



# WPI

# Visualizing SGA's Budget

**A Major Qualifying Project**

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**MQP Presentation Video**

**GitHub Repository**

**Hosted Website**

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# 1 Abstract

Worcester Polytechnic Institute provides students with the opportunity to get involved on campus with clubs, organizations, and school-sponsored events. Funding these endeavors is a large-scale operation that the Student Government Association (SGA) is tasked with handling. SGA's budget is comprised of the Student Life Fee, which is paid yearly by each student. Many students are not aware of the purpose of this fee, and due to this, SGA has made financial transparency one of their goals for this fiscal year. With this project, our team aims to use data visualization to bring awareness to the student body about where their portion of the student life fee goes. Students involved in SGA, club executives, students interested in their finances, and even future WPI students alike can all use our site in some way. This is just a start to bringing clarity to the student life fee, and we believe our project will provide a strong foundation to continue increasing transparency and spark important conversations about how students want their money allocated.

## 2 Introduction

Worcester Polytechnic Institute (WPI) provides students with the opportunity to get involved on campus with numerous clubs, organizations, and school-sponsored events. Campus life and community involvement is a huge part of the traditional college experience and something most incoming students are excited to participate in. However, funding these endeavors is a large-scale operation, and at WPI the Student Government Association (SGA) is tasked with handling it. SGA's budget is comprised of the Student Life Fee (SLF), which is paid yearly by each student. The fee, per student, was \$280 in 2019 and has increased to \$316 in 2020. Similarly, the SGA budget during the fiscal year 2019 was approximately \$1.2 million and grew to \$1.4 million in 2020. Each year SGA then allocates this budget through the financial board to fund its 259 clubs, events, initiatives, and services that better students' lives.<sup>1</sup>

Unfortunately, many students are not aware of the purpose of this fee. While most have heard of it before and some are aware that they pay it, they have no idea where that money goes or how it benefits their personal experience at WPI. Furthermore, looking at our student surveying data in Figure 1 we found that although 62% of students know that the SLF falls between \$100-\$400 only 37% of students know what range the yearly SGA budget falls in.

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<sup>1</sup> <https://wp.wpi.edu/sga/student-life-fee/>

What do you think SGA's yearly estimated budget is:

89 responses

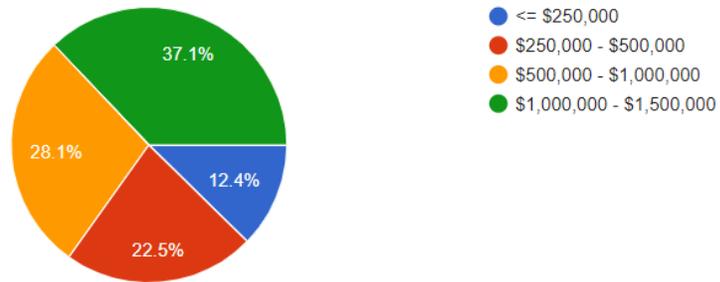


Figure 1: SGA Budget Understanding

Additionally, we asked whether or not students know the resources that are available to them to learn more about SGA financials. This data in Figure 2 shows us that most people have no idea how to access this information and with our follow up questions we found that 97% would be interested in having a more easily accessible way of seeing an SLF breakdown.

Do you know the resources available to WPI students to see where your Student Life Fee goes?

89 responses

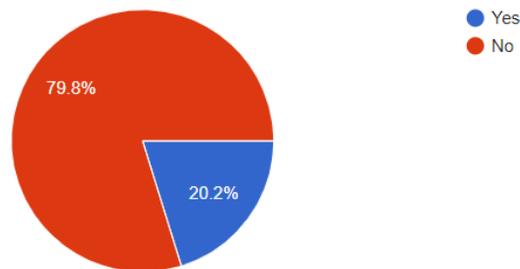


Figure 2: SLF Resources

Due to this lack of knowledge and resources, SGA made financial transparency one of their overarching goals for the fiscal year of 2020. Our team aims to fulfill that goal by spreading

understanding of the Student Life Fee and giving students further insight into how their money is distributed. We specifically hope to do this through the use of an informative website narrating the story of the SLF and visualizing the budget data in an easily understandable way.

