. The evaluation is based on the concluded features of the literature review as well as expert point of view about the results. Finally, the investigation is concluded in chapter 7 by summarizing the final findings and introducing the possible future directions of similar studies.

# 2 RELATED WORK AND THEORETICAL BACKGROUND

The related literature is divided into four different categories, each presented in an own sub-chapter. First, the presence of multimedia in journalism is discussed and the multimedia elements are defined and classified. In the second part, the impact of using maps and spatial analysis in news rooms is discussed. Moreover, the newly introduced concept of "spatial journalism" and the importance of expanding location-based services in news industry are highlighted. In the third section, different narrative storytelling approaches are described, since the presentation of multimedia content is usually in a form of a story. Lastly, the frameworks and technologies involved in a web mapping project are thoroughly explained. Different types of web maps are outlined and a sample web mapping assessment is further explained.

## 2.1 Multimedia in online journalism

The widespread practice of multimedia presentations through the World Wide Web has greatly influenced the realm of journalism. According to Hoogeveen (1997), Multimedia can be defined as "a property of a system or object, indicating that multiple perceptual representation media". In regard to online journalism it stands for any combination of text, images, audio, video, and graphics used to create a rounded news story or package.

Multimedia, along with interactivity and customization, has become the dominating feature of online journalism. A well-edited news page tells the story in full, using a mix of media that informs and engages the readers, however, it should not overwhelm them[6].This adoption of using multimedia elements has been driven by the notion of imposing more positive impacts on message receivers.

Tran (2015) investigates whether the greater use of multimedia in online news will actually enhance the communication of the content and whether news users appreciate such integrations. In his study, he takes into account two other related

[6] http://www.mediahelpingmedia.org

variables of multimedia use which are perceived vividness and congruency. Steuer (1992) describes vividness as a way in which information is exposed to the senses and it depends on two variables: sensory breadth and sensory depth. Sensory breadth is defined by the number of sensory elements that are simultaneously presented, whereas sensory depth refers to the quality of the sensory information available in each perceptual channel.

Congruency, on the other hand, is about the match or mismatch of these vivid elements to the theme of information itself when it is presented in multimodality. A congruent presentation draws in little elaborations, while the incongruences will invoke a high level of cognitive intensity (Russel, 2002) and might induce a negative effect on reader's perception. Tran (2015) concludes that the greater use of multimedia will indeed advocate perceived vividness, however, there seems to be a ceiling effect in this practice. Besides, his findings demonstrate that the incongruent multimedia did not result in negative evaluations, presumably because multimedia stimuli are more vivid and they are likely to be absorbed and processed at the expense of the news text.

A detailed consideration of the research in the area of multimedia effects in journalism is beyond the scope of this thesis. However, it is valuable to bear in mind the significance of multimedia elements and especially visual graphics such as maps since they are more favorable to be first perceived and consequently shape viewer's perception.

Jacobson (2012) examines multimedia packages that are produced by nytimes.com[7] from 2000-2008. *The New York Times*, an American daily newspaper is chosen as a sample of study due to its popularity and the great news coverage. Jacobson (2012) argues that previous studies show the potential of online journalism to incorporate new forms of presentations that the Web makes possible, but news organizations have not yet fully embraced these features. In her study, the multimedia packages are divided into four distinct categories: 'Video', 'Audio', 'Slide Show', and 'Interactive Features' and all share the characteristic that they cannot

[7] https://www.nytimes.com

be presented similarly in a printed newspaper. Also, to determine storytelling intent, packages are coded as either hard news (time-sensitive stories that are reported on immediately), feature stories (less time-sensitive reports that are often background information or human-interest stories), opinion (stories produced for the opinion section that advocate a course of action or a point of view), analysis (stories where the reporter or an expert source provides insight to current events or trends), or 'other'.

Jacobson finally concludes that most of the multimedia packages (72 percent) fall into the news category of 'Feature' and even though, 'Slide Show' was the first numerous and 'Video' the second most repeated format, the audio slideshow which is defined within 'Interactive Features' is the most-recognized new multimedia journalism format that is developed on the Web.

An audio slideshow consists of a set of pictures which are accompanied with a background audio. The audio can be selected as music, ambience and/or speech. As an illustration, *The New York Times* has applied this format to portray the lives of fifty-four average citizens of New York City in a story named "One in 8 million"[8]. Song (2016) analyzes this multimedia format in an introductory course on online journalism. The article demonstrates that using audio slideshow in multimedia storytelling will help to engage the audience both emotionally and attitudinally. It will ultimately enhance the validity and trustworthiness by creating dialogues among the subject's/characters' voices.

Other examples of 'Interactive Features' include interactive infographics, interactive web maps, and interactive timelines. Smiciklas (2012) defines infographics as visualization of data that are intended to convey complex information or ideas more quickly and clearly. Interactivity in media is a method of communication in which the user's input affects the program's output[9]. Therefore, as shown in figure 2-1, interactive infographics consist of three main components.

[8] http://www.nytimes.com/packages/html/nyregion/1-in-8-million/index.html
[9] https://www.investopedia.com/terms/i/interactive-media.asp

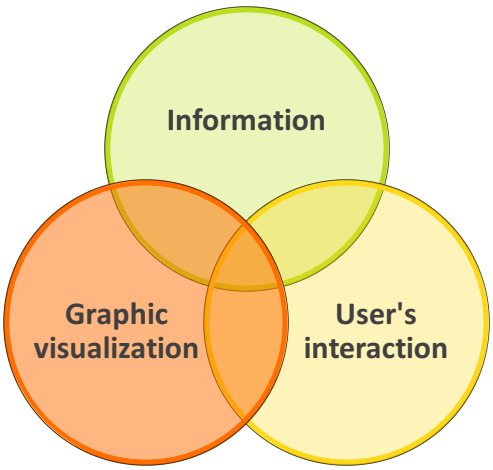



*Figure 2-1: Components of an interactive infographic*

According to Paskin (2009), graphics can be divided into six main categories: maps, tables, charts, timelines, illustrations and breakout boxes. Among all graphics maps are the most used type of the media. Maps also mark the beginning of graphic usage in media, when for the first time *Times of London* used maps to describe a murder that took place in a victim's mansion in 1806. The appearance of maps laboriously continued during both first and second World Wars, to clarify where the key battles took place. Nowadays, the internet has changed the traditional way of spatial information presentation for better, therefore, it's necessary to introduce and utilize the new possibilities like easier user accessibility and higher actuality (van Elzakker, 2000).

This thesis is inspired by the content of literature on the use of multimedia in journalism. However, the main focus will be on the multimedia presentation of "spatial data".

## 2.2 Spatial journalistic content

The presence of spatial data in journalism is divided into two different sections. First the use of maps and spatial analysis and their impact on journalism is discussed. The next section will introduce spatial journalism which is the field to connect geographical information in the practice of journalism.

### 2.2.1 Maps and spatial analysis in news

A substantial amount of data has geospatial components and employing proper visual narratives or interactive maps are necessary for visualization purposes. This shows the significance of connections between cartographic practices in online journalism. Feigenbaum et al. (2016) argue that while maps are proliferating in the news, there is currently a lack of journalistic education on how power inequalities can get embedded and reproduce through these visualizations. The importance of cartography doesn't only confine to the knowledge of spatial analysis and preparation of data, but also the delicate factor of design principle of maps.
Churchill (2006) asserts that apart from the geographic consideration of the spatial data what may be implicit in these concerns, and of greater importance, are the messages conveyed by journalistic maps. It is especially overarching, given the acknowledged role of the media in the geographic education of the public at large. In his article, he further discusses the power and authority of maps in shaping people's geopolitical perceptions.
Churchill finally concludes that even though the maps in the news magazine exhibited different design characteristics and mapping techniques, there seem to have no significant difference in their cartographic voice and perspective. Since they are created by some commercial entities they are reflecting a specific point of view which will affect and to some degree construct their reader's perception.

The aforementioned article influences this thesis for presenting and elaborating the substitute of online platforms for creating and sharing spatial data in news in form of narrative and interactive web maps. Considering the crucial impact of maps in news, it is of high importance to introduce the spatial platforms that facilitate production of maps with high cartographic quality and accuracy. Maps of newsroom sometimes reflect the objectives and values of their journalistic institution. It is more conspicuous in terms of geopolitical content; however, the aim of this thesis is to inform how can everyone tell their particularly location-based stories and share their voice with proper data and tools.

Another important asset of geo-data is that it enables spatial analysis which is best performed within a geographical information system (GIS). The history of using GIS

in journalism goes back to 1993 when a reporter at Miami Herald used GIS to plot the path of hurricane Andrew over a surveying map to disclose the hidden pattern of damage trends[10] (figure 2-2 source: Miami Herald). It was shown in the contrary to the epicenter areas which have good building regulations and inspections, the buildings with poor standards are being highly decimated (Herzog, 2003). The spatial analysis enabled the journalist to draw attention to the difference between wind patterns and property damage patterns. It was shown that the damage to the properties was not entirely due to the hurricane but because of the not proper housing inspections of the authorities after 1980.

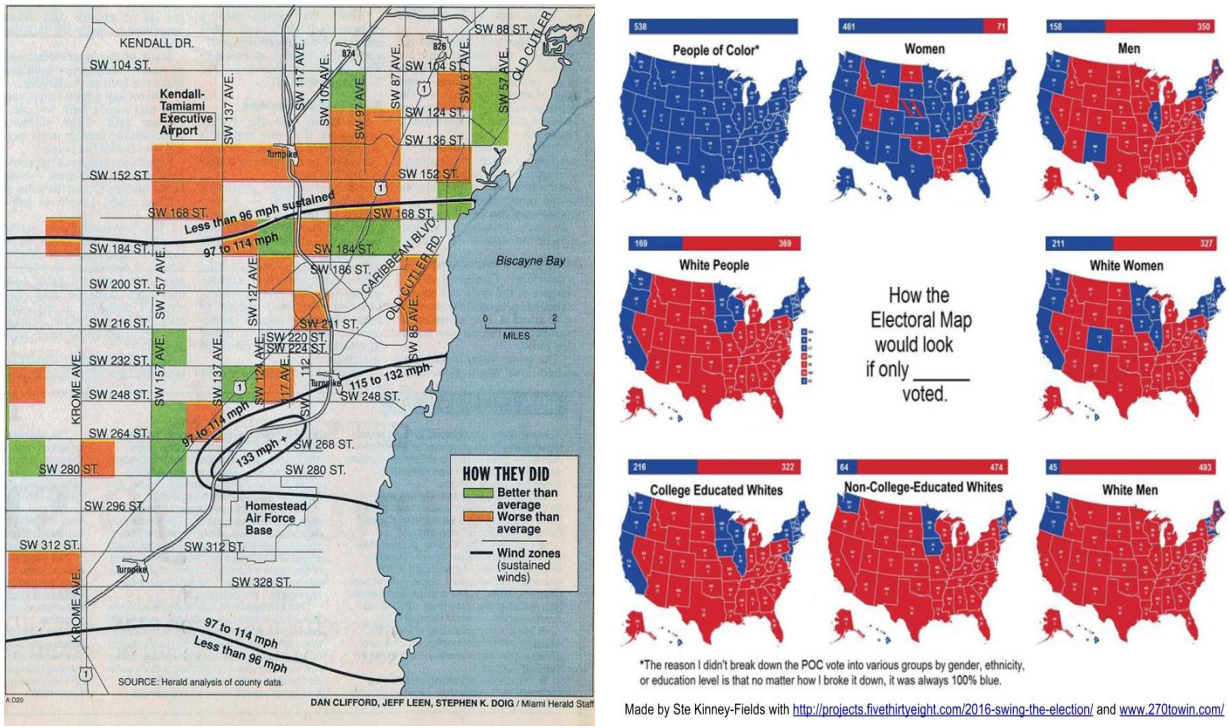



*Figure 2-2: Samples of GIS use in journalism*

Now, more and more journalists are using GIS to make sense of data and to pinpoint the hidden patterns. They use it for election result's analysis (see figure 2-2 source: made by Ste Kinney-Fields), census data, demographic changes, disaster, and hazards response planning and many more.

[10] https://richybedford.wordpress.com/2014/01/10/why-journalists-sould-use-geographic-information-systems-gis-the-views-of-leading-data-journalism-experts/

In a similar study, Black et al. (2005), explore the capabilities of web-enabled GIS that are now providing functionalities once used to be limited only to the desktop environment. The article further discusses the integration of web-cartography improvements particularly in the areas like geo-visualization with extensive possibilities of web-enabled GIS. The reason to do so is to provide highly functional and usable tools combined with a flexible and intuitive interface easy to use for non-GIS users to better understand and present the information. It is noteworthy that the examples author used to illustrate such integrations are done using Esri technology.

When choosing a web-mapping platform in journalism, it's necessary to consider the different usage of spatial data. Whether it is the exposition of simple layers of information on a base map or a rather complicated spatial or analytical analysis, an ideal platform should be able to provide that.

### 2.2.2 Spatial journalism

Schmitz (2012) introduces a new concept named "spatial journalism" which elaborates on the connection between geographic space and place-based information within the process and practice of journalism. Since most of the devices are now embedded with geo-location capabilities such as GPS, the popularity and widespread usage of location based services is of high significance both for consumers and providers. Such services have the power to renovate several industries especially news industry. Because location is an inevitable component of where things happen and the news can better serve its public in regard to location.

In 2014, the World Association of Newspapers and News Publishers (WAN-IFRA) assumes that there were 1.1 billion digital news users worldwide who are accessing content across platforms including smartphones and other electronic devices. Statistics shows that 56 percent of adults seek local news on their phone, of which 77 percent are adults between the ages of 18 and 29, representing the highest percentage among all other age segments (Rosenstiel et al., 2011). Schmitz (2013)

addresses this concept in her article and highlights the importance of creating more news and location orientated applications. The article examines all of the news apps from Apple store to verify whether they provide proper geo-located news content to address this increasing demand of people especially young adults. Finally, she concludes that most of the newspaper, television station, or news radio station apps don't offer geo-location news stories in their mobile apps. Therefore, a suitable web mapping platform should address this current demand to supports mobile applications. Furthermore, since more than half of the news consumers access the news through smaller screens it should be fully compatible and responsive with every screen size.

## 2.3 Digital narrative storytelling

The history of storytelling goes as far back as the beginning of human's life when the cave paintings were the way people try to express their line of events. Finding the answer to questions of what, why, who, how, when and where things happened are what involve journalists and it is usually explained in a form of a story.

Sagel et al. (2010) examine the use of data visualization in storytelling and especially in narrative online journalism. In this study, different samples of data visualizations with narrative components have been selected and the aim is to identify and categorize the design patterns.

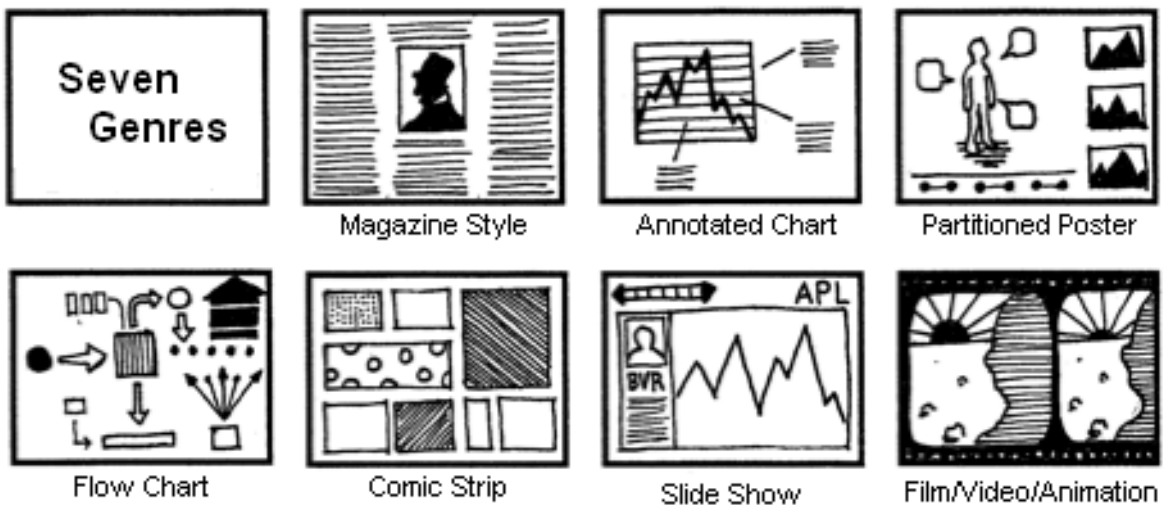



*Figure 2-3: Genres of narrative visualization (from Segel et al., 2010)*

As shown in figure 2-3, the authors divide the visualizations into seven distinct genres: magazine style, annotated graph/map, partitioned poster, flow chart, comic strip, slide show, and film/video/animation. From the 58 visualization samples, 71 percent were taken from online journalism and the most repeated genre was found to be annotated chart/map among all. The article further defines different visual narrative tactics as well as narrative structuring patterns. Visual narrative is coded as strategies to assist narrative, for example, highlighting. Highlighting refers to visual design techniques that guide viewer's attention towards a particular element in the display. This is achieved through the use of color, boldness, size and more, to emphasize the salient of an element relevant to its surroundings. Narrative structuring is also further subdivided into ordering, interactivity, and messaging. Ordering refers to the path that viewers take while they observe the visualization. It could be either completely prescribed and determined by the author or be reader-driven, where there are multiple alternative paths for the reader to decide. Messaging is the use of text for explanations and its use can vary widely between different genres or even different samples of the same genre. Interactivity is defined by the ways that the viewer can manipulate the visualization. Most common forms of interactivity in narrative visualization include navigation buttons, hover highlighting, hover details-on-demand, filtering, searching, drill-down, zooming, and time sliders.

Finally, the article introduces the most common interactive visualization models that were used frequently within the samples (figure 2-4).

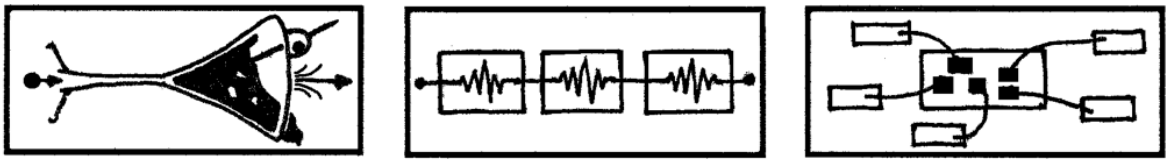


*Figure 2-4: Most common interactive visualization models (from Segel et al., 2010)*

As shown in figure 2-4, the first structure is "Martini Glass" structure; it starts with an author-driven approach, which resembles the stem of the glass, to drag the viewers towards the intended path by using questions, observations or written articles. Then the visualization opens up, same as the mouth of the glass, to a reader-driven approach where the user can interactively and freely explore the data.

