Creative Technologies Project: Research Report

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Abstract

This report summarizes research in the area of investigating the use of d3.js and angular.js in developing a single page chart builder web application. Which charting library will be the most beneficial to my application? Find out if using AngularJS will improve the performance of the application. What's the most suitable method of storing data?

Introduction

The aim of the project is to produce a web based application to which will allow users to turn their existing data file into a high quality interactive chart ready for publications. I will develop a website to provide supporting documentation, resources and illustrations to provide support and assistance to the user.

The user will be taken through a step by step process from the initial upload of the data file to the chart, preview ready to export to an image ready to be published inside a publication.

The key features the application will provide:

- On screen chart tools editor
- Chart Preview
- Exported image

As a result of the application it will decrease the amount of time spent on producing the charts, and increase workload on other tasks and overall improve productivity within Ministry of Defence (M.O.D)

The aim of the report will be to discuss my findings from undertaking research specifically to finding the answers to my research questions:

- Between D3.js Library and chart.js library, which charting library would be suitable to apply the process data into to display the chart?
- Is my project feasible and works as a solution to the problem with irregularities with charts in publications?
- Would angular.js be the most suitable framework to create my application as a single page application?
- Within Technical research, what possible methods can I use for the storing of user's data for processing?
- Between SVG and Canvas, which rendering output would the most beneficial to my application?

Research methods

For the project to be successful it was important to identify key areas of research to focus towards to gain a better understanding of how the application is going to function and identify potential users. The 3 most important area's I feel my research needed to focus on is:

- Problem Domain
- Technical Research
- User focused Research

It is important to understand the problem domain around my application. I needed to find out whether there is a real need for the application and whether not out the project can contribute to providing a solution. To help understand about the problem domain I needed to conduct a survey with staff within the M.O.D. Because the nature of M.O.D it was extremely important to make sure no personal information was collected and remained anonymous.

I chose to use a survey for to help me gather qualitative data as I felt it is an efficient way to collect data. In relation to the problem domain for my project, it can be used to identify software currently being used in the M.O.D specifically for handling data and creating charts, but also what they think about the technology they use. With the information gathered from the survey it will help me decide whether my application is feasible to do and whether it be provide a possible alternative to the existing methods. In order for my survey to start getting responses I needed to get in contact with an employee of M.O.D and ask them if the survey could be sent out to people within the department who specifically handle and process data within their job role.

For the technical Research, the most appropriate method to help me understand how the different stages of my application will work is through secondary research. From the technical research I wanted to focus the research around 4 main stages of my application, these include: storing the clients data, processing of data, integrating the data and the chart library, output of the chart and the exporting of the chart. Furthermore I would like to investigate the possibility of building my application using angular.js framework.

The secondary research will involve searching the web for various web articles and tutorials such as Lynda (Lynda.com,2015) alongside the online resources such as W3 (W3 Schools, 2015) to help provide possible solutions.

The third main area of research I wanted to focus on is the usability and UI aspects of my application. Through the use of the survey and secondary research I wanted to find out if the application should be aimed at a user with lots of technical skills (developer) or a less-technical based user (statistician). This is important part of my project as it can have a significant impact of the overall structure and design of the application. This is an efficient way to start understanding the common features included in these types of application competitors have included into their products. This helped me to identify key features that I missed out but also point out the difference my application can provide.

Research findings

Between D3.js Library and chart.js library, which charting library would be suitable to apply the process data into to display the chart?

One of the main areas of my applications is to get the processed data and display the data into a chart. To do this I will need to use a JavaScript charting library to build the foundation of creating the basic type of charts such as Bar Chart, Line chart etc.

My initial research led me onto a best 15 JavaScript charting library (Rahman S F, July 2015) article which briefly talked about the charting libraries individually.

From the list I was able to identify 2 charting libraries which I have come across before. These 2 are:

- D3.js Library
- Chart.js

I highlighted both of these charting libraries as they are both open source libraries suiting the project and recognize them from other previous research during placement.

"D3.js is a JavaScript library for manipulating documents based on data. D3 helps you bring data to life using HTML, SVG, and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation." D3 (D3js.org , 2015)

Through previous experience with using D3.js I find the charting library can time consuming creating the basic layout for the charts. This is something for me to consider when developing my application as it could restrict the amount of possible charts my application can produce as developing for each chart type will be time consuming.