To achieve this goal, we had two main objective phases as a team: preparation and action. During the first term, our objective was preparation. We gained an understanding of SGA's data and manipulated it into formats that we could use, researched best data visualization practices, assessed current student knowledge of the SLF, and finally created design mockups. For the remainder of the project timeline, our objective was to put our preparation into action. We did this by developing a working website, creating interactive data visualizations, and finally assessing the effectiveness of what we had created. Our biggest deliverable is our website which is accessible to the entire student body and will provide every student with detailed budget information. It shows a breakdown of how each student's fee is utilized, changes overtime in SGA financials, and allows people to make direct comparisons between their club involvements.

We designed our website to be scalable, robust, and accessible to the entire student body. Students involved in SGA, club executives, students vaguely interested in their finances, and even future WPI students alike can all use the site in some way. It will alleviate any concerns about SGA and mismanagement of the SLF by communicating financial data through detailed, intuitive visualizations. Constructive conversations about the allocation of the SLF will provide feedback for SGA that they can use to accurately cater to the current needs of the student body. This is just the beginning of bringing clarity to the SLF, and we believe our project will provide a strong foundation to continue increasing fiscal transparency and will spark important conversations about how students want their money allocated, allowing students to make the

most out of their time here at WPI. In summary, our team performed comprehensive background research about the Student Life Fee and the current perception of it, created a fully functioning website (Figure 3 Part of Website Homepage) that can be found at <http://sgaviz.cs.wpi.edu/>, designed interactive visuals that users can use to personalize their experience on the site, and finally assessed the effectiveness of the site while also making recommendations for the future of this project.

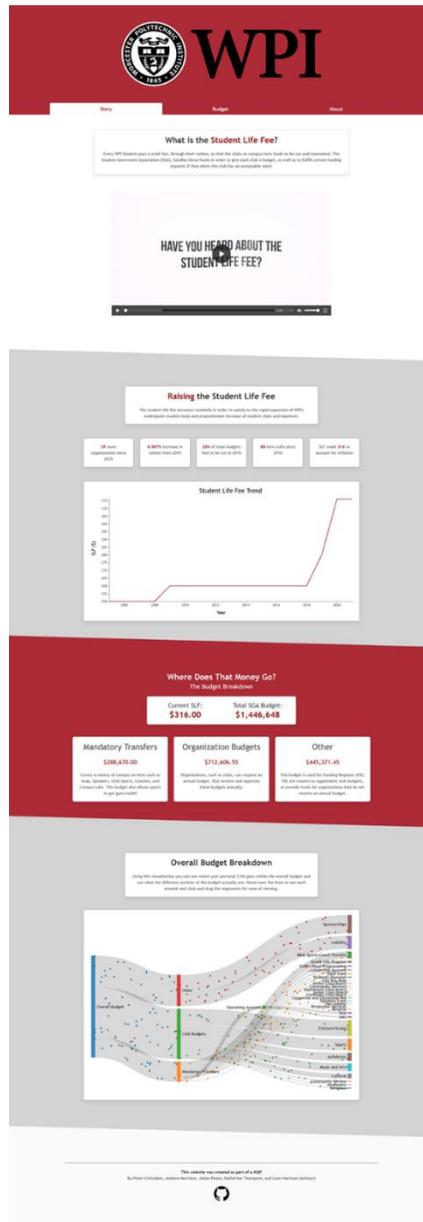


Figure 3 Part of Website Homepage

### 3 SGA Background and Data Visualization Overview

All of SGA's data is recorded in their MySQL financial database. It covers mandatory transfers, club budgets, and funding requests. To effectively visualize this data, it is essential to first understand SGA's storage procedures as well as their terminology. Additionally, established strategies in data science for creating compelling visualizations must be utilized. Research in these areas helped to ensure that our graphics had an impact.