The next common structure is “Interactive Slideshow”; it follows the typical slideshow format and is a mix between author-driven and reader-driven approaches. This format especially works well with complex dataset and narratives. It allows the author to expose different data dimensions and manipulations step-by-step and at the same time, give the user this chance to only move forward when he is ready to do so and also allows him to repeat steps if needed. The last structure is defined as “Drill-Down” story. It displays a general theme and then will provide detailed information on user’s demand. For example, a map with markers of prison camps that user can click on them for more details. The “Drill-Down” structure is more reader-driven approach since the user will determine when and which story should be told.

## 2.4 Web mapping

Web mapping is discussed in two parts. First, a sample web mapping architecture is described and the involved technologies are explained. Next, a sample study on evaluation of web mapping technologies is presented.

### 2.4.1 Web mapping architecture

Neumann (2008) defines web mapping as the process of designing, implementing, and delivering maps on the World Wide Web. It has to deal with interactivity, usability and multimedia issues. The author argues that even with the availability of free accessible geo-data and mapping technologies, the web maps are still complex to develop. Many technologies, modules, services, and data sources have to be mastered and integrated. Neumann further revises the previous classification of Kraak in (2001) about web maps and presents a new categorization (figure 2-5).

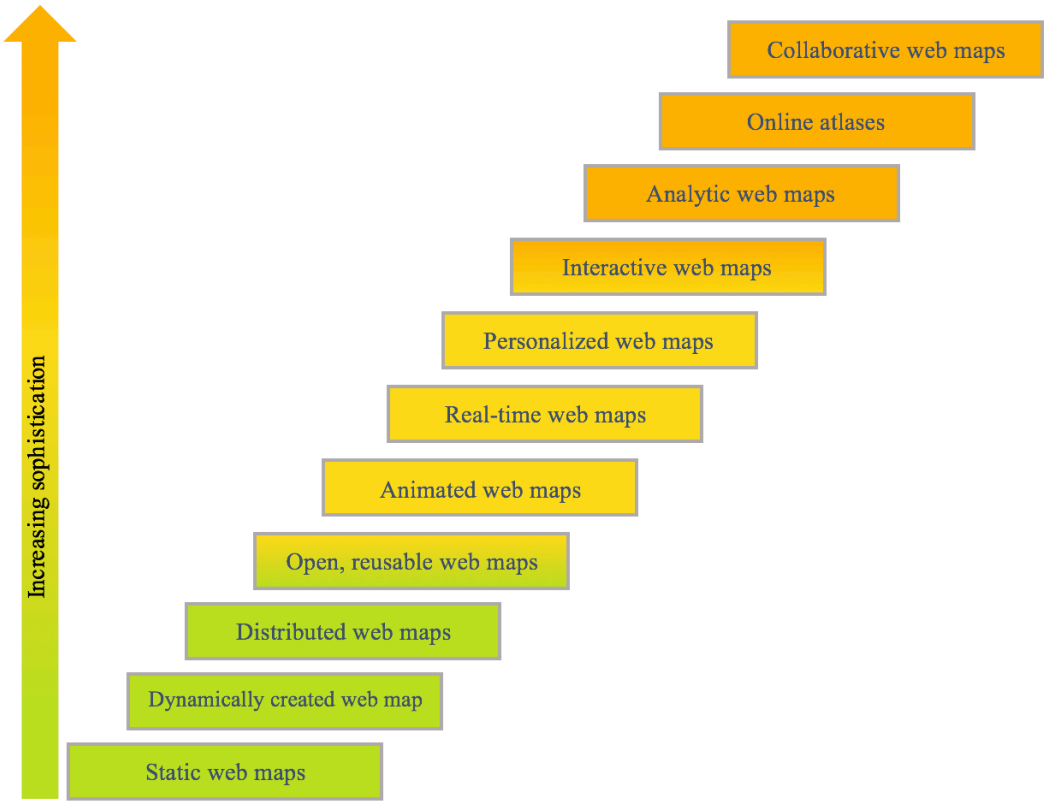



*Figure 2-5: Potential properties of web maps (adapted from Neumann 2008)*

One type of web maps in Neumanns classification are reusable web maps that offer APIs for reuse in other people's web pages and products. The API consists of a set of routines or functions that can be called by a programmer using JavaScript, PHP, or similar scripting language (Udell, 2008). An example of such systems is Google Maps with the Google Maps API.

Hu (2012) has implemented and explained in detail a case study of developing an online map service for displaying the location of hundreds of gardens in the United States using Google Maps API, Google Geocoder and other JavaScript libraries such as jQuery, XML, MarkerClusterer and Spry Framework for Ajax. Analytic web maps towards the top of this hierarchy, offer spatial analysis, either with the geo-data that a user uploads or with the geo-data provided by the map publisher. This list provides detailed properties of different web maps. It can be applied by this thesis work to determine which types of web maps each platform can deliver, in order to ascertain its level of sophistication.

Neumann further discusses the technologies used to implement a web-mapping project with SVG both from the server-side and client-side. A sample of such web mapping structure is presented in figure 2-6. SVG can be replaced with any other web standard.

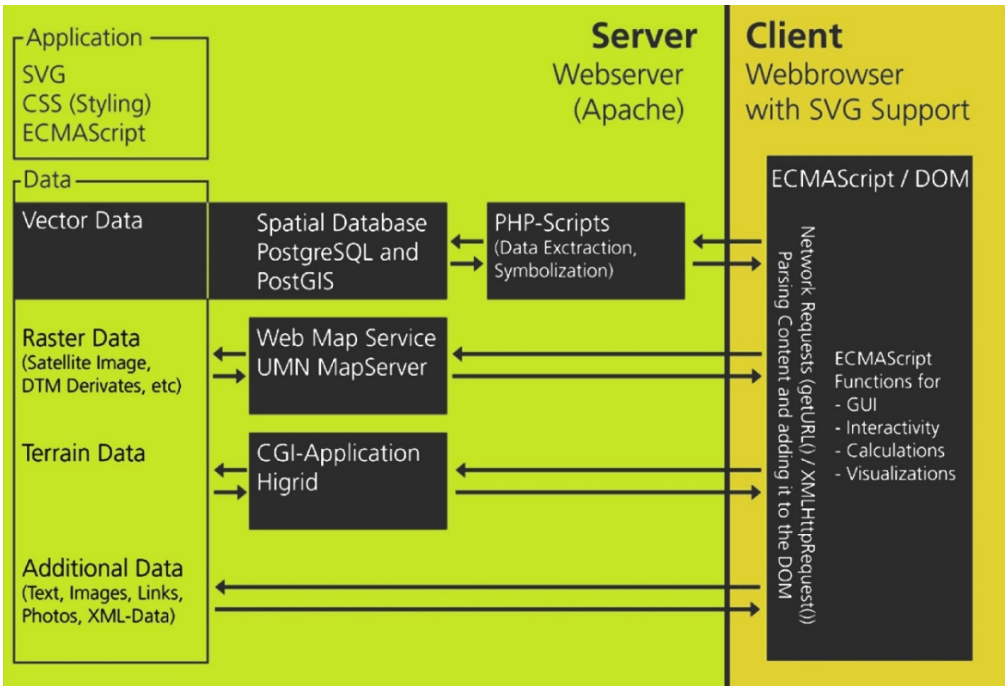



*Figure 2-6: Sample web mapping architecture (Flüeler et al. 2006)*

The server side is responsible for handling HTTP requests by the user, which is mainly done through a web browser. The tasks like processing input data, displaying pages or interacting with databases or other data storages (SQL, files) are done in the server-side environment. A usual connection between the web page and the web server is defined as “Common Gateway Interface (CGI)”. CGI is a platform-independent interface that allows a web server and a CGI script to share responsibilities of responding to client requests. Web application servers also work as a system software, through which a web application or desktop application runs. They act as a middleware to connect software components with the web server and programming language. For example, a web application server can connect the API of GIS with the web server and a spatial database.

Spatial databases are databases that are enhanced to access and store geographic data types. They are especially important whenever a web mapping application

deals with a large amount of spatial data or need to frequently update dynamic data. Currently, PostGIS is the most advanced as well as open-source spatial database.

Web Mapping Services (WMS) which perform as a CGI application or web application server. They are specifically implemented for generating maps on request. Examples of such servers are UMN Mapserver or Geoserver which are under an open-source license or ArcGIS server which is one of the commercial alternatives.

For the client-side technologies, only a web browser is required to load and display an HTML document/website. The client-side includes the interaction that the user perceives in the browser, such as clicking on a drop-down menu or getting an error on a wrong input entry. In the client-side mostly the ECMAScript is used and it is also necessary to refactor the DOM of the web-page and handle the network requests. These network request are either performed through a get and post HTTP requests or alternatively with a getURL () and postURL () methods. The latter method is also known as AJAX. Document Object Model (DOM) is a language-neutral platform and interface which allows scripts to dynamically access and update document tree of web page. DOM manipulation along with scripting is also defined as Dynamic HTML (DHTML). Many web mapping sites such as Google Maps or Microsoft Bing Maps use the combination of DHTML, AJAX, and SVG.

In the followings, some of the key terminologies in the field of web mapping which are frequently used within this thesis are explained (see figure 2-7):

**Web mapping technologies**: this term is broadly applied to all server side and client side applications such as libraries, services, frameworks, etc., that are somehow involved in the process of creation and dissemination of web maps.

**Web mapping platforms**: web mapping platforms are toolkits which enable publishing and sharing spatial data to the web and building web mapping applications.

**Web mapping frameworks**: frameworks are set of reusable codes that provide functionalities to facilitate implementation of web applications. Frameworks are usually included in a larger application, instead of being used as a standalone tool. For example, a web mapping platform utilizes various frameworks to address its different capabilities.

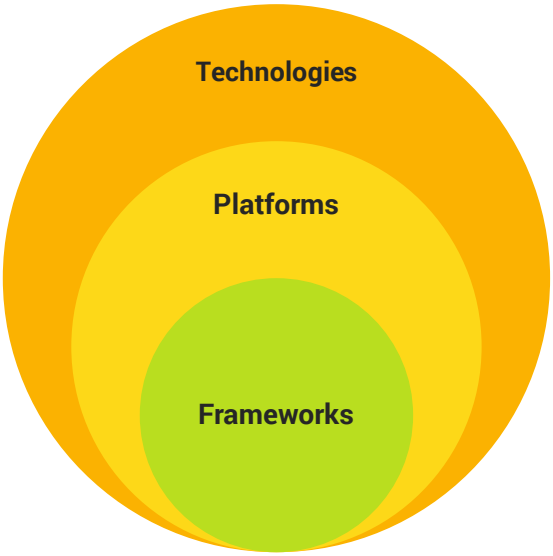



*Figure 2-7: Relation between web mapping terminology*

### 2.4.2 Web mapping assessment

Considering the numerous options for implementation of web maps and regarding the current pace of technological development in this area, the decision upon the evaluation method is of pronounced importance. Roth et al. (2013) investigate the open-source client-side web mapping technologies through a three-step study process. In this article, first, a competitive analysis study was conducted based on secondary sources such as websites in order to discern possible technologies. Then all different representation and interaction functionalities were coded and verified within the scale range of not possible to fully supported functionalities. The second step of the assessment was presented as a need assessment survey from the people who either design/develop web maps or supervise such design/development. The survey evaluated the level of familiarity of participants to the web technologies, whether they have not heard of it, they just know it exists or

they have been using it in the past years. Furthermore, the survey rated the importance of different web map characteristics, practical considerations, and technical considerations. It's noteworthy to mention that participants rated the **interactivity** as the most essential characteristic of web maps, **maintenance/stability** as the most important practical consideration and **cross-browser** and cross-platform compatibility as the most necessary technical consideration. After analyzing the result of the first two stages of the study process, four representative technologies were nominated for a diary study. In this phase, participants were asked to perform a web mapping example scenario within a limited time and try to fulfill as many requested requirements as possible. The participants should also log their activities per each hour regarding their accomplished requirements, main frustrations, and breakthroughs as well as their level of satisfaction with the technology.

This article presents a comprehensive process for evaluation of web mapping technologies. Even though the selection of web mapping technologies is based on a particular purpose (choosing the suitable studying material for a cartography course), it can be used as a good reference for similar studies. The work of this thesis is as well inspired by this methodology in applying a survey and examining a sample user in the evaluation process.

## 2.5 Summary

After reviewing the related work, a number of characteristics are concluded. These features are based on cartographic standards and previously emphasized functionalities for a spatial multimedia presentation. In the areas of multimodality in journalism, the feature of **multimedia integration** is selected as one of the vital requirement. Moreover, some of the selected elements within the test story (chapter 5.1), are inspired by the commonly used **multimedia practices** within journalistic articles.

Regarding the spatial data in multimedia presentations, there are a few factors to be considered, such as **spatial data type capabilities** or the possibility of **spatial**

**analysis**. Furthermore, taking the powerful impact of maps on people's geopolitical perception, it is important to consider a **platform** which everyone can use (either an expert programmer, a geographic specialist or a completely non-professional user). Additionally, some other web considerations such as **browser compatibility** and **speed of rendering** the data are significantly important for a proper online presentation. Another aspect that is essential for an ideal platform is that it provides different **narrative styles** to address different data **narrating approaches**.

More than half of the consumers use portable devices such as **mobile devices** or tablets; therefore, the **quality of presentation** on smaller screens is a chief factor. It also highlights that the **frameworks** for developing mobile applications.

Consequently, a list of the top ten features from the previous studies is summarized as below:

- Multimedia capabilities (e.g. audio, video, slide-show, interactive features)
- Different narrative structures for digital storytelling
- User-friendly and intuitive GUI that could be used by non-professional users
- Compatibility with more spatial data types
- Spatial analysis tools
- Browser compatibility
- Extensive framework for developers (e.g. API)
- Mobile support
- Speed of rendering in browser and server
- License and pricing

At this stage of the thesis work, these concluded criteria have no order of importance. However, they will be rated in a web mapping survey and ultimately influence selecting the proper platforms for the test story. The web mapping survey is fully explained in chapter 4. Moreover, they will be as well applied in the evaluation process of the result of the practical work (chapter 6.1).

In the next chapter, a web mapping survey is conducted and analyzed. The survey will investigate the most commonly used web mapping technologies and platforms. Ultimately, based on the literature review and the results of the survey, the qualified platforms will be selected.

# 3 METHODOLOGICAL OVERVIEW

In this chapter, the methods which are applied to address the research questions (stated in chapter 1.3) are discussed. The chapter is divided into three sections based on the three proposed questions. In each section, the approach for addressing the question and the logic behind the chosen methodology is explained in detail.

## 3.1 Criteria of a good framework for multimedia presentation of location-based journalistic content

In order to detect the important consideration for a multimedia presentation of spatial data in journalism, reviewing the related literature was taken as a first step (chapter 2). The reason for taking this approach is to inspire this study with the valuable findings of previous works. The search of literature was based on the closely related areas such as use of multimedia elements in journalism, spatial data and use of maps in news and web mapping technologies. Consequently, in chapter 2.5, ten important characteristics for such presentations were proposed. As a next step, a web mapping survey will be conducted in chapter 4. The participants of the survey will be asked to rate the importance of these ten proposed features and add any other feature which they hold important and it is not listed. By reflecting the opinions of the participants which will be targeted mostly from journalism background, the list of selected criteria will be completed and sorted by the degree of importance.

## 3.2 Suitability of platforms for creation of web maps along with different types of multimedia elements

The research will address the second research question by the following methodology: First a number of web mapping technologies will be gathered from secondary sources such as websites. Then the familiarity of participants with these technologies will be inquired within the web mapping survey in chapter 4.

Additionally, the users can comment any other framework which they use and it is not mentioned in the survey.

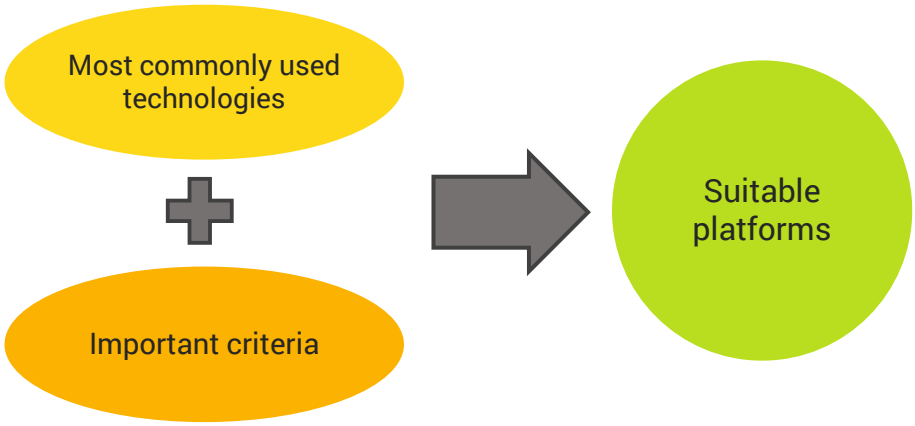



*Figure 3-1: Methodology for finding the suitable platforms for implementation of a multimedia presentation with spatial data*

As shown in figure 3-1, the results of the most commonly used technologies will be then filtered based on the findings of the first research question. Consequently, the most commonly used platforms which fulfill the basic requirements will be introduced. It is important to note that the thesis doesn't aim to find an overall winner and the considered criteria could as well lead to different selections based on the purposes of implementation.

## 3.3 Strengths and weaknesses of the selected platforms

To address the third research question, further investigations for the candidate platforms which are derived from the findings of the previous questions will be applied. First, a sample multimedia story (chapter 5) will be proposed and introduced. The story will be then implemented by each selected platform. Based on the two created stories the platforms will be then evaluated in chapter 6. The results of the evaluation will highlight the strengths and weaknesses that each platform has in terms of overall presentation as well as presentation of web maps. This methodology is applied because of the following reasons:

1. The self-diary and experience of the creator of the story can be used as reference in the evaluation section.

2. The final results of a same scenario with two different platforms can be simply used for further judgments. For instance, the results can be evaluated by a journalist.

The applied methods in this thesis to address the proposed research questions are dependent to each other. The important characteristic of a spatial multimedia presentation (answer to research question one) will influence the decision upon the suitable web mapping platforms (answer to research question two). Question 3 will be as well answered by investigating the selected web mapping platforms (answer to research question two) and the list of important features (answer to question one) will be employed in the evaluation section. The overall methodology to guide the research in addressing the questions is presented in figure 3-2.

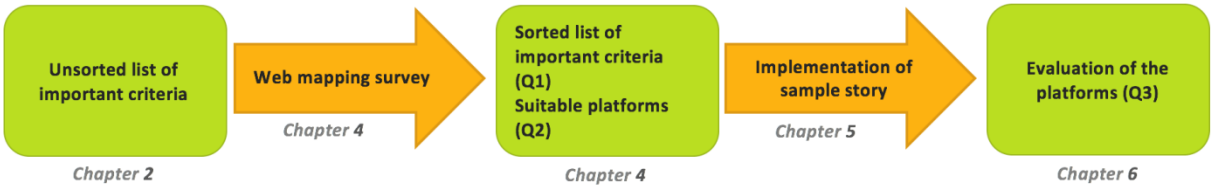



*Figure 3-2: Research methodology*

# 4 WEB MAPPING SURVEY

A web mapping survey was conducted as an initial method to connect the subject of the thesis and the hypothesis of the theoretical review with today's journalism. Since this thesis also aimed to present some of the current web mapping platforms and technologies, it was of great importance to involve more professional reviews while making such decisions.