My first decision was to go with chart.js because the lightweight library would benefit my application the most and would be more efficient to integrate into the application. Furthermore, my focus of the project is to produce basic chart types it would seem the least appropriate to not use a large charting library like d3.js as I would not be using the full capabilities.

However through further research into the chart formats, I found a useful comparison of JavaScript

charting frameworks (See appendix B)from Wikipedia (Wikipedia, 2015) which showed that chart.js does not support SVG as a rendering technology and D3.js is supported. This is important as my initial thoughts were to render my charts out as SVG.

My final decision is to go with d3.js charting library as chart.js does not support SVG. This is an important factor as I will be looking to allow the user to control and edit the chart on screen.

To guide me through the process of developing my application using D3.js I will be looking to "D3 and Angular" (Dashing D3.js, 2015), "AngularJS & D3: Directives in Angular.js" (angularjs, 2015) and "Drawing SVG graphics with D3" (Lynda, 2015) tutorials to help me develop this part of the process of my application. A lightweight library would benefit my application the most and would be more efficient to integrate into the application. Furthermore, my focus of the project is to produce basic chart types it would seem the least appropriate to not use a large charting library like d3.js as I would not be using the full capabilities.

Research Question: Is my project feasible and works as a solution to the problem?

The aim of my project is to build an application which can be used as a platform to produce consistent charts across the M.O.D and improve regularities across publications. I will need to find out whether my application can be a suitable alternative to the existing methods they use. To find this out I conducted a survey specifically aimed at Statisticians and other members of the staff in M.O.D who handle publications and produces charts with data. It will be important to find out what is being currently being used and if users are satisfied with the current technology they are using.

To gather the results I decided to use the Google form's tool which I have previously used before in other projects and found the tool particularly useful and easy to set up. Google Forms allowed me to see results and quickly create charts with the data and identify clear patterns. All the results from the survey can be found in Appendix C.

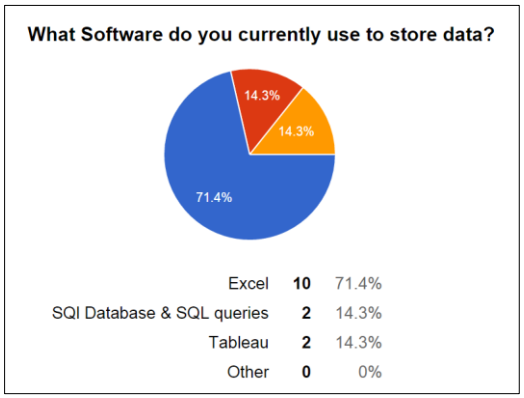
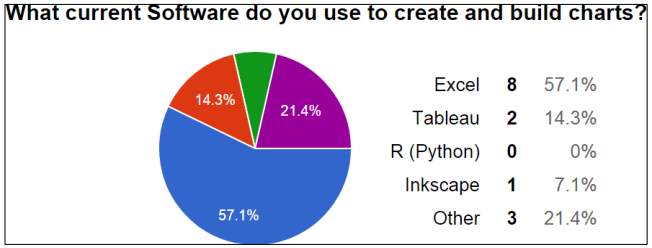


figure 1: Shows the survey results from the survey conducted.

The survey results showed that 71.4% of the participants use Excel software to store the data. This figure matches up to my previous assumption prior to the survey based on the information I gathered from placement. This information helps me clarify that the majority of the potential users will be coming with some experience with using excel.

The next results link into the question as my first uses to store and handle the data is usually the same

software which they use to build the charts with.



The survey results show that 57.1% of the participants use Excel to create and build their charts. Comparing this with the first survey result, this shows that less users are still using the excel software and are using another technology to create the charts. This suggested to me that a possible reason could be that the users are unhappy with the capabilities of excels charting features and are towards other software.

Placement experience: This is beneficial towards the project as my placement job role involved attending various work groups specifically towards Data visualization. Part of the work group was to discuss the current issues with Data visualization within the department in M.O.D. It became clear the biggest issue was the irregularities in the publications as charts were being produced in different software which was recognizable and the quality of the charts varied. It was also apparent that many of the charts did not follow some of the guidelines which are used across Official National Statistic(ONS, 2015).

Due to the nature of the M.O.D it took a considerable amount of time to get in contact with an employee in M.O.D and get the Survey sent. As the survey was sent out at quite short notice I wasn't expecting to get many results back due to various factors.