#### 3.1 Overview of the SGA Budget<sup>2</sup>

The student life fee (SLF) for the fiscal year of 2020 totaled to \$316 per student, putting WPI's SLF at the lower end of the spectrum, compared to other schools around the area. Figure 4 shows that WPI would place between MIT and Holy Cross for FY 2020's SLF.

SGA's budget can be broken down into 3 sections: Mandatory Transfers, Organization Budgets, and Sponsorship & Rollbacks. Out of the approximate budget of \$1.4 Million for FY 2020, Mandatory Transfers makes up 19.5% of this budget, Sponsorship & Rollbacks is 28.5%, and Organization Budgets is the largest portion at 52%.

Other Schools' SLF	
MIT:	\$312
Holy Cross:	\$330
RPI:	\$347
Clark University:	\$350
Northeastern:	\$398

Figure 4: Surrounding Schools' SLF

<sup>2</sup> (Student-Life-Fee-1xurjkm.jpg (1441×1920), n.d.)

*Mandatory Transfers* is a term used to describe all on-campus student services such as Student Night Assistance Patrol (SNAP) and salaries for club sports coaches. Figure 5 shows a more detailed description of services within *Mandatory Transfers*.

The *Organization Budgets* category is for non-student services and is broken down into three classes. Class one is reserved for organizations that partake in student hobbies and any form of community service or community outreach. Class two represents all club sports, and class three is the remainder of programs and services. Figure 7 shows more descriptions of each class as well as their percentage of budgeted funds.

Lastly, *Sponsorship & Rollbacks* consists of the remainder of the SLF and is used to rollback any money from clubs that was not spent the previous fiscal year. One use for this money is funding requests where clubs or organizations that do not receive an annual budget can petition the Financial Board for supplemental funds. See Figure 6 for more information.



Figure 5: Mandatory Transfers

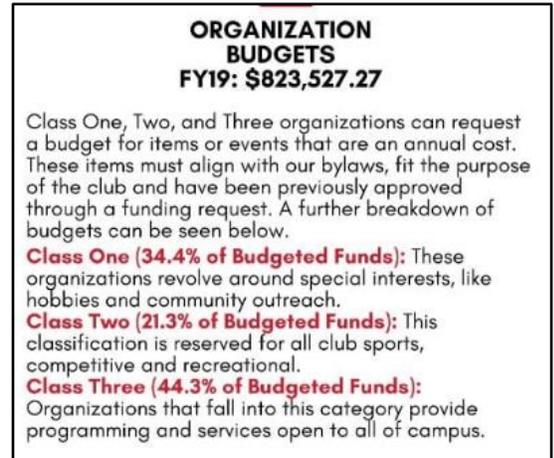


Figure 7: Organization Budgets



Figure 6: Sponsorship & Rollbacks

### 3.1.1 Accessing & Understanding SGA Data



Figure 8: SGA Access File UI

Currently, SGA keeps track of its budget through a Microsoft Access database file, which contains data from FY 2018 up to the present. Upon launching the database, the user is greeted with a User Interface to easily add any data about club portfolios, budget input, and funding request input.

Figure 8 shows a screenshot of what this interface looks like. At the moment, to add any data for upcoming fiscal years an SGA member must use that Microsoft Access user interface and save the file.

This Access Database has a variety of tables that holds data about the members, comments, descriptions, and funding for every organization. Every club requests a certain amount of money each year for events and supplies. It is up to SGA to either approve, deny or counter the funding request. Each organization is given a class (depending on the type of organization) and a grade. The grade follows WPI's grading scale which ranges from A to NR. At the end of every year, a grade is given to each club depending on how close the amount of money they spent was to their approved amount. Each grade level has a certain threshold for going over or under budget. For example, if a club is given \$500 for supplies and they only spend \$300, they will receive a similar grade as if they spent \$700.