## 4.1 Web mapping survey

The main focus of this survey was to investigate the following three questions:

- What are the most common web mapping platforms and technologies?
- How often do journalists work with spatial data and implement web maps?
- What are the most important characteristics of a web mapping platform?

As the first and foremost important query, it was necessary to perform the survey because the decision upon the choice of a web mapping platform remained inconclusive from the literature review (see chapter 2.5). Additionally, the most used platforms and technologies in the domain of web mapping could greatly vary from journalistic point of view to for example cartographic point of view. Therefore, the core target groups of the survey were journalists and computer programmers who work in the area of journalism.

Secondly, the survey inquired the frequency of using spatial data and implementing web maps by journalists. When journalists have a high level of engagement with spatial data, it will be invaluable to bring disciplines such as cartography closer to journalism. By doing so, the presentation and meaning-making of spatial data in media will be greatly enhanced.
Lastly, after concluding some of the most significant characteristics of a web mapping platform from the previous articles, the survey revealed how current participants of the survey will rate them. This information will help in the evaluation process of the platforms to see what features received the most emphasis.

Furthermore, this knowledge could be further applied to adjust the existing platforms as well as implementing new ones that better suits the community of journalists.

In the following section, the details about the survey will be discussed. It will first follow with the survey questionnaire and a procedure of making and distributing the survey. Then the participants will be described. Finally, the results that are gathered from all the respondents will be explained and analyzed.

### 4.1.1 Survey questionnaire

The survey consisted of ten questions in total and it was designed with the online platform "SurveyMonkey"[11]. Then the web link of the survey was shared via email and Facebook to journalistic groups and organizations which their details will be discussed in the survey participants (section 4.1.2).

The questionnaire was composed of four parts: It first started with a few personal and educational background questions. Asking the age range of participants and their educational background and their current job title. These questions were included to ensure that the respondents of the survey were either coming from a journalistic background or they were working currently in this area.

Then, the questionnaire was followed with the questions of how frequently they were involved with using spatial data in their articles and how often they have produced multimedia stories which contain web maps. For statistical purposes and potential further research, the theme of articles which usually contained web maps was also inquired.

Most importantly, it regarded the web mapping platforms and technologies. In the third part of the survey, the respondents chose from a list of most commonly used platforms and technologies which they were most familiar with and they were

[11] https://www.surveymonkey.com

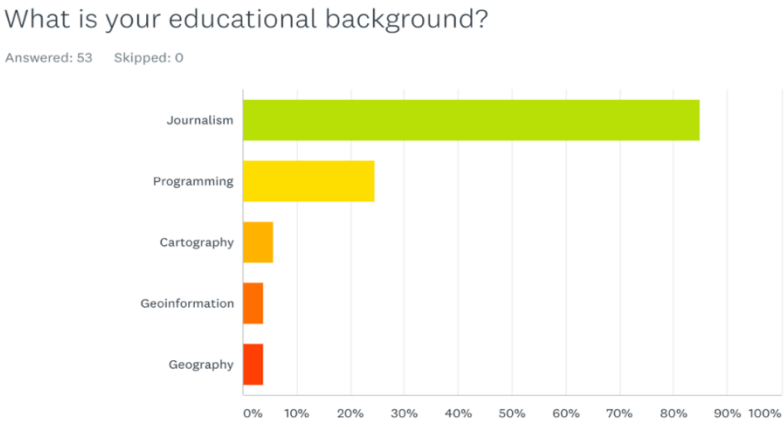
applying more frequently. The list of the online platforms was concluded from the top reviews of the GIS-related forums and websites. The participants were also asked to add any other frameworks which they used and it is not listed. The result of this part of the survey reflected within the choice of proper platforms for the practical example.

The last question was about the importance of web mapping platform's characteristics. The features were presented in a matrix and they were concluded from the previous studies and related literature. In this section, the participants added weight to the existing important qualities of a web mapping platform from their own aspect.

The questions were all marked as required and the average time span to respond was approximately four minutes. The full questionnaire is provided in appendix 9.1 and the results of all questions is presented in appendix 9.2.

### 4.1.2 Survey participant

In total 53 participants took part in the survey from which as it is shown in figure 4-1, more than 80% of them had a background in journalism.




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Journalism | 84.91% | 45 |
| Programming | 24.53% | 13 |
| Cartography | 5.66% | 3 |
| Geoinformation | 3.77% | 2 |
| Geography | 3.77% | 2 |
| Total Respondents: 53 | | |

*Figure 4-1: Web mapping survey question regarding participant's educational background*

The survey was distributed directly to the respective journalist members of BR Data[12]. BR Data is the data journalist team of the main German radio and television broadcasting company in Bavaria. It was also filled out by a few journalists from "Süddeutsche Zeitung"[13]. Süddeutsche Zeitung is the largest German subscription daily newspaper[14]. Six responses were collected from these two sources in total.

The next approach for collecting more responses was through the journalistic Facebook groups such as "Data Journalism Research"[15], "Freelance Journalists UK"[16], "National Union of Journalists (NUJ)"[17] and "United Arab Emirates (UAE) journalists"[18]. Nine participants found the survey link through Facebook groups and filled it.

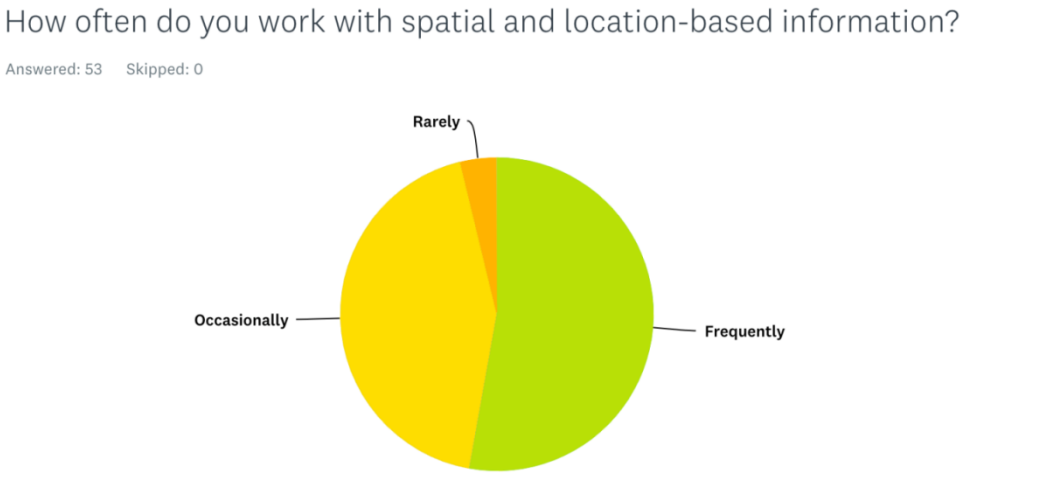
The last portal which provided the most responses, 38 out of 53, was through the subscription to the mailing list of the "National Institute for Computer Assisted Reporting (NICAR)"[19]. NICAR is a part of "Investigative Reporters and Editors (IRE)" which is a non-profit organization for improving reporting quality. Their mailing list is made to help journalists from all over the world to help each other in different aspects of journalism.

An overview of the participant's reply to their current occupation is shown below in figure 4-2. The word cloud is created by "Wordle"[20]. Wordle is an online application that turns a list of words into an artistic visualization and gives greater prominence to the words that are more frequently repeated.

[12] http://www.br.de/extra/br-data/index.html
[13] http://www.sueddeutsche.de
[14] https://en.wikipedia.org/wiki/List_of_newspapers_in_Germany
[15] https://www.facebook.com/groups/498284983562174/about/
[16] https://www.facebook.com/groups/FreelanceJournalistsUK/
[17] https://www.facebook.com/groups/nujournalists/about/
[18] https://www.facebook.com/groups/350104005054003/
[19] https://www.ire.org/nicar/
[20] http://www.wordle.net


*Figure 4-2: Web mapping survey question regarding participant's current occupation*

Moreover, the respondents showed a great involvement with location-based information. As shown in figure 4-3, more than 50% of the contributors are dealing frequently with spatial data in their daily work.




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Frequently | 52.83% | 28 |
| Occasionally | 43.40% | 23 |
| Rarely | 3.77% | 2 |
| Never | 0.00% | 0 |
| TOTAL | | 53 |

*Figure 4-3: Web mapping survey question regarding frequency of working with spatial data.*

### 4.1.3 Survey results

The results of this survey are explained in three different parts. First, regarding the web mapping platforms, as shown in figure 4-4, Google map dominated with a considerable difference among others as a first and foremost used platform. Then it was followed with Carto, Mapbox and ArcGIS Online as the next alternatives.

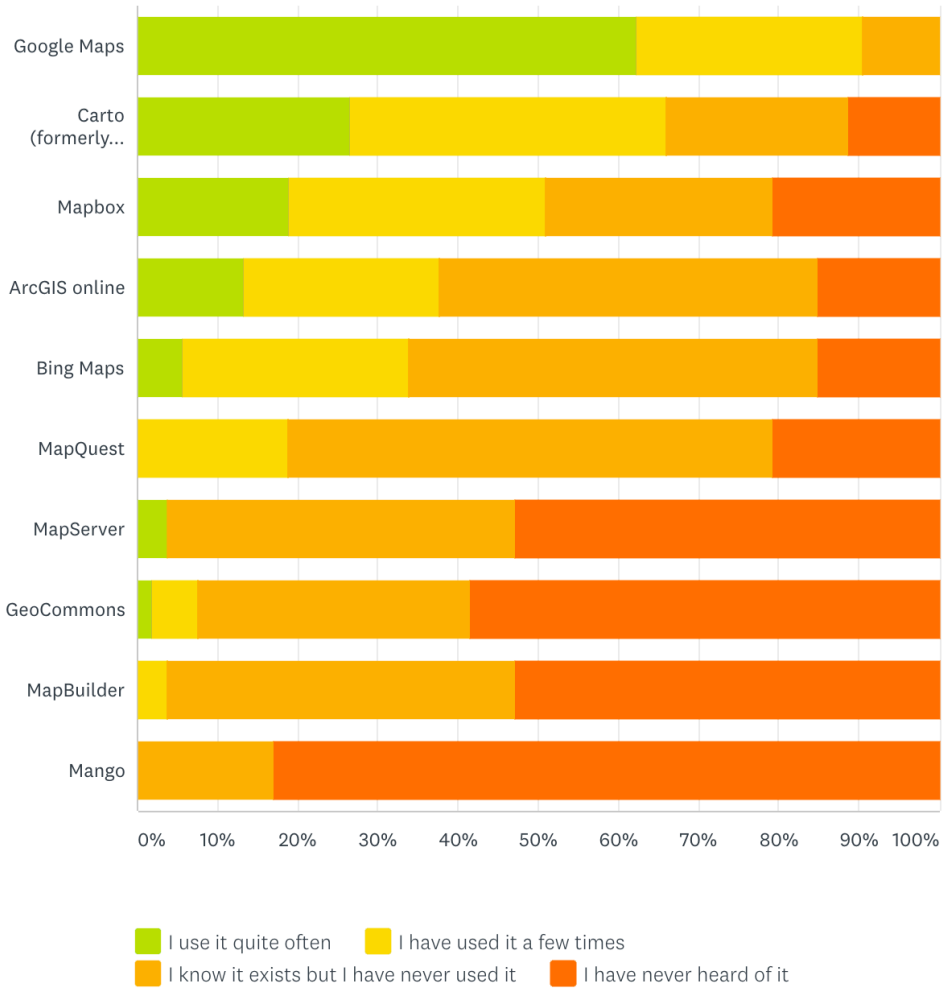



*Figure 4-4: Web mapping survey question on the most used web mapping platforms*

Additionally, besides these platforms, users named “Tableau” and “Datawrapper” quite frequently as their main platform in the comment section. Furthermore, considering the most frequently used web mapping technologies, in question number nine, a similar query was inquired form the participants. The result

indicated that the top three most popular technologies were “Leaflet”, “Google Maps API”, and “D3” respectively.

Finally, regarding the most important characteristics of a web mapping platform, users ranked “Browser capability” and “Mobile support” as the two first highest. More interestingly the users rated a “user-friendly GUI” almost as the same level of “pricing and license” and the “framework for developers” with a lower level of importance (figure 4-5). This implies that the community of journalists will not refuse to pay a reasonable price for a more convenient platform which facilitates making web maps for them.

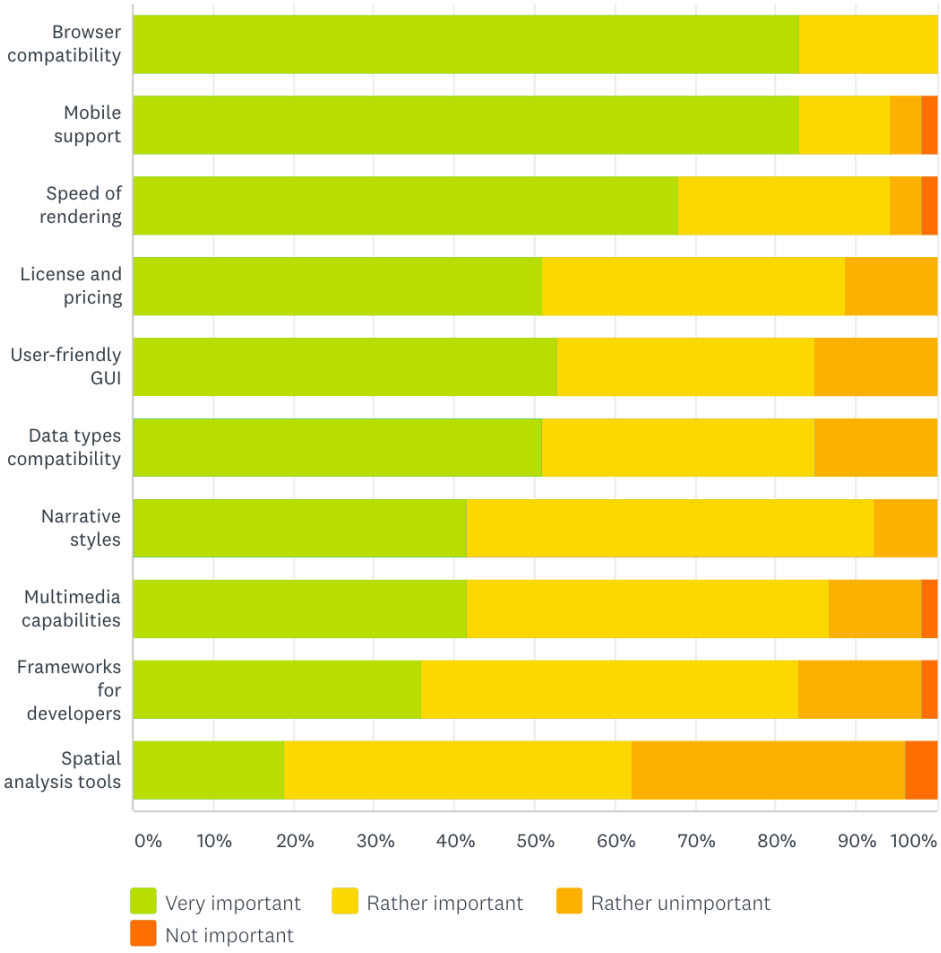



*Figure 4-5: Web mapping survey question about ranking the characteristics of a web mapping platform*

## 4.2 Summary

The main idea behind this survey was to investigate the most used web mapping platforms and technologies with a focus in creating a multimedia story. Therefore, among the top-rated results, it was also necessary to check which of them are better suited for adding all other multimedia elements, such as audio, video, picture and etc.

The decision upon the number of web mapping platforms was narrowed down to only two choices for the sake of proper comparison. Among the first few results, the two platforms after all considerations were “CARTO” and “ArcGIS Online”. Both of these two online platforms offered a builder for making web maps and this was especially important for users who have no or little knowledge of programming. Moreover, both of these platforms provided a specific application for developing a story. CARTO developed Odyssey.js[21] and ArcGIS Online had Esri Story Maps framework. However, at the time of writing the thesis, November 2017, Odyssey.js was not functioning due to some technical issues.

Even though Google Maps was ranked first among all other platforms, it did not provide a consistent UI for producing a multimedia story nor a builder for making web maps. Both Google Maps Engine[22] and Google Map Maker[23] have discontinued working and the basic platform of Google Map will only enable adding markers on the map with a limited additional fields and mapping styles. Hence, it was not selected as a target platform for the work of this thesis.
Additionally, the high engagement of journalists with spatial data demonstrated that the joint research in the area of cartography or similar disciplines with journalism should be expanded and emphasized.

After making the final decision upon the proper web mapping platforms, a sample multimedia story will be explained and the platforms themselves will be also described. Then the story will be implemented by the two selected platforms.

[21] https://cartodb.github.io/odyssey.js/
[22] https://mapsengine.google.com/about/index.html
[23] https://support.google.com/mapmaker/answer/7195127?hl=en

# 5 TEST STORY

After finding the appropriate platforms for developing a multimedia story, a sample story is built with all predicted multimedia elements. In this chapter, the selected platforms are described and the procedure of creating the story with them is explained in detail.

## 5.1 Story description

As the first step, the essential elements that are expected to be considered in this example are listed and described below in table 5-1.

| Element | Description |
|---|---|
| **Text** | Text will be used as a main component, to convey the concept of the story. It will be in different formats and sizes. |
| **Graphics** | Related pictures will be attached to correspond with the text. Graphics are also considered to be assigned in proper size and quality. |
| **Video** | Embedding a video to the body of the story |
| **Choropleth map** | An Interactive choropleth map to present a global overview of the related data |
| **Timeline map** | Visualization of data with time factor by using a time slider |
| **Infographics** | Presenting statistical data in form of an interactive chart |
| **Animation** | An Interactive transition within a specific section of a story or from one section to another |

*Table 5-1: Essential multimedia elements for the story*

The content of the story is about how women's social roles have changed within the years and introducing some influential women in history. This topic is chosen because of the availability of proper and easily accessible data in global scale for instance statistical data about gender equality or suffrage year. Additionally, other multimedia elements such as photos and videos can be easily found under a free license to publish. Furthermore, this subject can interest many people especially young female scholars. It can be inspirational for creating more related stories from a different perspective.

it is important to note that the topic and content of the story are not at the place of emphasis for this thesis and the content of the story is mainly copied from online resources. In the followings, different sections of the story are further discussed and explained.

1. Introduction

In the Introduction section, an image and a headline are considered to be implemented. Then it will be followed with an introduction text to give an overview about the subject of the story.