After expecting to get 20 responses I only received 14 back in the short amount. After doing the survey it was clear to me that I needed to send the survey out for longer in order for people to complete the survey. Although the total amount of responses was quite low it has still provided me with enough information to get a better understanding of whether my project is feasible.

Through the gathered information from the survey and placement experience, it shows that the users are looking for an alternative from the Excel software to build better quality charts. I am able to identify there is a possible gap my application can fill as it can provide a universal platform to people to use and could be the main tool to use after the extracting the data from the excel tables.

Would angular.js be the most suitable framework to create my application as a single page application?

The aim of my project will be to build the app as a single page application. I was previously aware of 2 frameworks, Angular.js and node.js, which are quite similar so it was important for me to investigate and make comparison between them to find out which will be the most appropriate to use for my project. From the research it became apparent that the 2 frameworks were quite different.

"AngularJS is a structural framework for dynamic web apps. It lets you use HTML as your template language

and lets you extend HTML's syntax to express your application's components clearly and succinctly." (AngularJS,2015)

"Node.js is a JavaScript runtime built on Chrome's V8 JavaScript engine. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient." (NodeJs,2015)

Although they both are based on JavaScript frameworks it was clear that NodeJS is a JavaScript Runtime and AngularJS is used to build dynamic web application. Furthermore I Found an interesting comparison chart which identified the difference between AngularJS and node.js (vsChart, 2015). By identifying this early it meant I could spend more time in looking in more detail into Angular.js.

By using angular.js it will allow me to develop a client-side application which will require minimal server-side requests and which will benefit the overall performance of my application.

As the open sourced framework is a popular framework amongst developers it means that there are a lot of resources available to help me when it comes to developing the application.

To learn the basics of Angular.js I will be reading through "Angular.js first application" (tutorial point, 2015) tutorials and creating demos to help me understand the basics and vocabulary until I feel comfortable to implementing it to my project. I will also be following the video tutorials "up and Running with AngularJS" (Lynda.com, 2015) as I find these really useful and easy to follow.

From the research, I feel more confident in being able to build the application in AngularJS knowing there are a lot of resources to follow but also that AngularJS framework can be used to create my single page application.

Within Technical research, what possible methods can I use for the storing of user's data for processing?

For my project to work, the application will require the user to upload there file into the application and then my application will need to store the file to be used throughout the processing and creating of the chart. For the research I decided to look at the possible methods of storing the data.

Through my research(see Appendix A) on storing data, I have looked through the advantages and disadvantage of three methods of storing data I made a decision to store actually store a temporary file server side instead of storing data through HTML5 web storages.

The HTML5 have introduced web storage which is referred to as localstorage and sessionstorage as an alternative to cookie http. The advantage of using web storage is that it's supported across multiple browser which is useful in terms of accessibility from users. Furthermore, web storages can store larger files (Up to 5MB) than cookies which make it more useful and the information is never transferred to the server.

Although Webstorages are better than cookies HTTP for storing larger files my application will involve handling considerably large data file, which means it would not

be suitable to use HTML5 web storages due to the limitations of storing maximum file sizes of 5mb.

I made the decision to store the data as a temporary file because it allows the application to access the file easier to allow it to interpret the data. Although there is a risk to storing files on the server such as overloading the server, because the application will be used internally, it will mean there is a limit of amount of users.

Opportunities after to expand: If there is time at the end of the development stage, it could be possible to integrate a user login system to gain access the application. By incorporating user login systems feature to help reduce the misuse of the application and limit the amount of users having access.

To help me with the accessing and processing of the data file I will be referring to the workshop from the Advanced Web Topics module which involved formatting and restructuring data particularly from a CSV file. This will be useful as it means I will contribute to the project by using what I learnt from other module meaning I can speed up the development stage.

Between SVG and Canvas, which rendering output would the most beneficial to my application?

The aim of my project will be to render the charts with the data loaded onto the screen to allow the user to get a preview of the chart and can allow the user to make on screen edits. Because I want this part of the process to be dynamic I wanted to find out which rendering output will be the most suitable.

I found an interesting article from Craig Buckler (Sitepoint, 2015) which helped to identify the differences between SVG and canvas.

SVG	Canvas
Interactive Graphic(allows change after page loads)	Useful for fixed graphics(cannot be changed after page load)
Vector based (allows scalability)	Pixel Based
Defined in XML	Low-level graphic
	Script-based(requires JavaScript enabled)

Figure 1. Table shows differences between SVG and Canvas.