While Microsoft Access is a useful tool for easily storing data locally, using a database server would add versatility to accessing and potentially visualizing the data and depending on the type of database, would provide greater concurrency seeing as Access only supports

concurrency up to 255 users. Keeping these things in mind at the beginning of the 2019-2020 school year SGA decided to make the switch to a MySQL database. This database requires credentials for someone to access it and can only be accessed on WPI Wi-Fi or by using a VPN. The MySQL data can be viewed using MySQL Workbench and it has information about the SLF dating back to 2005 and club budget data dating back to 2016. This switch to MySQL has allowed for more accessibility to the data and has opened the doors for projects like ours to be possible.

### 3.1.2 The Goal of Financial Transparency

SGA started FY 2019 with a pledge to increase financial transparency. They want students to understand how they use and allocate the money they are given. This will hopefully increase cooperation and incentivize students to participate more in the organizations they are paying for. One way they would like to increase financial transparency in particular is by adding to their website where they already have a section dedicated to this goal. Right now, they only show static data and a static infographic, but they are looking to also add a narrative visualization component to their website. This component would show an overall breakdown of the individual student life fee as well as other metrics to help tell a story about each club and their budget and show students how they can make the most of their SLF.

## 3.2 Data Visualization and Information Conveyance

Data visualization is a graphical representation of information and data. It uses visual elements like graphs and charts to show users interesting trends and patterns in data. It provides a means through which creators can creatively convey information to their audience. There are

many different types of data visualizations, depending on the size of the audience and information being shared. One popular category of data visualization is storytelling, in which data is being visualized not to solely analyze, but also to explain a point of view through a story. Storytelling is a key component in data visualization because it offers, “an incredibly popular way of conserving data and passing it on, stories also provide the connective tissue between facts that make them memorable.”<sup>3</sup> Our project focuses particularly on one branch under storytelling, self-running presentations, or narrative visualizations, whose main purpose is to transfer some variation of insight from the author to the audience. This section will briefly overview the concept of storytelling, dive into the three main ingredients that make up a narrative visualization, and finally show some example visualizations with descriptions.

### 3.2.1 General Visualization Techniques<sup>4</sup>

Before starting to develop a visualization there are a few key factors that should be considered. The first factor to consider is the audience of the visualizations. In our case, we are focused on WPI students and faculty. We can use this information to make informed design decisions. For example, we know that they have at least college-level education is most likely a STEM-related field, so we can give the user more freedom to explore the data on their own. The next key factor is the content is the data being visualized. The visualization technique should match the type of data available. For instance, a budget visualization for one school would not work well as a choropleth or two numerical attributes would often best be shown by a scatterplot.

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<sup>3</sup> (Kosara & MacKinlay, *Storytelling: The next step for visualization*, 2013), 1

<sup>4</sup> (Munzner, 2014)

Finally, the last factor is the purpose of the visualization which can greatly affect the design process. The purpose of our website is to allow students to explore SGA's budget, so we provided a lot of interactivity in our visualizations allowing for self-guided discovery.<sup>5</sup>

Visualizations are made of marks and channels. Marks are geometric primitives such as points or lines that represent data points. Channels are appearance modifications on marks that show information about the point. Color, size, and position are all examples of common channels. In a scatterplot, the points are marks and each point's position is a channel to display numerical information. However, not all marks and channels are equally effective. Deciding which to use for which purpose affects how the visual is interpreted.