2. Changing women's role

In this section of the story, a quick overview of the history of changing women's social role since 1900 until today will be presented along with a number of related pictures.

3. Women's suffrage

Based on the available information about the time line of women suffrage in different countries, a choropleth map will be designed. Additionally, a related video of the struggles of women during these times will be attached.

4. Gender equality index

There are available data for gender equality and gender development indexes in global scale. One of these two statistics will be illustrated as a chart or infographic

in this part of the story. The detailed information about what this index means will also be explained.

5. Influential women

At the last part of the story, an interactive timeline will be implemented. It will be synchronized with a map and by moving forward in time, the influential women will be displayed by their birth year. By clicking or hovering on each appeared point, further information will be introduced in a pop up window.

As explained above, the story is divided into five different sections. The idea is to perform all the expected elements of each section as it is described. However, if there was no such possibility within a certain platform, for accomplishing a particular task. It will be substituted with the closest option. Such compromises will then be noted in the evaluation part. In the rest of this chapter, the two selected platforms are described and they are applied separately for creating the story.

## 5.2 Test story with platform 1

In this section, first an introduction to the selected platform will be discussed then the procedure of creating the test story with this platform will be explained.

### 5.2.1 Introduction of ArcGIS Online

ArcGIS Online is the main Web GIS platform of the "Environmental System Research Institute (Esri)". Esri is an international provider of GIS software for handling and managing location information. The company was founded in 1969 as a land-use consulting firm in Redlands, California. Esri is a dominant shareholder in GIS market[24] and aims to develop core GIS technologies for mapping, visualization, and spatial reasoning. The company initially centered on developing software products and it has extended from a Desktop GIS to a geospatial platform in the last years.

[24] ARC Advisory Group reports

ArcGIS Online is a collaborative web GIS platform that enables the users to explore, measure and understand geographic data. It is widely used to create and access maps, scenes, apps, layers, and analytics. It provides a place for sharing user content, as well as a large library of ready-to-use base-maps and other geospatial services. ArcGIS Online provides different apps to facilitate performing specific tasks more efficiently and effectively. Among all possible Web applications, one that particularly interests this thesis is the Esri Story Maps framework.

### Esri Story Maps

Esri Story Maps are web applications that integrate interactive maps with multimedia content such as texts, graphics, and videos. They are designed to facilitate making and spreading stories. Story Maps are free and open-source applications which are licensed under the Apache 2.0[25] license and distributed on GitHub[26], a development platform for hosting and reviewing codes. Apache License is a permissive free software license that allows the user to use, modify, and distribute the modified version of the software under its terms without royalty concerns.

These applications use an interactive builder hence the users can benefit from a ready-to-use, simple, and friendly user interface with no knowledge of coding. They are as well responsive with all screen sizes. The stories will be hosted on ArcGIS Online servers; however, the users can also choose to host it on their own web servers.

### Story Maps apps

Esri Story Maps offer eight different story templates besides the custom designs (figure 5-1). The prototypes are each based on a common practice for a specific type of story. For instance, the “Story Map Tour” template is designed for presenting sequence of places along with narrative text, image or videos.

[25] https://en.wikipedia.org/wiki/Apache_License#Version_2.0
[26] https://github.com/Esri?q=Storytelling#org-repositories

The custom designs are developed by developer APIs from scratch to provide storytelling practices that are not yet available in the standard Story Map apps. This is done to help prototype new user-experiences and patterns which will ultimately lead to the creation of new Story Map application templates[27]. Furthermore, there is also the possibility to embed one or more story templates into another one which allows the user to have even more freedom and creativity while presenting the story.


*Figure 5-1: Story Maps templates*

For choosing the most suitable template for the story, there is an option to select "Ask the Pros" (figure 5-1). This section will guide the user through simple questions and answers for helping them to optimize their choice. Moreover, the gallery of Story Maps provides a myriad of examples of their template apps in order to inspire new story makers. The content of the gallery is sorted by the applied template, subject, industry, format, and author to facilitate finding the most relevant

[27] https://storymaps.arcgis.com/

examples. Each of these story apps has its own design and configuration that are simply explained within the application.

**Multimedia Elements**

Story Maps support different types of multimedia to be embedded in their builders. They are usually classified in four different categories: map, image, video, and other contents.

**Map**: maps are ArcGIS Online web maps. Users can either create a new map or access an already created map in their ArcGIS Online account.
**Image**: images can either be uploaded from the computer or accessed through online sources such as Flicker, Google plus or any other online links. As of the September 2016, Facebook photos are not supported anymore in Story Maps due to some technical issues.
**Video**: videos can be added via YouTube, Vimeo or other online links.
**Other contents**: Story Maps in some cases allow the users to embed a web page link or to embed an HTML code. This enables the users to insert other sorts of media such as charts, infographics or even maps of other sources.

However, it is important to bear in mind that there are slight differences in terms of available multimedia for each Story Maps application. For instance, in contrast to some other builders, “Map Tour” only allows the users to upload images from their own computer only if they have an ArcGIS for Organizations account. Alternatively, users can upload the pictures to a public photo sharing service or their own web server and then reference it in their Map Tour via URL.

### 5.2.2 Implementation of the test story with ArcGIS Online

As the first step in making the story with Story Maps, it was important to choose the right application. For the implementation of this test example, Story Map Cascade was the most appropriate choice, since it is very well designed to combine narrative texts with all other desired multimedia content.

The possible ways for adding multimedia contents to the Story Map Cascade application is shown below in figure 5-2. The options are listed as “ArcGIS”[28], “Flicker”[29], “Google+”[30], “Unsplach”[31] and link to content. ArcGIS will link the user to the contents of ArcGIS Online account. In Flicker tab, user can search and browse pictures form this photo sharing website. It is also possible to set the preferred licensing within the Flicker search. Similarly, Google+ and Unsplach are other online photo sharing services that the user can access to find a desired photo.

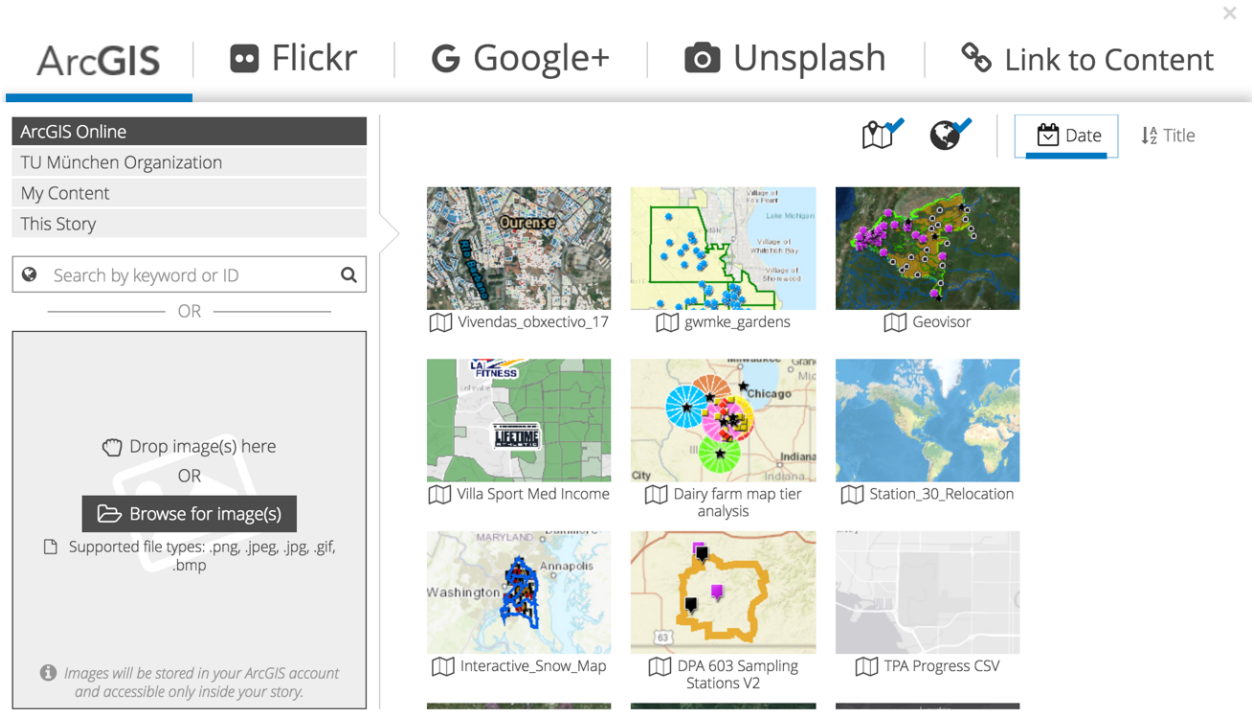



*Figure 5-2: Possible multimedia inputs for Esri Story Map Cascade*

From the “link to content”, user can copy and paste an internet link to multimedia contents such as photo or video. Alternatively, an iframe code can be added to the box and then be visualized in the Story Map (figure 5-3).

[28] https://www.arcgis.com/home/signin.html
[29] https://www.flickr.com/photos/tags/flicker/
[30] https://plus.google.com/+GooglePhotos
[31] https://unsplash.com

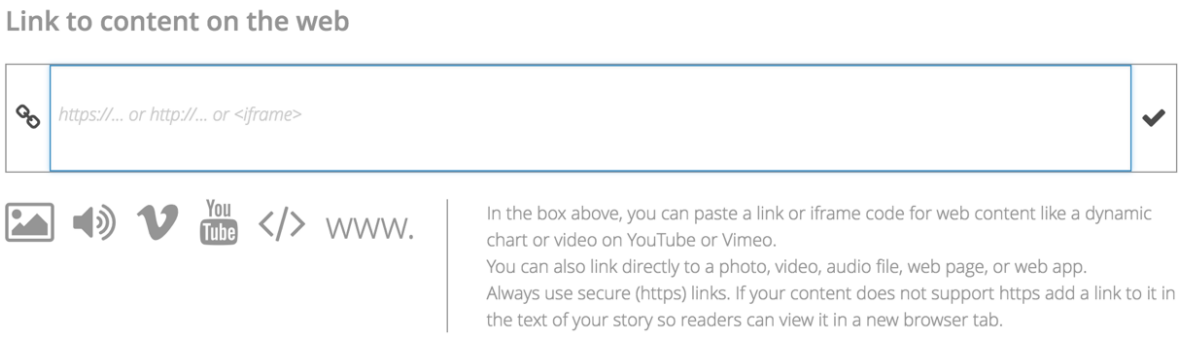



*Figure 5-3: Adding multimedia content via an internet link within Story Map Cascade builder*

In the followings, all the five sections of the story, as explained in chapter 5.1, will be explained and implemented by Esri Story Map Cascade.

1. Introduction

The introduction section of the story only needed a picture as a background accompanied with a related title and the introduction text. In the “Appearance” tab, the user can choose between four different themes for the title of the story. For this story, a transparent text box with a white color was selected since it harmonized better with the chosen picture. Additionally, the position of the picture can be adjusted in regard to different screen sizes in the “Background” section (figure 5-4).

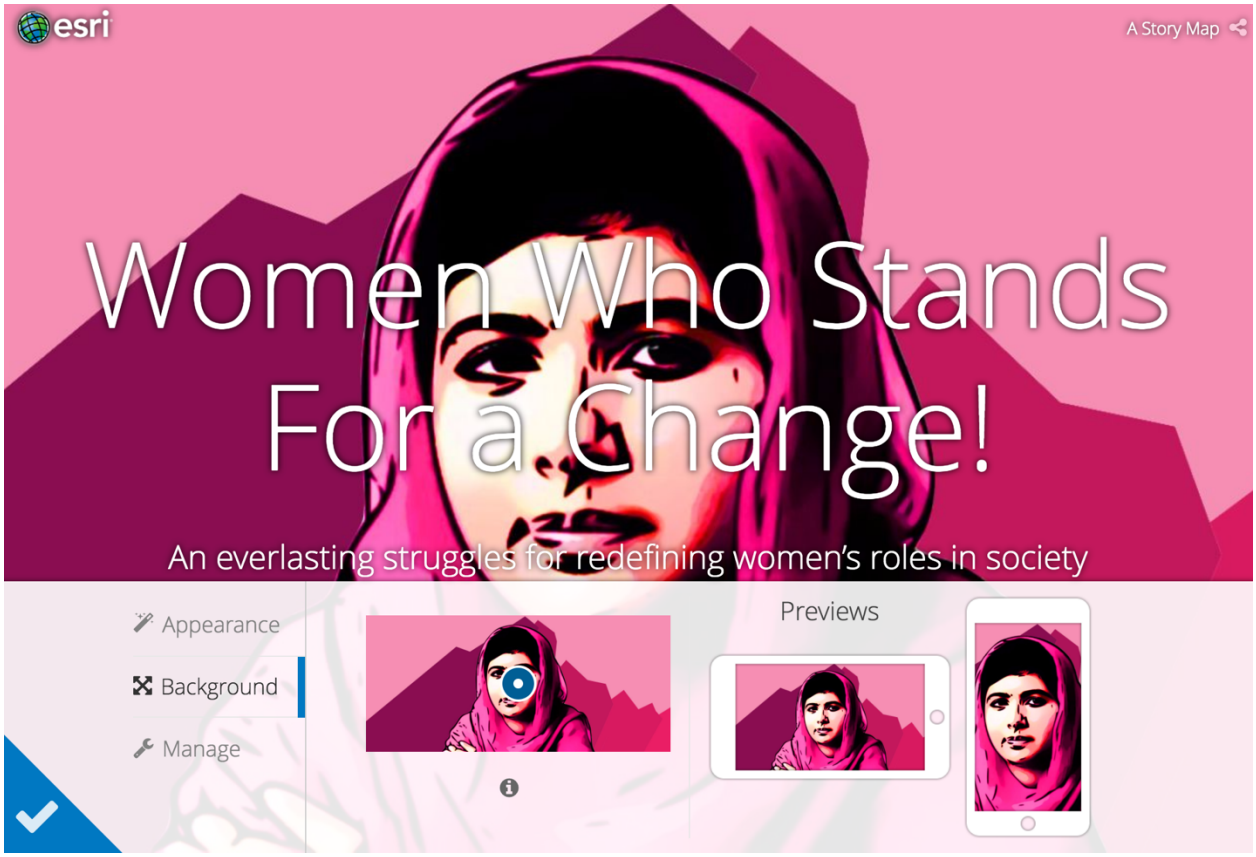



*Figure 5-4: Story Map Cascade builder, creating the introduction section of the test story*

2. Changing women's roles

The next part of the story, changing women's roles, contained a number of pictures which were either accessed directly from Flicker or downloaded from Google search engine and then uploaded from the computer. The pictures were accompanied with the narrative explanations about how women's role in society has changed from 1900 until today. The texts were mainly copied and added from online resources. For presenting this part of the story, Cascade builder offered an immersive section, where the user could fill the page with the desired number of media and combine it with narrative texts as the viewer scroll down the page. Hence, it was very suitable for texts and in-line media.

3. Women's suffrage

The third section of the story was dedicated to women's suffrage. This part included a choropleth map for depicting the timeline of this movement in different countries. The map was first prepared in ArcGIS Online and then accessed via Story Map application.

The data for the map was a CSV file including the name of the countries, countries' ISO code, the year in which women were granted with the voting right, and further descriptions when needed. By adding the CSV file to the map, ArcGIS Online automatically asked how the data should be located on the map (figure 5-5).

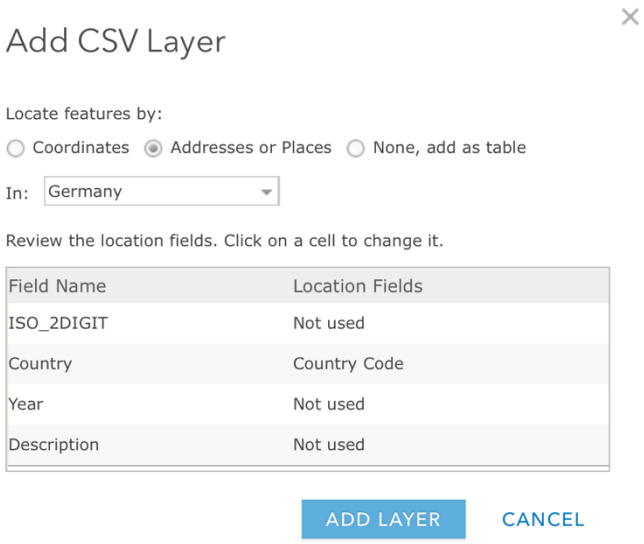



*Figure 5-5: ArcGIS Online pop up for locating the CSV file on the map*

It was possible to locate the data by coordinate or by place name or even the file could simply be added as a table. The data for the choropleth map (see figure 5-6) was located by the county's name. It was important that ArcGIS Online recognized the CSV file as point features, then the points could further be styled by size, color or type. As shown in figure 5-6, the points were first styled by color based on the suffrage year. However, the aim was to style the entire countries. For this means, the point features needed to be converted to polygon features or the input file should be a shapefile of the world countries that also contained the suffrage year in its attribute table.


*Figure 5-6: Styling the point features by color based on the suffrage year*

For executing the aforementioned task, first the generalized polygon layer of world countries was added from the already existing layers of ArcGIS Online. Then as shown in figure 5-7, two layers were joined together as a new layer by the “join feature” analytic tool. The new layer was created based on the same attribute field in both files which in this case, it was assigned as their ISO code. For performing analytical functions within ArcGIS Online, it was necessary to have access to a subscription account and they were not provided for public users.

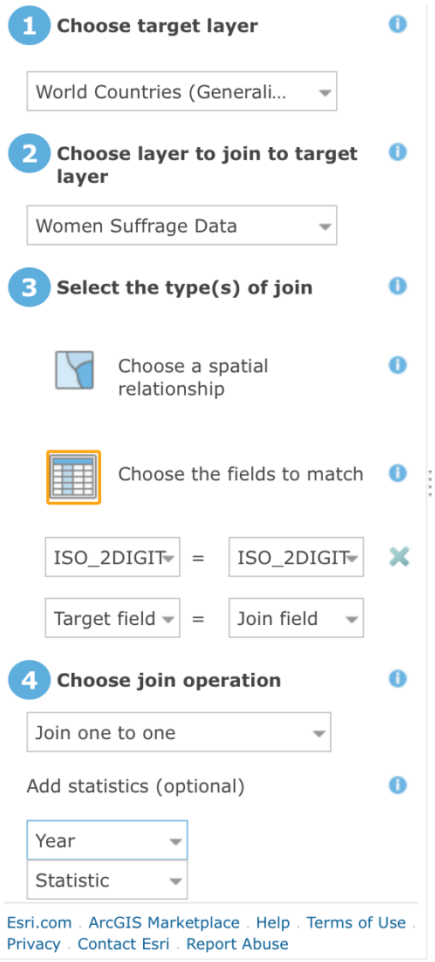



*Figure 5-7: Join feature analytic tool within ArcGIS Online*

ArcGIS Online offered a variety of possibilities within its pop-up configuration. It was feasible to add or remove desired items from the attribute table. Besides, there was an attributes expressions section which enabled the users to derive and calculate new information from the data to be displayed in the pop-up windows. Finally, media such as images or charts could be presented within the pop-up.