From the research, I have decided to go with SVG as it is more suitable for interactive graphics. As my application will require the output to be dynamic, to allow the user to make changes, Canvas would not allow the graphic to change after page load. This is important as application will need to allow change to incorporate one of my key features. Furthermore, With SVG being vector based it will allow the output to scale down to smaller browsers and resize.

Conclusion and recommendations

In conclusion to the research carried out, I've feel it has helped to narrow down my target user which is going to be a non-technical user. This is important to identify early as it means that when designing the wireframes and prototyping I focus on designing the application to suit the non-technical users. This will have a big influence on the UI and overall layout of the application. By doing the research it has help to understand how my application will function at the different stages.
For the next stage of the project I will begin developing a list of functional requirements for the application so that I can start to map out the main structure of the application.

I feel my application can provide a solution to creating high quality charts suitable for publications for the M.O.D. Furthermore I feel my application can be the foundation to a platform which can be extended to produce greater range of charts and handle more complicated data.

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Appendixes:

Appendix A- Data Storage Technical Research

Table the results of the data gathered. Strengths and Weaknesses

Web Storage:

Strength	Weaknesses
Supported by the majority of the browsers	Poor performance for large/complex data
Storage Limit >5MB	Poor performance when storing and retrieving large/complex data structures
Doesn't transmit to remote web server	
Implemented natively in web browsers	

(webgranth)

SQL database storage:

Strength	Weaknesses
cross device browser support	Storing multiple sets of users data could overload the server
Store large amounts of data	Security level of allowing the application access to the server database.
Fast response times	

HTTP Cookies:

Strength	Weaknesses
cookies are easy to implement	Data storage limit is around 4kb per cookie

Occupies less memory	Users can delete cookies
Cookies persist a much longer period of time	Increases data traffic
	User browser can block cookies

(Lalit Raghuvanshi, web code expert)

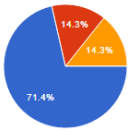
Appendix B: JavaScript Charting Library Comparison

Charts showing the comparison of the charting libraries available to use.

Framework Name	Supported Chart Types								Supported Bar Chart Types				Other Features	Interactivity		Rendering Technologies		
	Line	Timeline	Scatter	Area	Pie	Donut	Bullet	Radar	Stacked	Negative	Discrete	Horizontal	Legends	Mouse Over	onClick	HTML5 Canvas	SVG	VML
amCharts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes[3]	Yes
AnyChart	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
CanvasJS	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[9]	No	No
Chart.js	Yes	No	No	Yes	Yes	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Chart Builder By Livegap	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No[14]	No
Charts 4 PHP	Yes	No	No	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	No
Cytoscape.js	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	No	No
D3.js, formerly Protovis[17][18]	Yes	No	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	No	Yes	No	No	Yes[20]	No

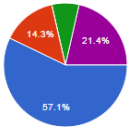
Appendix C: Survey summary of the results gathered in Google Forms

What Software do you currently use to store data?



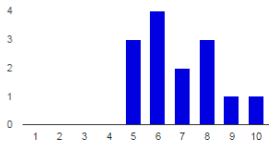
Excel	10	71.4%
SQl Database & SQL queries	2	14.3%
Tableau	2	14.3%
Other	0	0%

What current Software do you use to create and build charts?



Excel	8	57.1%
Tableau	2	14.3%
R (Python)	0	0%
Inkscape	1	7.1%
Other	3	21.4%

How would you rate the current software?



Terrible: 1	0	0%
2	0	0%
3	0	0%
4	0	0%
5	3	21.4%
6	4	28.6%
7	2	14.3%
8	3	21.4%
9	1	7.1%
Superb: 10	1	7.1%

What is good about the current software you use for building charts?

Manipulate the data, create high quality interactive charts. Change the whole design of the chart. Reads in lots of data types. Lots of developer support.
Can create the charts instantly and can also select which columns of data to use in the charts.
Quick & Easy to build
Creates instant charts within the browser. Includes preview of the chart. Lots of choices between chart types. Saves chart as image.
Easy to create instant charts
Quick to publish
Easy and quick to populate charts.

Is there anything which needs improving?

- More choices of colours and styling - Less fiddly
Restricted of design
poor choice of colours Low quality charts produced
-
Hard to work around the charts created in the spreadsheet Plain and boring choices of colour Hard to make edits
Poor quality Hard to manipulate the charts
The quality of the charts is quite outdated, dull.