There are two main principles to consider when sculpting a visualization. They are expressiveness and effectiveness. The expressiveness principle states that attributes of data

should be expressed entirely and only. Nonexistent data should not be suggested by the visual encoding. For example, unordered data should not be given channels that suggest an order. The effectiveness principle states that the importance of an

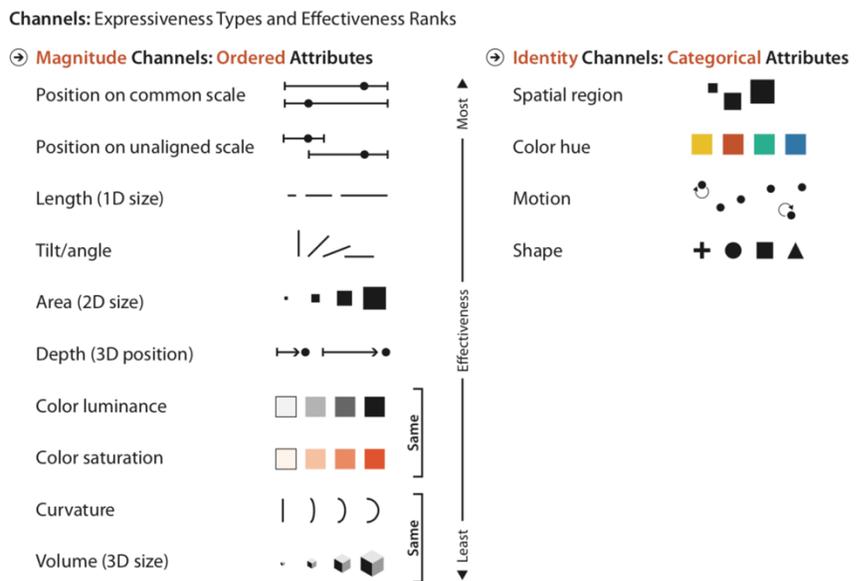


Figure 9: Channel Salience Order

<sup>5</sup> (Digitium, 2018)

attribute should be reflected by the salience of the channel. Paying attention to these principles ensures that visualizations are intuitive and interpreted correctly and are something that we kept in mind throughout our design process.

As effectiveness suggests, channels have different levels of salience. So, which channels are the strongest? Figure 9 ranks them from strongest to weakest. The left side of the image is for numerical attributes, which are best represented by position, length, and size. The right side is for

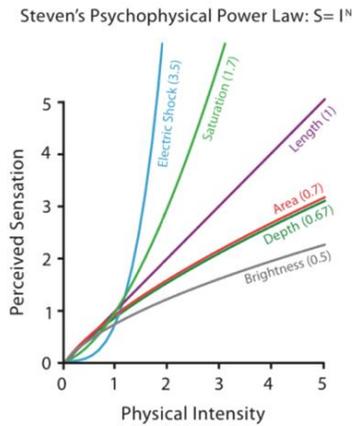


Figure 10: Channel Intensity

categorical attributes where special region and color are the strongest. Channels for displaying data are not always perfectly accurate, as they can easily be overestimated or underestimated by the user. Figure 10 maps physical intensity to perceived sensation. Length is the only channel that maps intensity to sensation exactly. Electric shock is overestimated, while brightness is greatly underestimated.

There are several other properties to take into consideration when making an effective visualization such as separability and pop out. The ones outlined in this section are the most important to our project, as we want to convey all information and allow students to draw their own conclusions. By understanding these principles, we can develop useful and compelling visuals to teach about SGA's financial data.

### 3.2.2 Storytelling through Visualizations

Storytelling was created for three main styles of presentation – small group presentations, live presentations, and self-running presentations for a large audience. Small group presentations typically involve more interaction between the presenter and the audience and the overall presentation. Due to the smaller and more personal environment, the presentation takes a less conventional form and becomes more of a vehicle not only for dissemination of information but also for collecting and considering additional knowledge.<sup>6</sup> Live presentations, on the other hand, involve a larger audience where interaction is typically limited to questions. In this case, the presenter can pause the story he or she is trying to tell and interact with the audience in response to questions. Lastly, self-running presentations are part of an environment unique from its storytelling counterparts: A presentation is created once and then viewed by multiple people independently. These presentations will most likely be self-running film clips or interactive visuals that require the user to do some clicking. Since this style of presentation is more self-guided, a big concern is how to engage viewers and create memories associated with the presentation. These self-running interactive visuals, or narrative visualizations, are the basis of our SGA Budget Visualization project.