The finished map was first saved within ArcGIS Online and then accessed via adding multimedia content to the story. After adding the map to the story, cascade builder allowed the user to adjust the size and position of the map. Moreover, the map could either set to be interactive automatically or it could be activated by clicking a bottom. Otherwise, the map could also be presented statically.
Another important consideration by Story Maps was that in case the map was not properly supported in smaller screens, the user could set an alternative image instead. One drawback was that it was not possible to embed the map with legend.

At the end of this section, the struggles of American women for the suffrage movement was attached via a URL link.

### 4. Gender equality index

This section of the story was about the gender equality in different parts of the world. The related data was provided at the global scale[32]. The online platform for creating the interactive charts of the data was Datawrapper. It was possible to create an interactive chart with Datawrapper and it offered responsive embed and iframe export formats. The iframe code was then added to the story through the "link to connect" (see figure 5-3).

### 5. Influential Women

The last part of the story introduced some of the influential women of the world. This part of the story was presented with a timeline map based on the birth year of these women. The map was first prepared in ArcGIS Online and then added as a "Time Aware" application to the story map.

The data used to create the map was a CSV file containing the basic information about a selected number of women. The data also included the year in which these women were born and this was the time factor for this test example. A sample of the data is shown in figure 5-8.

| Name | Country | City | Category | Born | Image | Wikipedia link |
|---|---|---|---|---|---|---|
| Elizabeth 1 | United Kingdom | Greenwich | Politics | 1533 | https://upload.wikimedia.org/wikipedia/commons/a/af/Darnley_stage_3.jpg | https://en.wikipe rg/wiki/Elizabeth _England |
| Jane Austen | United Kingdom | Steventon | Author | 1775 | https://www.biography.com/.image/t_share/MTE1ODA0OTcxNTQ2ODcxMzA5/jane-austen-9192819-1-402.jpg | http://www.biogr online.net/writer -austen.html |
| Harriet Beecher Stowe | United States of America | Litchfield | Author | 1811 | https://www.awesomestories.com/images/user/5d12ee0819.jpg | https://en.wikipe rg/wiki/Harriet_B er_Stowe |

*Figure 5-8: A sample of the data for creating the timeline map*

The first step for creating the timeline map was to add the CSV file in the content section of the ArcGIS Online account. While adding the layer, it was important to check the box for publishing the layer as a "Hosted feature layer". For adding a

[32] http://hdr.undp.org/en/content/gender-inequality-index-giii

hosted feature layer to ArcGIS Online, it was necessary to have access to the subscription account. Afterwards, in the overview tab, it was possible to configure time settings (figure 5-9).

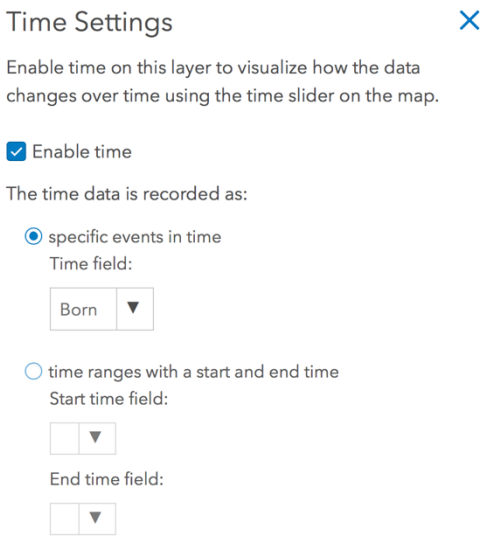



*Figure 5-9: Time Settings for the added layer to ArcGIS Online*

By opening the layer in map viewer, a time slider appeared automatically on the map which as shown in figure 5-10, could be further adjusted.

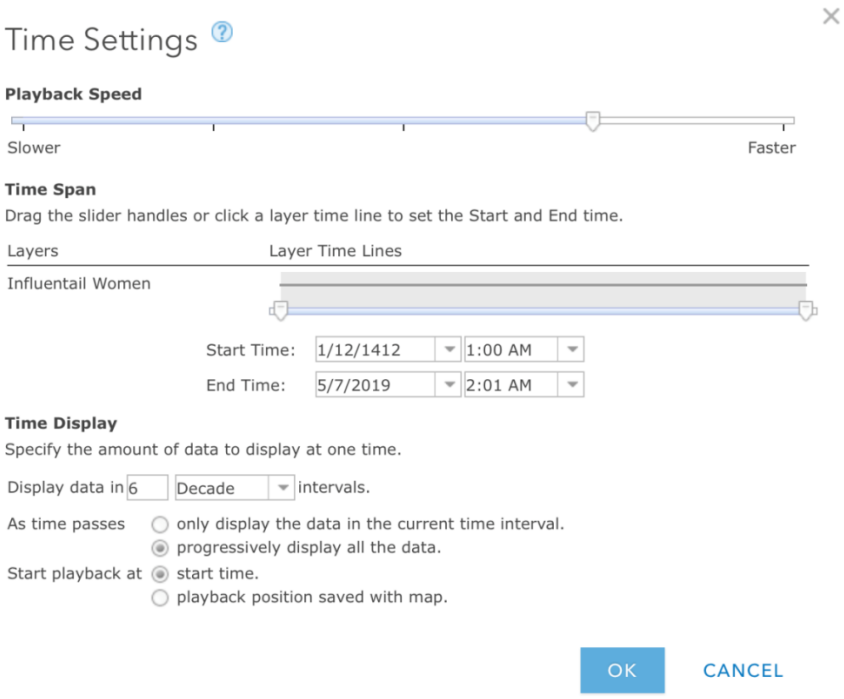



*Figure 5-10: Time settings for the time aware map*

Finally, for adding the map to the story, the map was shared via a web map application called “Time Aware” application[33]. In the process of creating the app, the details and configurations of how the map should be displayed were possible to be customized. The final result of the timeline map is displayed below in figure 5-11.

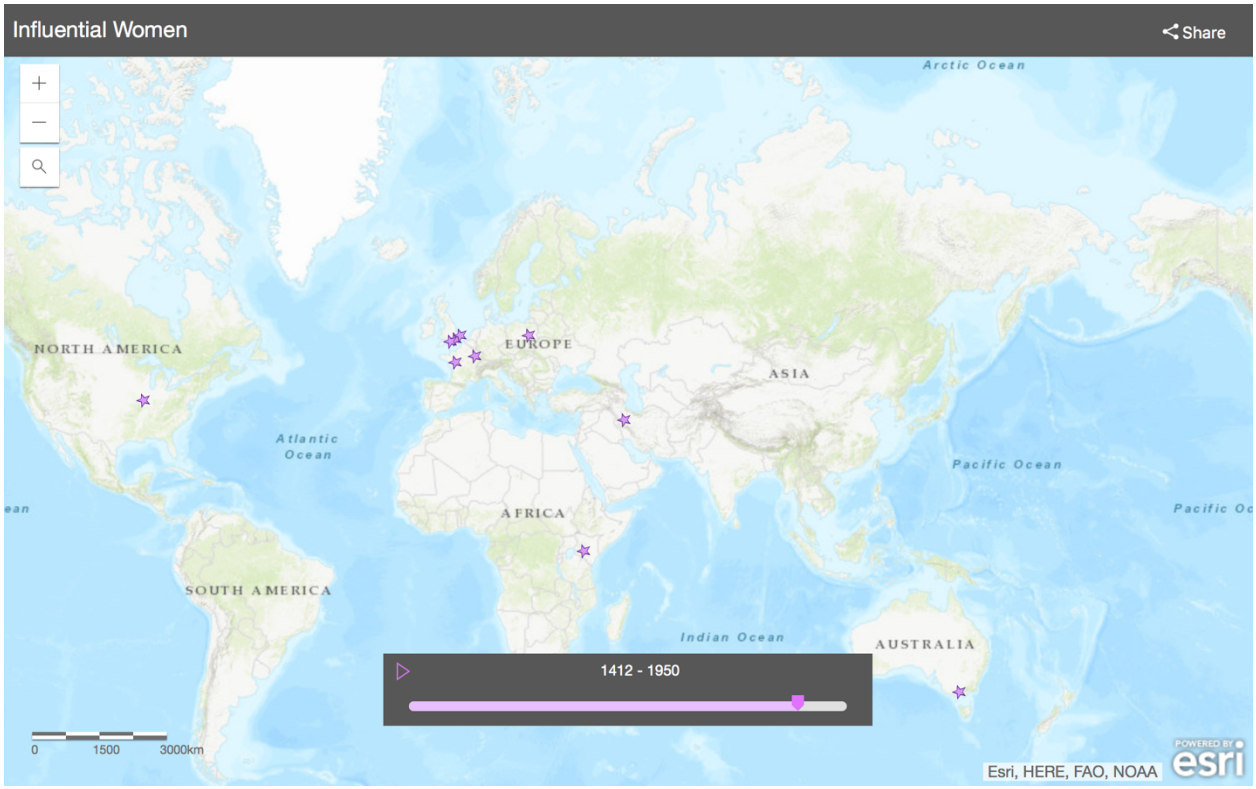



*Figure 5-11: Timeline map created in ArcGIS Online*

The result of the test story with Story Maps Cascade can be accessed via this link: http://arcg.is/2zCV238. The validity of this link is temporal.

[33] https://blogs.esri.com/esri/arcgis/2016/07/27/using-time-aware-app-template/

## 5.3 Test story with platform 2

In this section, first an introduction to the selected platform will be discussed then the procedure of creating the test story with this platform will be explained.

### 5.3.1 Introduction of CARTO

CARTO is a geospatial cloud computing platform which was founded in 2012 in Madrid. The platform provides online GIS and web mapping tools. It was formerly known as CartoDB and has changed its name after introducing its new analysis tool called CARTO Builder. CARTO is a "freemium" service, where accounts are offered as free and after a certain storage capacity, a fee is applied. It is an open source software[34] based on PostGIS and PostgreSQL. CARTO offers different solutions in regards to location intelligence in diverse areas of specialties which also includes media and journalism. In the following, two primary services that CARTO offers will be explained.

**CARTO Builder**

CARTO Builder is a drag- and- drop web application. It assists the users to manage data, run spatial analysis and design web maps. CARTO Builder has a friendly user-interface that can be used both by developers and non-coders. Advanced users have access to a web interface, where they can manipulate data with SQL statements or apply custom styling via CartoCSS. CartoCSS is a cartography CSS language which is developed by MapBox[35]. One important feature of CARTO builder is dynamic features called widgets. Widgets are designed to enhance the instant analysis of one or more entries within the dataset. There are four types of widgets: category, histogram, formula, and time-series.

[34] https://github.com/CartoDB/cartodb
[35] https://www.mapbox.com/help/define-cartocss/

### CARTO Engine

CARTO Engine consists of a set of APIs and developer libraries for building advanced geospatial datasets and creating custom, scalable maps. For instance, it offers Maps API to create map tiles based on client's request, or Data Service API, which enable functionalities such as geocoding or routing. Finally, one important JavaScript library that is used in CARTO Engine is Carto.js. This library allows the users to combine different APIs into a complete visualization or to connect to an already stored visualization. Furthermore, it enables the users to add desired interactions or integrate data into other web applications.

## 5.3.2 Implementation of the story with CARTO

In order to create a multimedia story, CARTO offered an open source library named Odyssey.js.[36] The application was created to integrate narrative texts with other media elements. However, it was at the early stage of development and it only offered text and graphics beside map interactions. Odyssey.js had three story templates to design the narrative structure of how the story should proceed (figure 5-12).

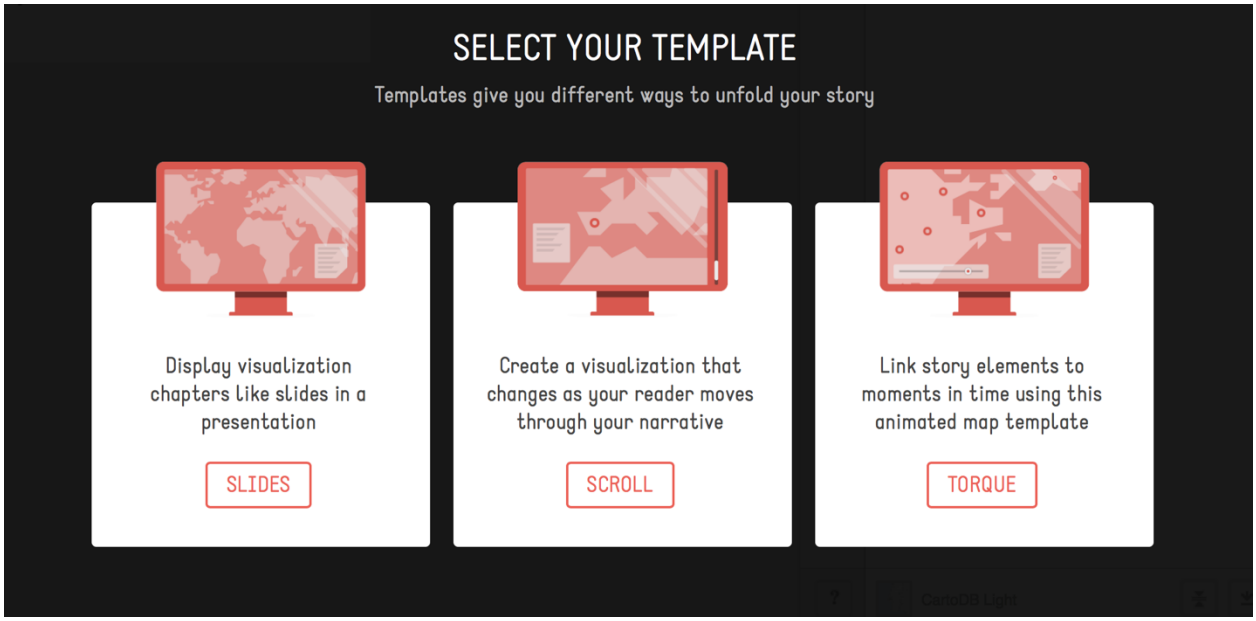



*Figure 5-12: Odyssey.js story templates*

[36] https://cartodb.github.io/odyssey.js

This framework was not functioning at the time of writing this thesis, November 2017, since the current version of CARTO.js (3.15.8) did not support publishing map as Viz.JSON[37] which is the format that is used in Odyssey.js. Therefore, a custom web design was used to create the body of the story for adding other multimedia elements such as texts, pictures, video, and infographics. CARTO was only applied in section 3 (women's suffrage) and section 5 (influential women) of the story for creation of the two web maps.

Custom web design

For presenting the story with a good visual aesthetics and most importantly responsive with all screen sizes, Bootstrap was used as the basic framework. Bootstrap is an open source toolkit that provides HTML and CSS based design templates as well as some additional JavaScript extensions[38]. It is a powerful, responsive and open source font-end framework for developing web applications. It is based on a "mobile first" approach which considered the mobile users as the number one priority. The design pattern was based on the Google material design[39] which was further customized and provided by "Creative Tim"[40]. Some other technologies which were used in this example were JavaScript libraries such as JQuery[41], and Scroll Reveal[42].

## 3. Women's suffrage

The same CSV file containing the name of the countries, suffrage year and further descriptions which was used in the ArcGIS Online section, was also added into CARTO Builder. CARTO automatically geocoded the data and displayed it as polygon features on the map. In the style tab of the layer panel, the color of the polygons could be set in regard to a value in the attribute table. Then the color scheme and the method of quantification could be specified. CARTO did not have the option for manual classification of the data. however, for assigning a custom

[37] https://www.ibm.com/developerworks/library/bd-vizjson/index.html
[38] http://getbootstrap.com
[39] https://material.io
[40] http://demos.creative-tim.com/material-kit/index.html
[41] http://jquery.com
[42] https://scrollrevealjs.org

classification it was possible to write the related codes in the CartoCSS panel (figure 5-13).

The Pop-up and legend configurations were also designed to be further customized if the user had different preferences. CARTO allowed the users to publish and share the web maps either as an URL link or as an “iframe” code. The result of this map was published as an HTML code in order to be embedded in the website.

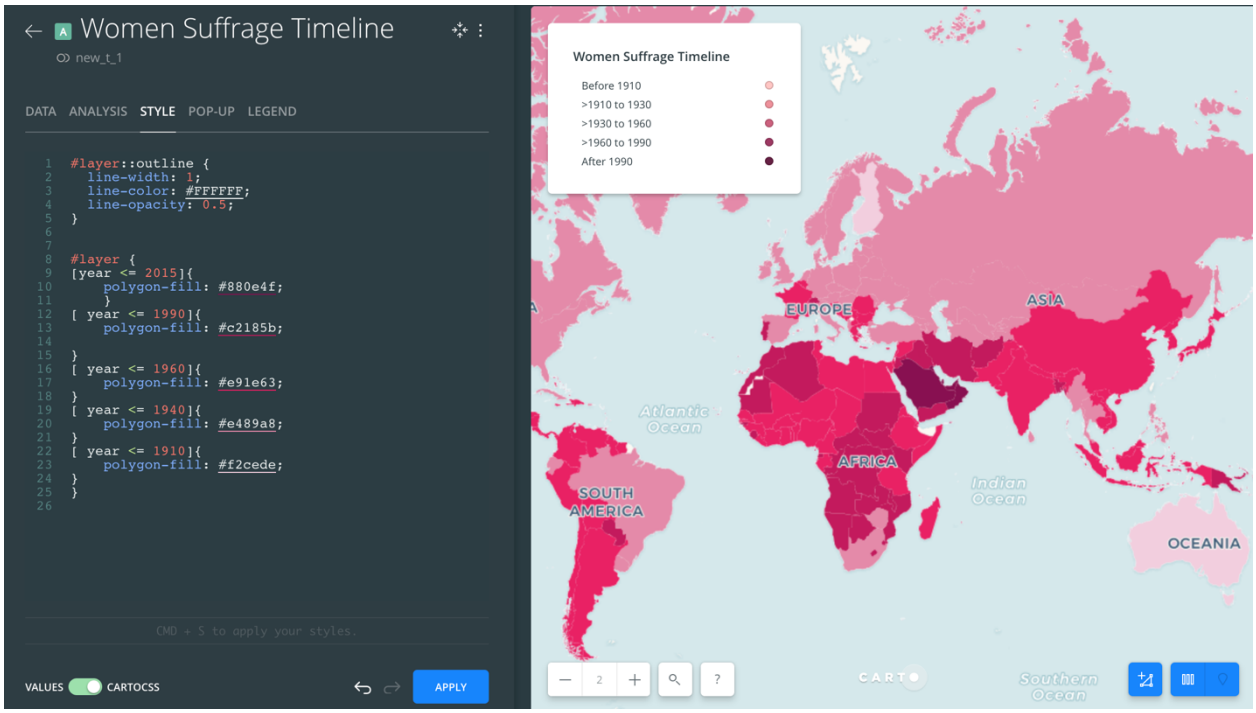



*Figure 5-13: Carto Builder, assigning custom styling for the choropleth map in the CartoCSS panel*

## 5. Influential Women

The CSV file containing the basic information of the influential women and their birth year as a time factor was added into CARTO Builder. CARTO automatically sorted the entries of the data by their type. The birth year was recognized by CARTO builder as a date format to be further styled and displayed. Besides the possible “animated time” style, there was also an option to add the birth year entry as a separate widget along with the map. As explained before, widgets were classified into four different categories from which a time-series widget for the birth year was selected for this example (figure 5-14).

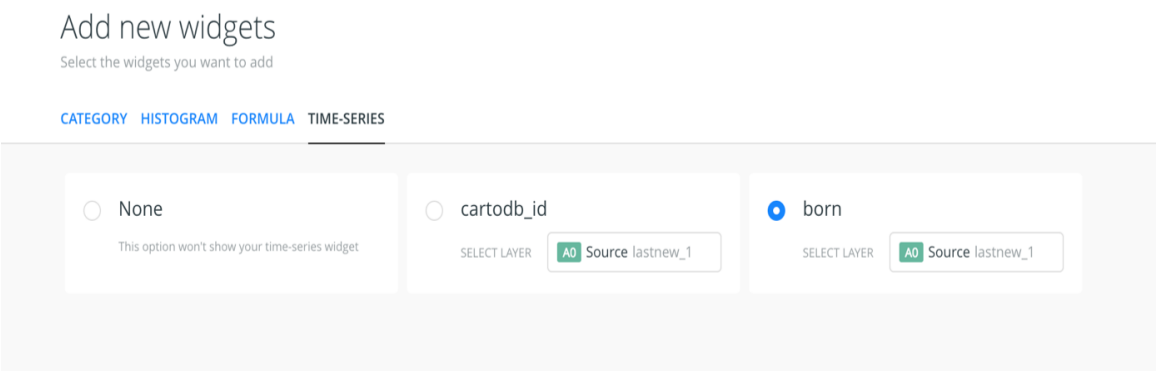



*Figure 5-14: CARTO Builder, adding time-series widget as a layer to the map*

Further designs could be considered for the widget after adding it as a layer to the map. Finally, like before, the result of the map was published via an HTML code and then embedded into the body of the story.

The result of the story with the custom web design and CARTO can be accessed via this link: http://www.womencan.byethost18.com/Index.html

## 5.4 Summary

The aim of this chapter was to create a sample test story with the two selected platforms in order to facilitate evaluation and comparison of them. In regard to platform 1, which was ArcGIS Online, all the five sections of the story (chapter 5.1) could be implemented. ArcGIS online provided the necessary tools for creation of web maps as well as the Esri Story Maps framework for presentation of the story will other multimedia elements.

CARTO on the other hand, did not provide a well-functioning framework for storytelling. Therefore, a custom web design has been created as a substitute for this shortcoming. CARTO builder is only applied for creation of web maps within the story.

After the implementation of the test example with the selected platforms, the results will be evaluated in the following chapter. The evaluation will be based on a user-based experience as well as the expert-based point of view. The two platforms will be compared with each other and the advantages and shortcomings of each of them will be presented and further discussed.

# 6 EVALUATION DISCUSSION

After the test story was implemented with the two chosen web mapping applications in the preceding chapter, an evaluation and comparison is done in the followings.

The evaluation of the selected platforms is analyzed from two different aspects: literature-based and expert-based.

The literature-based evaluation is the evaluation of the ten proposed important features which were concluded from the previous studies. The expert-based analysis is carried out by interviewing an expert in the field of journalism.

## 6.1 Literature-based evaluation

The first method of evaluation is based on the top designated characteristics for a proper multimedia presentation of spatial journalistic content. These features were introduced in chapter 2.5. The importance of these potentially necessary features was as well rated by the participants in the last question of the web mapping survey (see figure 4-5). The details about the results of this question of the survey is displayed below in table 6-1. Each feature is rated between four (very important) to one (not important) from most to least important. The last column of the table displays the average rating of each feature.

| | Very important (4) | Rather important (3) | Rather unimportant (2) | Not important (1) | Total participants | Average rating |
|---|---|---|---|---|---|---|
| Browser compatibility | 44 | 9 | 0 | 0 | 53 | **3.83** |
| Mobile Support | 44 | 6 | 2 | 1 | 53 | **3.75** |
| Speed of rendering data | 36 | 14 | 2 | 1 | 53 | **3.60** |
| License and pricing | 27 | 20 | 6 | 0 | 53 | **3.40** |
| User-friendly GUI | 28 | 17 | 8 | 0 | 53 | **3.38** |
| Data types compatibility | 27 | 18 | 8 | 0 | 53 | **3.36** |
| Narrative Styles | 22 | 27 | 4 | 0 | 53 | **3.34** |
| Multimedia compatibility | 22 | 24 | 6 | 1 | 53 | **3.26** |
| Framework for developers | 19 | 25 | 8 | 1 | 53 | **3.17** |
| Spatial analysis tools | 10 | 23 | 18 | 2 | 53 | **2.77** |

*Table 6-1: Details of the average ratings for the ten important characteristics by survey participants*

In this evaluation three followings methods are involved:

1. The sample user-experience
2. Test of the results of the two created stories
3. Existing documentation

The **sample user** is below 40 years, has experience in web mapping and programming but no previous experience with Esri Story Maps or CARTO. The

experience of the sample user in the process of creating the stories helps to detect **user-friendliness** of the platforms.
Additionally, creation of the two stories by the same user makes further judgments of the results less biased. Since, by having the same user and a fixed predefined test story, the platforms are the only variables to be compared.

The features such as browser compatibility and speed of rendering data are tested by comparing the results of the two stories. Most of the comparisons of this section are based only on the created web-maps, since CARTO did not provide a framework for presentation of the whole story. Therefore, the two created web maps are the only direct products of this considered platform.

Other features such as license and pricing, narrative styles, multimedia compatibility, and framework for developers are compared by the existed documentations. For The remainder of the list, more than one method is applied. For instance, the mobile support is evaluated based on the documented list of services that each platform provides and the comparison of the two created stories.
For making the results of this evaluation and the final comparison more conspicuous, each feature is graded within the scale of zero to four. A platform is marked zero when it did not have a considered feature and it is graded four when it fully met the desired expectations. Additionally, at the end of this sub-chapter, a short comparison between the custom web design and Story Map Cascade and possible web mapping style options within the two platforms are discussed. The results of literature-based evaluation are displayed in table 6-2.

| Characteristics | Esri ArcGIS Online | CARTO |
|---|---|---|
| Browser compatibility | 3 | 4 |
| Mobile Support | 4 | 4 |
| Speed of rendering data | 3 | 4 |
| License and pricing | 1 | 1 |
| User-friendly GUI | 2 | 4 |
| Data types compatibility | 4 | 4 |
| Narrative Styles | 4 | 1 |
| Multimedia compatibility | 4 | 1 |
| Frameworks for developers | 3 | 4 |
| Spatial analysis tools | 4 | 3 |
| **Overall average** | **3.2** | **3** |

*Table 6-2: Literature-based evaluation*

1. Browser Compatibility

As the foremost important factor in a web-mapping platform, the browser compatibility was tested via an online website-tester platform[43]. While CARTO showed complete compatibility with the most commonly used browsers, ArcGIS Online faced some issues particularly related to Internet Explorer (figure 6-1).

[43] https://www.powermapper.com

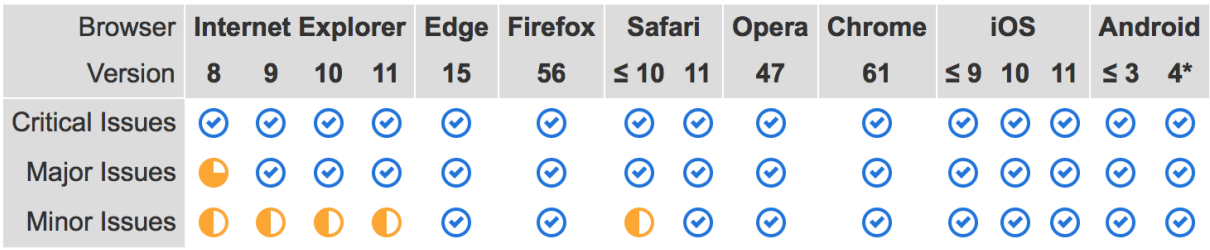



*Figure 6-1: Browser compatibility of the created story by Story Maps Cascade App*

Major issues:

The: empty CSS pseudo selector is not supported by IE8 and earlier.

The: last-child CSS pseudo selector is not supported by IE8 and earlier.

Minor issues:

CSS property border-radius is not supported by IE8 or earlier.

CSS selectors for INPUT TYPE="SEARCH" is ignored in IE 9 and iOS 4 or earlier.

DirectX filters are not supported by IE10 or later.

The box-shadow CSS property is not supported in Internet Explorer 8 and Safari 5.0 or earlier.

The opacity CSS3 property is not supported by IE8 or earlier.

## 2. Mobile Support

Both of the platforms provide a Software Development Kit (SDK) for creation of web applications for Android, iOS, and windows mobile platforms. Besides, the implemented maps functioned in mobile devices.

## 3. Speed of Rendering Data

The load time of web-maps was checked with a website speed tester[44]. The internet connection that the test was performed with had the average speed of 24.49 Mbps and the ping of 25ms. Although the difference was not considerable, CARTO rendered the data with a higher speed. As an illustration, the difference between the rendering speed of the two platforms in displaying the choropleth map is shown in figure 6-2. The first map was created in ArcGIS Online and the second one was built with CARTO builder.

[44] https://tools.pingdom.com

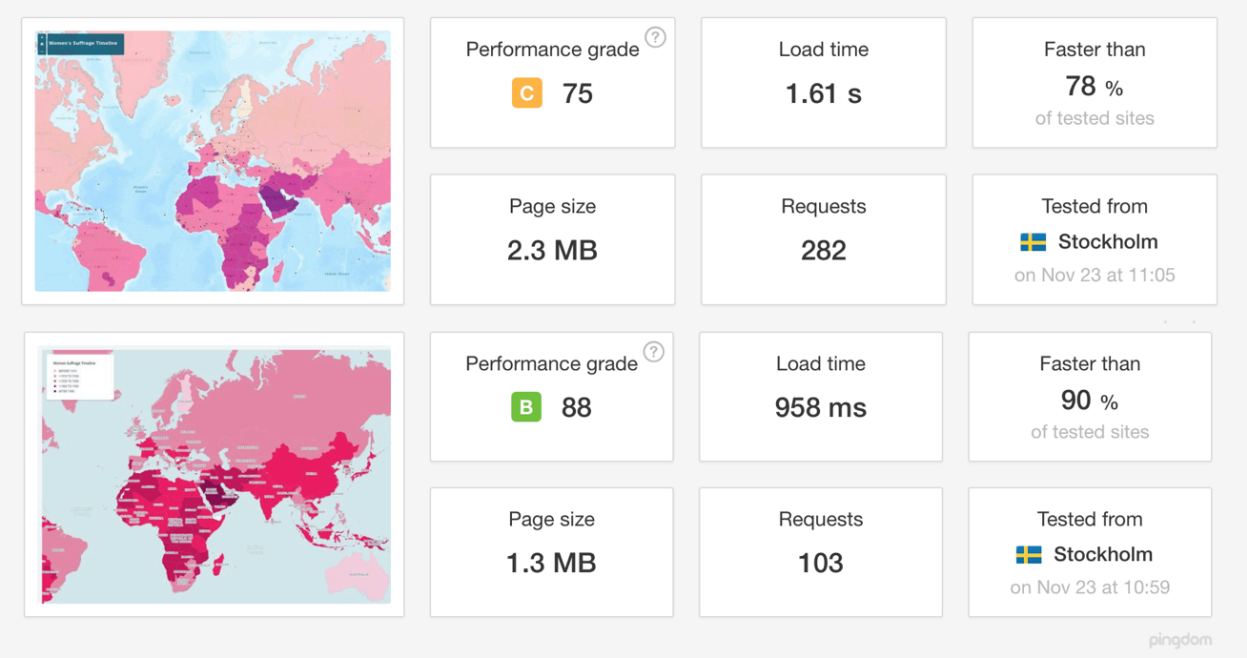



*Figure 6-2: Comparison between the speed of rendering in the two selected platforms*

## 4. License and Pricing

The ideal platform from the users' point of view, in terms of license and pricing, provides the desired requirements in the expense of no price. None of these platforms were ranked high from this aspect, since they both had a costly pricing for their full services. The annual pricing of CARTO[45] is approximately 1400€ for a personal user. ArcGIS Online provides its contributor (Level 2 user) subscription[46] for approximately 750€ per year. One difference between the pricing plans of these two platforms is that CARTO provides almost all of its services for free up to a certain scale and storage size (250 MB), however, ArcGIS Online does not offer completely some of its features such as its spatial analysis tools for the public account. Esri Story Maps offer all of its services for free and the Story Maps templates are open-source applications.

[45] https://carto.com/pricing/
[46] https://www.arcgis.com/features/plans/pricing.html

5. User-friendly Interface

Both platforms offer a simple, clear and, easy-to-use interface which is easy to navigate[47]. However, CARTO performed more intuitively and efficiently in handling and presenting the data form the sample user point of view. For instance, if the user inserts a CSV file containing any locational elements such as geographical names or coordinates, CARTO automatically locates the results on the map. similarly, the date type data is readily understandable by CARTO. On the other hand, ArcGIS Online needed some pre-configurations to recognize and perform these tasks. Consequently, the overall time that the sample user spent within the interface of CARTO for creating the web-maps was shorter than ArcGIS Online.

6. Data Types Compatibility

The platforms are well compatible with the necessary spatial data types. They offer support for a broad range of data formats such as CSV, GPX (GPS exchange format), Shapefile, KML and also file extensions like GeoJSON. GeoJSON is an open standard format for presenting simple geographical features along with non-spatial attributes.

7. Narrative Styles

By defining the narrative styles for this section of evaluation, as possible approaches for telling a multimedia story with spatial data. ArcGIS Online has developed a specific application for this purpose called Esri Story Maps. As explained before in chapter 5.2.1, Esri Story Maps offer eight different story templates (figure 5-1). The prototypes are each based on a common practice for a specific type of story. For instance, the “Story Map Tour” template is designed for presenting sequence of places along with narrative text, image or videos or “Story Map Spyglass” enables the user to peer through from one map to another with a spyglass tool. On the other side, CARTO created an open library called Odyssey.js which was not functioning at the time of writing this thesis, November 2017, and it only provided three narrative varieties.

[47] http://digiteratech.com/blog

## 8. Multimedia Capabilities

Apart from the interaction and presentation of web maps, CARTO supports text and graphics as other elements of multimedia. The integration of multimedia in CARTO is within the info-windows configuration. Beside text description, it is possible to link images via an external URL. In a similar way, ArcGIS Online provides text and image addition for its info-windows, plus the possibility to display charts. The charts are based on the related fields within the data and are possible in forms of pie charts, bar charts, and column charts. Furthermore, ArcGIS Online supports other multimedia forms such as audio, video and infographics to be embedded and presented within its Story Maps framework. The possible ways for adding the multimedia elements within the Story Map Cascade are: URL link, iframe code, computer upload, ArcGIS Online contents, and digital photo sharing websites such as Flicker, and Unsplash.

## 9. Framework for Developers

Both platforms provide frameworks for web developers. Esri has ArcGIS API for JavaScript which enables the users to create web mapping applications. Moreover, all Story Maps templates are open source and can be downloaded from GitHub. Therefore, the source code can be further customized by user's preferences. In a similar way, CARTO offered CARTO Engine service which consisted of a set of tools and APIs such as, Map API, and SQL API to perform data analysis and visualization. It also extended its service for developers within its builder, where the user can readily interact with the data by simple lines of SQL queries or customize the default design configurations with CartoCSS or HTML codes.

## 10. Spatial analysis tools

In terms of spatial analysis, both platforms offered variety of spatial functions. Some of these functionalities such as finding clusters or outliers within the dataset were provided by both platforms while some other tools were specified to only one of them. In general, ArcGIS Online analysis functions outnumbered that of CARTO and it enabled the user to unfold more in depth spatial patterns and geographical relationships within the data. The list of all spatial tools of each platform is listed below in table 6-3.

| ArcGIS Online | | CARTO |
|---|---|---|
| **Summarize data:**<br>Aggregate points<br>Join features<br>Summarize nearby<br>Summarize within<br>**Find Locations:**<br>Find existing locations<br>Drive new locations<br>Find similar locations<br>Choose best facilities<br>Create viewshed<br>Create watersheds<br>Trace downstream | **Data enrichment**<br>Enrich layer<br>**Analyze patterns**<br>Calculate density<br>Find hot spots<br>Find outliers<br>Interpolate<br>**Use proximity**<br>Create buffers<br>Create drive-time areas<br>Find nearest<br>Plan routes<br>Connect origins to destinations<br>**Manage data**<br>Extract data<br>Dissolve boundaries<br>Merge layers<br>Overlay layers | **Create and clean**<br>Filter by layer<br>Georeference<br>Join columns from second layer<br>**Analyze and predict**<br>Calculate clusters of points<br>Detect outliers and clusters<br>Find nearest<br>**Transform**<br>Intersect second layer<br>Create areas of influence<br>Find centroid of geometries<br>Group points into polygons<br>Filter by column value<br>Filter points in polygon<br>Connect with lines<br>Subsample percent of rows |

*Table 6-3: Spatial analysis tools of the two selected platforms*

In the process of creating the test story only “join feature” tool was applied in ArcGIS Online and no spatial analysis was needed to be used in CARTO.

## Web mapping styles

For creating a choropleth map of polygon features, both platforms offered the option to assign the values of a specific data field to a color scheme. It was as well possible to completely customize, the colors of the color scheme and the configurations of classifications method. Also point features, could be presented accordingly based on an attribute by shape, size, color, and type in both platforms.

Additionally, for time data, CARTO has a style named animated, to present the time-series data over time or the possibility to add a time-series widget into a map. In a similar way, ArcGIS Online offers a time slider for time data to animate it over time.

**Structure of the story**

Esri Story Map Cascade is built upon the technologies such as “dojo toolkit”, “JavaScript Infovis toolkit” and “ArcGIS API for JavaScript”. The interface of the builder was easy-to-use and simple to navigate. It allowed the user to create multimedia stories with a nice aesthetic look and interactivity within a very short time. The structure of the story was intended to unfold gradually as the reader scroll down the page. However, the interaction within the builder for subtle customizations such as changing to a desired font style was not possible. The users were confined to choose from the existing styling options unless the source code was downloaded and further modified. In that case, users need to host the code on their own website or web server. On the other side, coding a web page to present the multimedia elements of the story was very time consuming in comparison to using a builder such as Story Map Cascade. But it gave the creator of the story the unrestricted opportunities for customizations.