Figure 11 shows a Gapminder<sup>7</sup> presentation, a type of presentation that is animated, clickable, and uses many forms of metric visuals to show transitions over time. The use of aesthetic animated visuals draws in an audience and increases the likelihood of them clicking

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<sup>6</sup> (Kosara & MacKinlay, *Storytelling: The next step for visualization*, 2013), 3

<sup>7</sup> (Gapminder, n.d.)

through the entirety of the animation. One technique used by Gapminder is the gradual buildup of information to keep the audience from losing track. Using a unique color for each region also aids in not only simplifying but also unifying the stacked area chart, scatterplot, and bubble chart.<sup>8</sup>

### 3.2.2.1 The Narrative Visualization

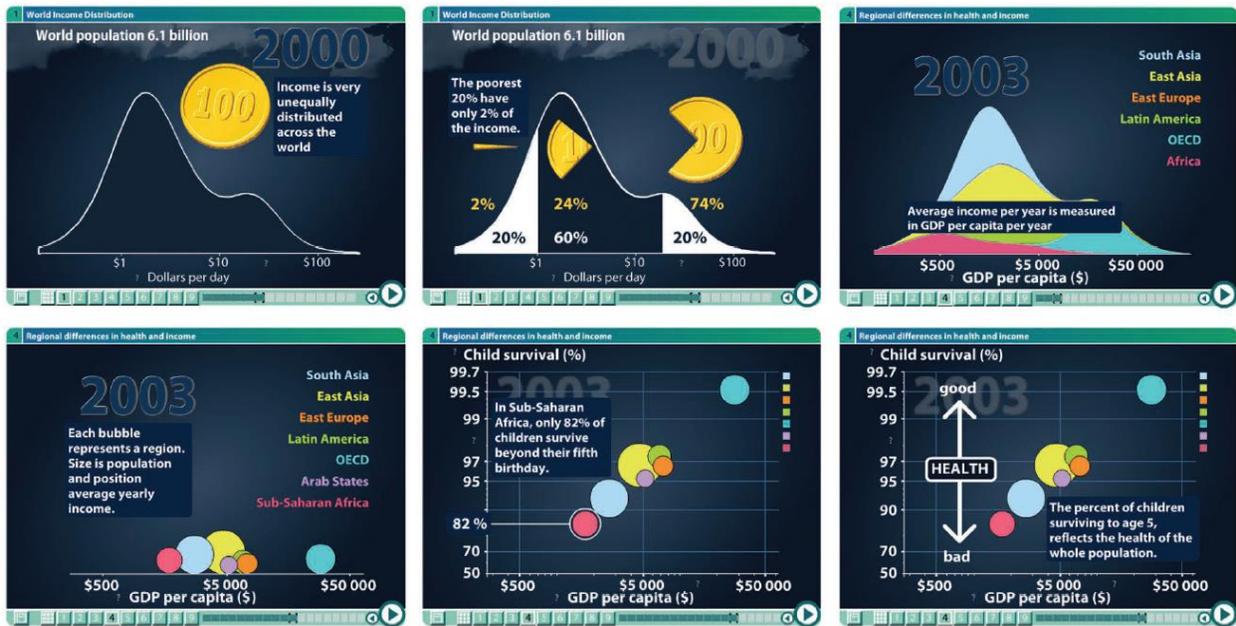


Figure 11: Gapminder

Narrative visualizations can be described as a style of visualization that explores the interplay between aspects of both explorative and communicative visualizations. “They rely on a combination of persuasive, rhetorical techniques to convey an intended story to users as well as exploratory, dialectic strategies aimed at providing the user with control over the insights they gain from the interaction.”<sup>9</sup> Essentially, by using a wide array of visual techniques, narrative

<sup>8</sup> (Kosara & MacKinlay, *Storytelling: The next step for visualization*, 2013), 4

<sup>9</sup> (Hullman & Diakopoulos, *Visualization rhetoric: Framing effects in narrative visualization*, 2011), 1

visualizations are used to guide the reader’s eye through the scene in a sequential matter. This will in-turn help the author pass down to the audience insight, or a discovery, that they uncovered through extensive research and data analysis. This section is the backbone of our MQP, and we will breakdown the narrative visualization into three categories – genres, narrative structure, and narrative techniques and explain what qualities make up the ideal narrative visualization.