## 6.2 Expert-based evaluation

The expert-based evaluation was done through a skype interview with a journalist. The journalist was selected from the data journalist team[48] of the main German radio and television broadcasting company in Bavaria “Bayerischer Rundfunk (BR)”. The collaboration of BR Data with this thesis was in responding to the web mapping survey and then upon request, their willingness to help in the evaluation of final results. This journalistic group that is composed of journalists, programmers, and designers, is specialized in preparation and visualization of data-driven stories. Therefore, this interview will properly reflect the opinions of one expert in regards to the quality of the created stories and the potential usability of the proposed platforms for such news organizations.

[48] http://www.br.de/extra/br-data/br-data-team-100.html

The skype interview was on 30th of October 2017 and it took thirty minutes in total. For this interview, a list of questions was prepared and the results of the two test stories (chapter 5.2.2 and chapter 5.3.2) were sent to the intended journalist one week in advance. The interview protocol can be found in appendix 9.3.

The interviewee had no previous experience with ArcGIS Online but was familiar with CARTO. In overall, the interviewee found the design of the Esri Story Map Cascade more professional and visually appealing in comparison to the custom web design. Notwithstanding, the web-maps which were the core elements of the story was better presented by CARTO in his point of view. He had thoroughly reviewed the two results and made the followings explanations about pros and cons of each platform (see table 6-4).

Another important aspect from a journalistic point of view which was asserted by the interviewee was that, it is highly important for news organizations to customize the map layout in order to make it look different from other news broadcasters. Furthermore, since the majority of news traffic comes from devices such as mobile phones or tablets, the functionality of web-maps within smaller screens is of great importance. Additionally, regarding the pricing plans of the platforms, the interviewee claimed that these platforms could specify a limited number of tools and services which were essential for journalists with a lower subscription plan. Since the current price of a platform such as CARTO was not easily affordable by many news organizations.

The interviewee mentioned that they have used CARTO in their organization. He also asserted that he doesn't see a huge prospect for their company to use Esri Story Maps templates, since they have programmers in their team to design their own website with the desired customizations. However, he observed the application potentially useful in journalism.

The final suggestion for further improvements for such web mapping platforms was adding more file export formats such as "GIF" which is very suitable especially for social media usage.

| ArcGIS Online | CARTO |
|---|---|
| **+ Basemap**<br>The basemap (Topographic basemap) for the choropleth map gives the viewer right amount of geographical information along with the thematic concept. | **- Basemap**<br>The basemap (CARTO Voyager) for the choropleth map is ambiguous and it does not clearly display countries' borders. |
| **+ Color scheme**<br>The color scheme for the choropleth map is apparent and informative in highlighting the variations between the data. | **- Color scheme**<br>The color scheme is less clear in drawing viewer's attention to important trends within the data |
| **- Info-windows**<br>The default appearance is not appealing<br>The customizations in not possible<br>User-unfriendly (for instance, the user cannot hover over the map to see the pop-up windows)<br>Weak performance in mobile devices | **+ Info-windows**<br>The default appearance is modern, artistic and attractive<br>The customizations are readily possible<br>The possibility to set the pop-ups by click, hover, or both.<br>Better performance in mobile devices |
| **- Mobile version**<br>lower performance in general in mobile devices in displaying info-windows or moving inside the map | **+ Mobile version**<br>The overall performance of the maps was better |
| **- Time slider**<br>The time slider is less informative | **+ Time slider**<br>The time slider provides the time of events within the presented time frame |

*Table 6-4: Overview of the interviewee evaluation*

## 6.3 Summary

This chapter was dedicated to the evaluation of the two selected web mapping platforms. The evaluation and comparison were examined by consideration of different factors.

First, the ten literature-based characteristics of a suitable platform which were as well rated by survey participants were investigated. The evaluation of these features was based on the results of the two created stories, existed documentation and the sample user experience in implementation of the test story. In this assessment, each feature was graded accordingly with a value between zero to four from least to highest level of performance. The result of the literature-based evaluation is shown in figure 6-3.

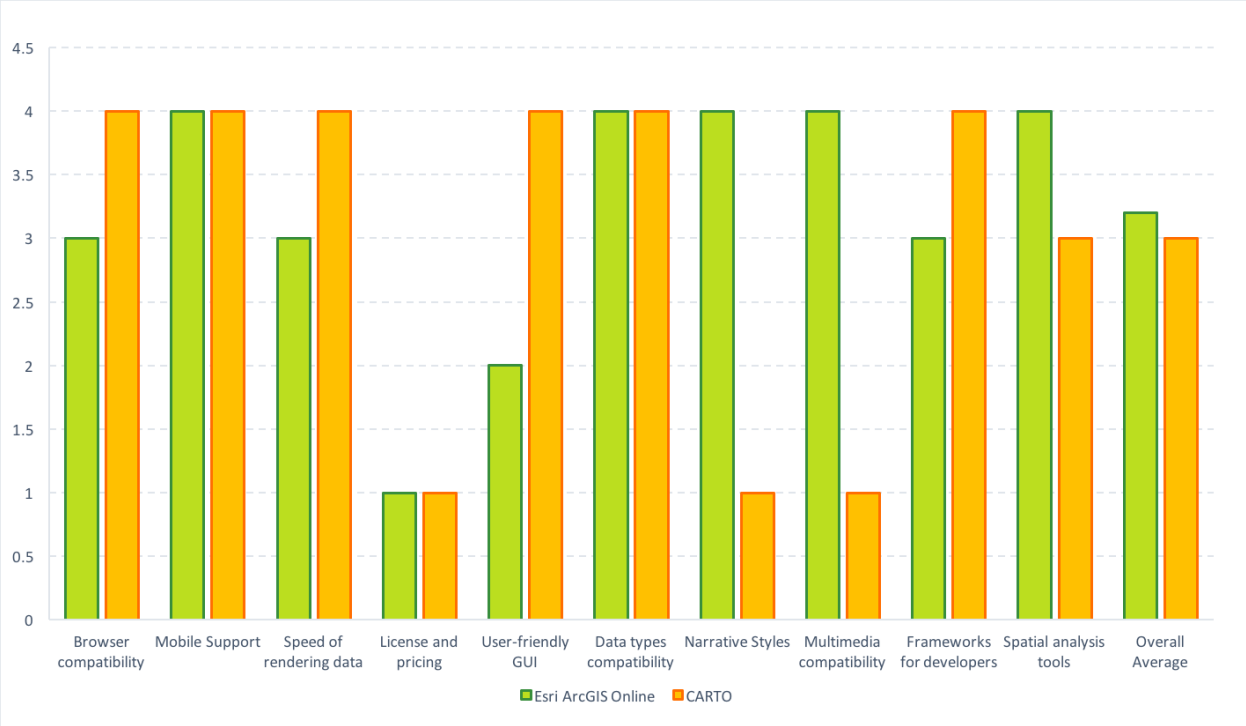



*Figure 6-3: Comparison between the two selected platforms based on literature- based evaluation*

Each of the tested platforms displayed areas of strengths and limitations. ArcGIS Online performed better for creating a multimedia story as whole by having a specific framework called Esri Story Map. Esri Story Map enables the user to embed desired multimedia formats such as text, video, audio, infographics and interactive

web maps into various story templates. CARTO, on the other hand, presented a higher performance in other areas such as cross-browser compatibility or having a user-friendlier user interface. The key factor in judging the user-friendliness of a platform was concluded from the time span for performing the same task with each platform by the sample user.

In total, both of the selected platforms gained a close overall rank. However, ArcGIS Online stayed in the first place while CARTO obtained higher value in more number of features.

Lastly, an interview with a journalist was explained as an expert-based evaluation. The assessment of the final results of the imperial example were the basis of this interview. The overall impression of the interviewee towards the Story Map Cascade design was very positive in comparison to the custom web design. In terms of the created web maps, even though the interview found both results satisfying, CARTO web maps gained higher credits from his point of view.

In the followings, the final conclusions of the thesis will be discussed by reviewing research questions. Consequently, the limits of the work will be portrayed and possible future research directions will be introduced.

# 7 CONCLUSION AND OUTLOOK

There is an increasing popularity of using spatial journalistic articles with multimedia and interactivity in online journalism. However, there is not much scientific studies done for addressing a more in-depth investigation of such practices. This thesis aimed to explore the important criteria of a multimedia presentation with spatial data and the ways of its implementation to address this gap. Furthermore, by comparing the important considerations for a well-suited presentation within the two of the existing platforms, the thesis determined how the existing platforms can be improved.

In the followings, the main findings of the research will be summarized by answering the research questions which were proposed in chapter 1.3. Finally, the thesis will finish by discussing the possible directions for future work.

## 7.1 Summary

**Question 1:** What are the criteria of a good framework for multimedia presentation of location based journalistic information?

The summary of findings on the first research question was a list of ten features which were first presented in chapter 2.5 from the related literature. These nominated features were then rated form **very important** to **not important** by the participants of the web mapping survey. The visualization of the average ratings of the participants based on table 6-1 is shown below in figure 7-1.

The survey participants confirmed the importance of the proposed features, since nine out of ten of them were rated between “very important” to “rather important”. Additionally, none of the participants add further characteristics to the list. More interestingly, “spatial analysis tools” which is considered a very essential feature in areas such as cartography or geographical science was placed at the least level of importance from the journalistic point of view (figure 7-1).

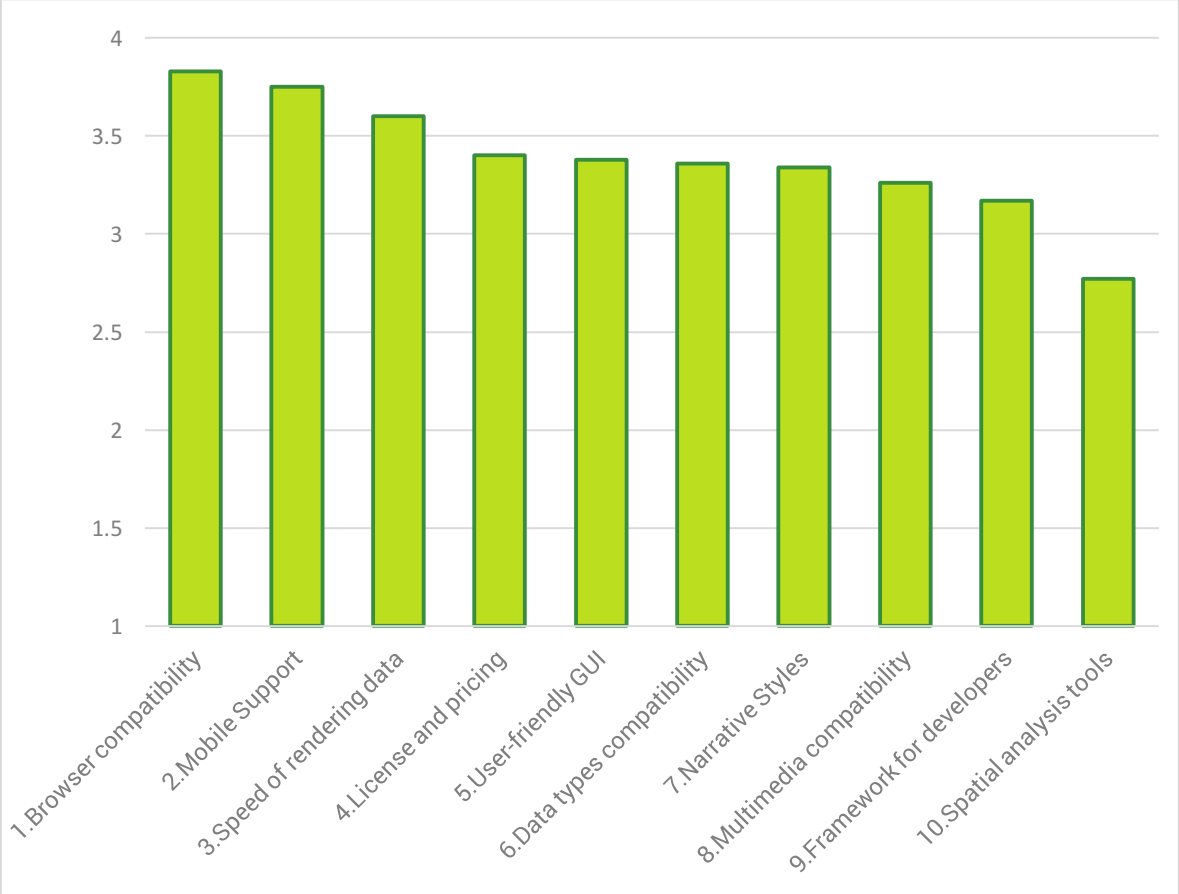



*Figure 7-1: Average rating of the ten proposed features*

**Question 2:** Which platforms are most suitable for creation of the web maps along with different types of multimedia elements?

The research addressed this question in a two-step methodology. First the most commonly used web mapping technologies were inquired form the survey participants (see chapter 4.1.3). The ordered list of the first four results of the most familiar platforms and frameworks are displayed in table 7-1. These technologies can be used partially in creation of web maps in a multimedia presentation. However, for finding the **most suitable** platforms the results needed to be further filtered by the ten important features which derived from the first research question. Consequently, CARTO and ArcGIS online were the two most qualified platforms.

| Most commonly used platforms | Most commonly used frameworks |
|---|---|
| Google Maps | Leaflet |
| CARTO | Google Maps API |
| Mapbox | D3 |
| ArcGIS Online | Bing Maps API |

*Table 7-1: Most commonly used web mapping technologies*

**Question 3:** What strengths or weaknesses each platform has in regard to overall presentation as well as presentation of web maps?

The thesis answered the third question from two different aspects. First, based on the ten most important features, and second from an expert point of view. A test story was proposed and implemented on the two platforms in this study to facilitate the evaluation process.

In reference to the literature-based evaluation, ArcGIS Online performs better and provides more services in terms of the overall presentation of multimedia stories with spatial data. However, in regard to creation of web maps of the test story (excluding narrative styles and multimedia capabilities), CARTO showed a better performance. Subsequently, by adding the average ratings of the survey participants to the results of the evaluation, figure 7-2 shows in which areas the platforms fulfill the most necessary expectations of the users or not.

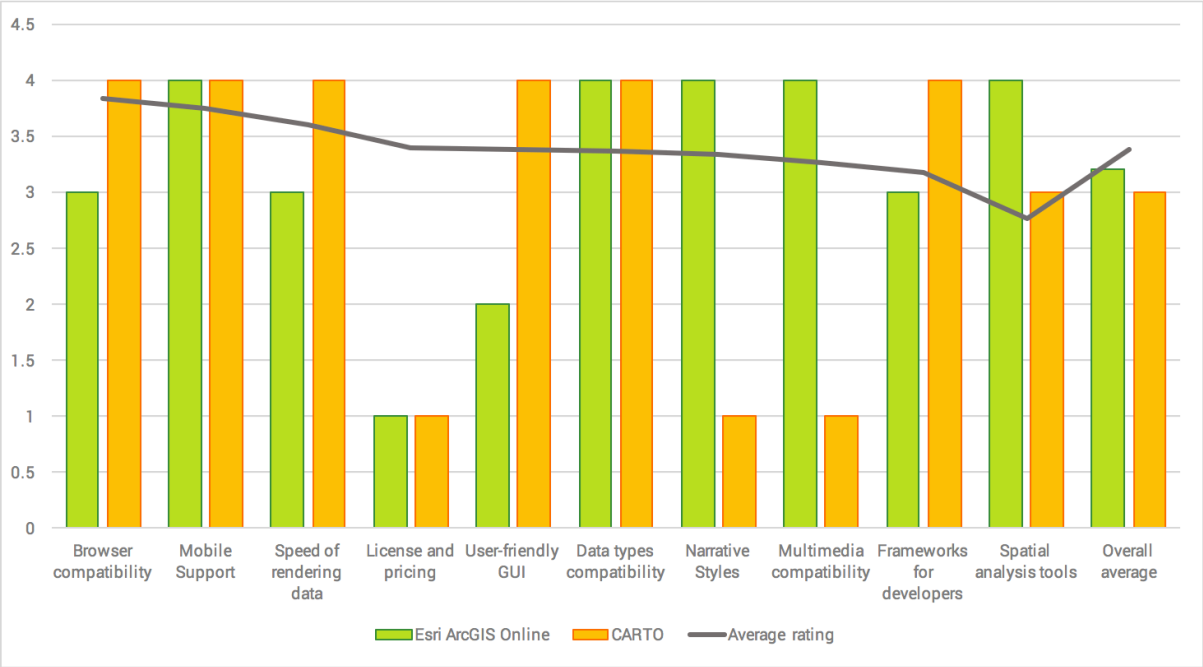



*Figure 7-2: Literature-based evaluation and the average ratings of the survey participants for the ten important Features*

For instance, while CARTO addresses the first most necessary features, it fails to fulfill further assistance for creation of a whole multimedia presentations with different narrative styles. ArcGIS Online, on the other hand provides professional analysis tools which are beyond the scope of journalist's usage and need. This could be one of the reasons why this platform is used less among the journalists.
Additionally, it is evident that both of the selected platforms do not meet the user's expectations in terms of license and pricing.

The findings of the interview with the journalist (expert-based evaluation) is in line with the results of the literature-based evaluation. The interviewee found the design of the overall presentation with Esri Story map more appealing than the custom web design which was applied as a substitute. However, he gave more recognition to the web maps that were created by CARTO. One important factor that was highlighted by the journalist was the importance of having the possibility to apply desired customizations to the web maps in order to make it look different from other news broadcasters.
This thesis has shed light on the important consideration of a spatial journalistic presentation with the use of multimedia elements. It has also detected suitable technologies for implementation of such practices and the ways for their

improvements. After the completion of this thesis, it was clearer to see the potential possibilities for further studies related to cartography and journalism. In the followings, some of the future directions will be discussed due to the limited scope of this work.

## 7.2 Future work

One important area of investigation that was not covered within this research is the evaluation of the most commonly used web mapping technologies in journalism, since this thesis was mainly focused on the presentation of spatial data along with multimedia elements and not just creation of web maps. The list of the most commonly used web mapping technologies also needs to be updated frequently to cope with the fast pace of technology's development.

There is also the possibility for future research to investigate different digital narrative styles (chapter 2.3) of the multimedia presentation of spatial data. For instance, examining different storytelling's approaches with maps in online journalism and their particular usage or impact on the readers.

Another suggestion for the similar studies would be the implementation of a more challenging story. Even though the test story within this thesis contained a number of essential elements, it did not test some of the capabilities of the two selected platforms. For instance, the platforms can be further assessed by the use of other spatial data types such as raster or real-time data.

The future work can also dig deeper in the direction of this research by testing more web mapping platforms. Moreover, extending the number of participants for the evaluation process can be another improvement, especially for the expert-based evaluation. Additionally, adding more sample users for completing the same task/story with different platforms under a time constraints can lead to a more comprehensive evaluation between the final results.

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NOTE

All online sources were last accessed on 25th of November 2017

# 9 APPENDIX

## 9.1 Web mapping survey

**Dear participant**

**This survey is a part of my master thesis as a cartography student to evaluate online web mapping platforms and technologies with the main focus on journalism. It will take approximately 7 minutes for you to fill it out and it will be a great help for my work. Consequently, if you are interested in the final results of this thesis or if you have any further comments or suggestions please feel free to contact me.**
**Thank you**

**Zeinab Torabi**
**z.torabi.19@gmail.com**

1. What is your age?

- ◯ 18 to 24
- ◯ 25 to 34
- ◯ 35 to 44
- ◯ 45 or older

* 2. What is your educational background?

- ☐ Journalism
- ☐ Geoinformation
- ☐ Cartography
- ☐ Geography
- ☐ Programming

Other (please specify)

* 3. What is your current job title?

* 4. How often do you work with spatial and location-based information?

- ◯ Frequently
- ◯ Occasionally
- ◯ Rarely
- ◯ Never

* 5. How often do you have to add a web map to a news article?

- ◯ Frequently
- ◯ Occasionally
- ◯ Rarely
- ◯ Never

* 6. How often do you create multimedia news stories which include web maps?

- ◯ Frequently
- ◯ Occasionally
- ◯ Rarely
- ◯ Never

* 7. To what kind of news articles do you usually add maps?

- ☐ Politics
- ☐ Economy
- ☐ Science
- ☐ Travel
- ☐ Sports
- ☐ Culture

Other (please specify)

* 8. How familiar are you with these following online web mapping platforms?

| | I use it quite often | I have used it a few times | I know it exists but I have never used it | I have never heard of it |
|---|---|---|---|---|
| ArcGIS online | ◯ | ◯ | ◯ | ◯ |
| Bing Maps | ◯ | ◯ | ◯ | ◯ |
| Carto (formerly CartoDB) | ◯ | ◯ | ◯ | ◯ |
| GeoCommons | ◯ | ◯ | ◯ | ◯ |
| Google Maps | ◯ | ◯ | ◯ | ◯ |
| Mango | ◯ | ◯ | ◯ | ◯ |
| Mapbox | ◯ | ◯ | ◯ | ◯ |
| MapBuilder | ◯ | ◯ | ◯ | ◯ |
| MapQuest | ◯ | ◯ | ◯ | ◯ |
| MapServer | ◯ | ◯ | ◯ | ◯ |

Feel free to add any further web mapping platforms which you usually work with.

* 9. How familiar are you with these following online web mapping frameworks?

| | I use it quite often | I have used it a few times | I know it exists but I have never used it | I have never heard of it |
|---|---|---|---|---|
| ArcGIS API for JavaScript | ◯ | ◯ | ◯ | ◯ |
| Bing Maps API | ◯ | ◯ | ◯ | ◯ |
| D3 | ◯ | ◯ | ◯ | ◯ |
| DigitalGlobe Maps API | ◯ | ◯ | ◯ | ◯ |
| GeoComplete | ◯ | ◯ | ◯ | ◯ |
| Google Maps API | ◯ | ◯ | ◯ | ◯ |
| Kartograth | ◯ | ◯ | ◯ | ◯ |
| Leaflet | ◯ | ◯ | ◯ | ◯ |
| OpenLayers | ◯ | ◯ | ◯ | ◯ |
| Polymaps | ◯ | ◯ | ◯ | ◯ |

Feel free to add any further web mapping frameworks which you usually work with.

10. How do you rate the importance of the following web mapping platform's characteristics?

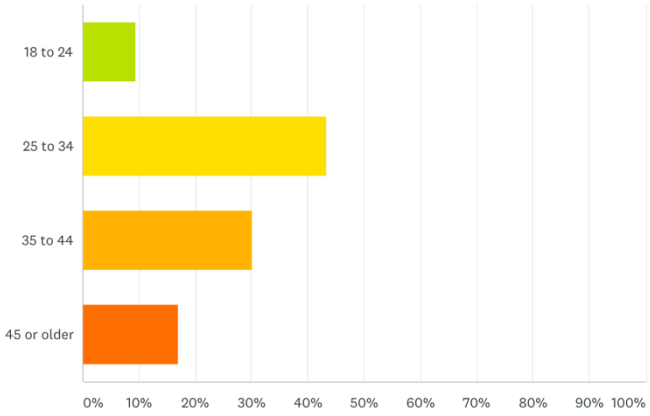
| | Very important | Rather important | Rather unimportant | Not important |
|---|---|---|---|---|
| Multimedia capabilities (support different multimedia formats and interactive features) | ◯ | ◯ | ◯ | ◯ |
| Different possibile narrative structures | ◯ | ◯ | ◯ | ◯ |
| User-friendly and intuitive GUI | ◯ | ◯ | ◯ | ◯ |
| Different data types compatibility | ◯ | ◯ | ◯ | ◯ |
| GIS analytic tools | ◯ | ◯ | ◯ | ◯ |
| Browser compatibility | ◯ | ◯ | ◯ | ◯ |
| Extensive framework for developers (e.g. API) | ◯ | ◯ | ◯ | ◯ |
| Mobile support | ◯ | ◯ | ◯ | ◯ |
| Speed of rendering in browser and server | ◯ | ◯ | ◯ | ◯ |
| License and pricing | ◯ | ◯ | ◯ | ◯ |

Feel free to add any further important characteristics that you have in mind.

## 9.2 Web mapping results

### What is your age?

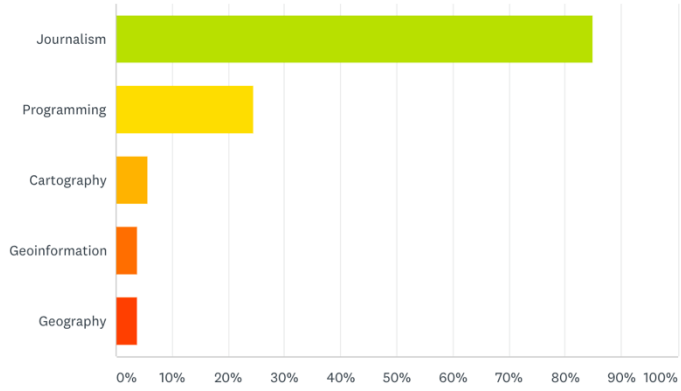
Answered: 53 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| 18 to 24 | 9.43% | 5 |
| 25 to 34 | 43.40% | 23 |
| 35 to 44 | 30.19% | 16 |
| 45 or older | 16.98% | 9 |
| TOTAL | | 53 |

### What is your educational background?

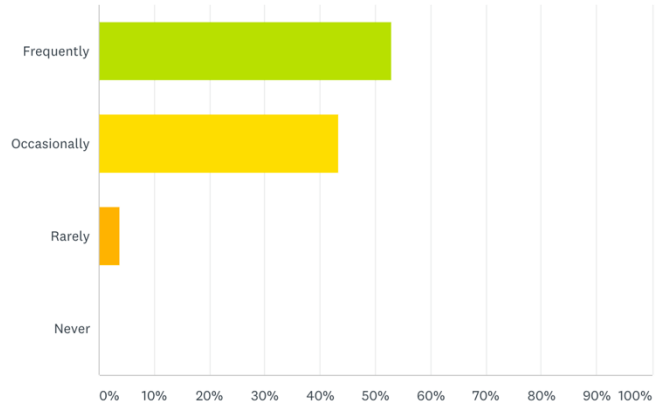
Answered: 53 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Journalism | 84.91% | 45 |
| Programming | 24.53% | 13 |
| Cartography | 5.66% | 3 |
| Geoinformation | 3.77% | 2 |
| Geography | 3.77% | 2 |
| Total Respondents: 53 | | |

## How often do you work with spatial and location-based information?

Answered: 53 Skipped: 0

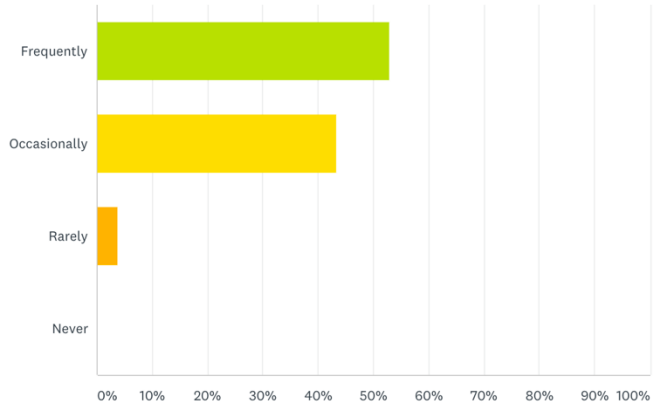



| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Frequently | 52.83% | 28 |
| Occasionally | 43.40% | 23 |
| Rarely | 3.77% | 2 |
| Never | 0.00% | 0 |
| TOTAL | | 53 |

## What is your current job title?

## How often do you work with spatial and location-based information?

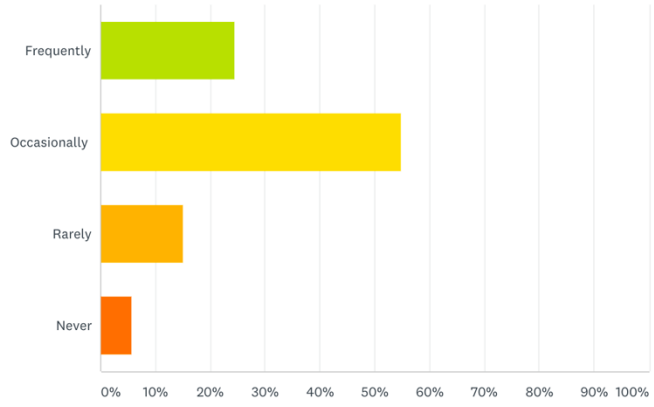
Answered: 53 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Frequently | 52.83% | 28 |
| Occasionally | 43.40% | 23 |
| Rarely | 3.77% | 2 |
| Never | 0.00% | 0 |
| TOTAL | | 53 |

## How often do you have to add a web map to a news article?

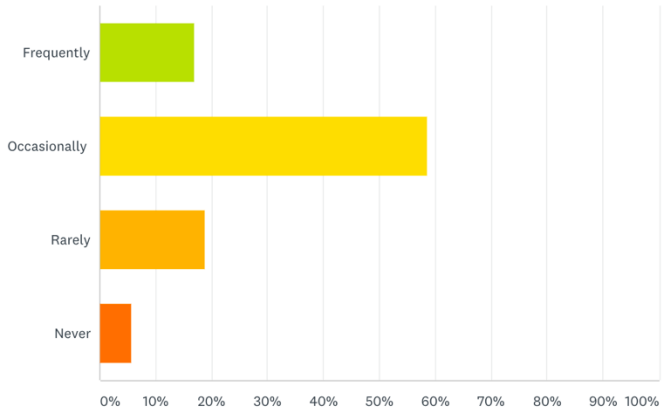
Answered: 53 Skipped: 0




| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Frequently | 24.53% | 13 |
| Occasionally | 54.72% | 29 |
| Rarely | 15.09% | 8 |
| Never | 5.66% | 3 |
| TOTAL | | 53 |

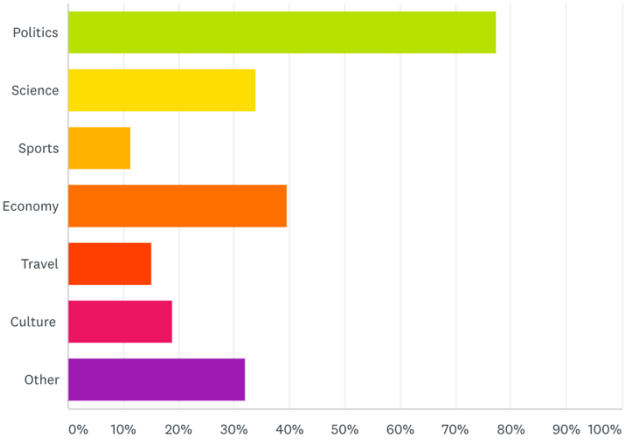
## How often do you create multimedia news stories which include web maps?

Answered: 53 Skipped: 0



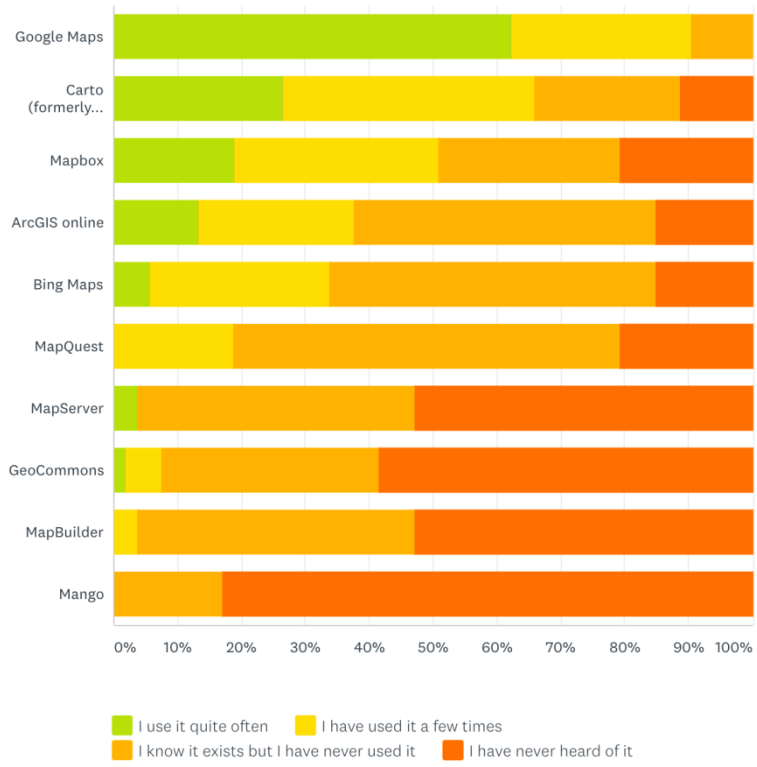

| ANSWER CHOICES | RESPONSES | |
|---|---|---|
| Frequently | 16.98% | 9 |
| Occasionally | 58.49% | 31 |
| Rarely | 18.87% | 10 |
| Never | 5.66% | 3 |
| TOTAL | | 53 |

## To what kind of news articles do you usually add maps?

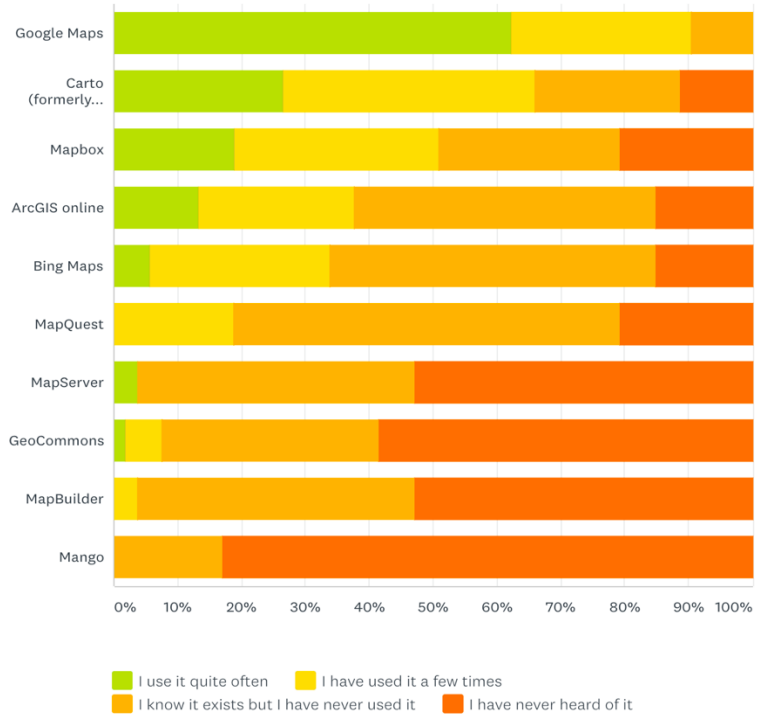



| ANSWER CHOICES | | RESPONSES | |
|---|---|---|---|
| Politics | | 77.36% | 41 |
| Science | | 33.96% | 18 |
| Sports | | 11.32% | 6 |
| Economy | | 39.62% | 21 |
| Travel | | 15.09% | 8 |
| Culture | | 18.87% | 10 |
| Other | Responses | 32.08% | 17 |

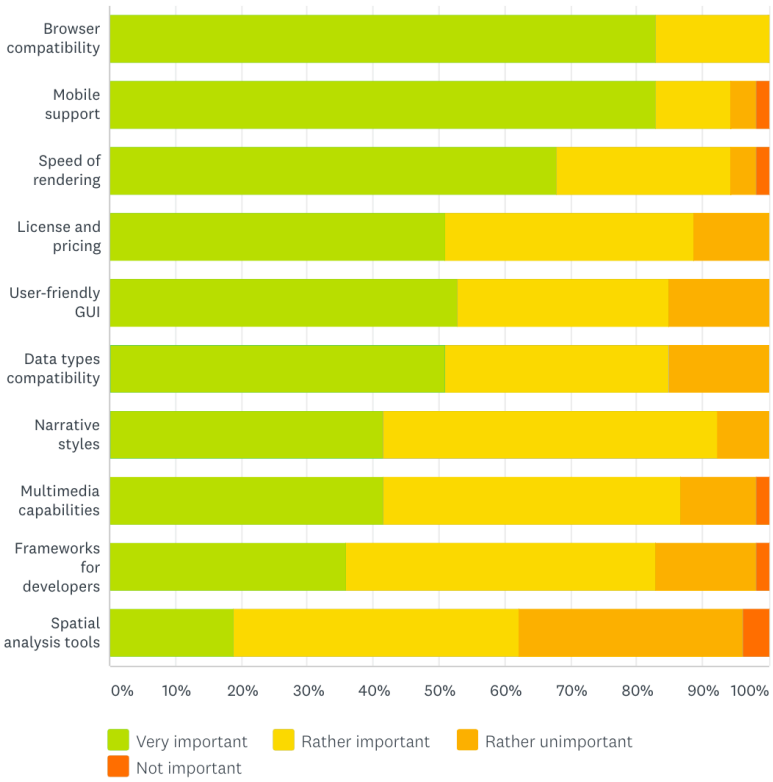
How familiar are you with these following online web mapping frameworks?




How familiar are you with these following online web mapping platforms?



How do you rate the importance of the following web mapping platform's characteristics?



## 9.3 Interview protocol

1. How familiar are you with the two platforms of CARTO and ArcGIS Online?
2. How do you compare the overall presentations of the two stories?
3. How do you compare the created web maps within the two stories? (what do you like or don't you like about them?)
4. What are the important considerations for such presentations from your point of view?
5. Have your company used any of these platforms? If not do you see a good prospect for it in your organization?
6. What suggestion do you have for improvement of the web mapping platforms?