3.2.2.2 Narrative Genres

There are 7 basic genres of narrative visualization as shown in **Error! Reference source not found.** They include annotated chart, partitioned poster, flow chart, comic strip, slide show, and

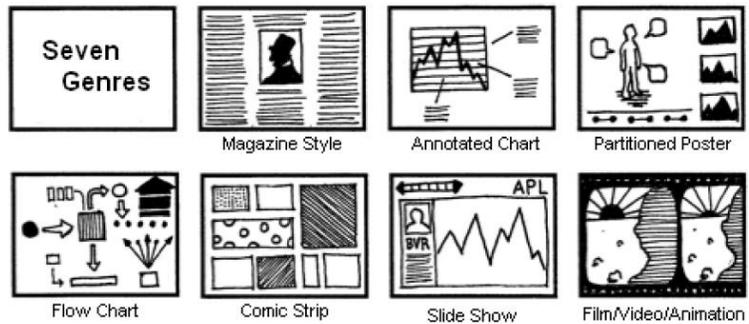


Figure 12: Genres of Narrative Visualization

film/video/animation. The factors that differentiate these genres include the numbering of frames and the ordering of their visual elements. Each of these genres is used to tell a story and the best

<b>Author-Driven</b>	<b>Reader-Driven</b>
Linear ordering of scenes	No prescribed ordering
Heavy messaging	No messaging
No interactivity	Free interactivity

Table 1: Properties of Author-Driven and Reader-Driven Stories

genre to use depends on the type of data, the complexity of the data, and the audience.<sup>10</sup> For

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<sup>10</sup> (Segel & Heer), 8

example, a science project is more likely to use an annotated chart to portray data over a comic strip. These genres can also overlap depending on the circumstance. When it comes to creating effective narrative visualizations, choosing the appropriate genre is a necessary start.

After choosing the proper genre(s) for a narrative visualization, an author must next choose the proper approach for presenting the data. A balance needs to be found between the author-driven and reader-driven ends of the spectrum (see Table 1). Strictly taking an author-driven approach will guide the reader entirely through the visualization with no interactivity and no need for exploring the visual. This can be an effective approach for certain circumstances, such as educational videos or business presentations, as it efficiently communicates the goals of the author. A purely reader-driven approach is highly reliant on interactivity and exploring the visual(s), with a limitation on ordering the data or guiding the reader in any way. This is most effective when the reader needs to do data exploration and make conclusions. It is often used in business dashboards and pattern discoveries. Narrative visualizations have historically fallen somewhere in between these two extremes due to the nature of the visualization. Authors typically have an insight that they would like to express to the reader, but they want to gently guide the reader through an interactive visualization to share the experience of realization. After determining the genre(s) and approach that should be taken for a particular narrative, the next category to consider is the structure of the visualization.

### 3.2.2.3 Narrative Structure

In visual media, most visualizations have a clear starting point. Often it is an overview of the story and it also may direct the reader's attention to the various points of interest.<sup>11</sup> Four main editorial layers make up the structure of every visualization: data, visual representation, annotations, and interactivity. These layers will be crucial to creating the most effective visualization once a proper genre is appointed.

In the data layer, the creator makes choices about the data source to represent, including what data should be omitted. Omittance is an important aspect of visualizations because it can help smooth out datasets by removing outliers, scaling data, or aggregating values to show stronger emphasis in a certain area of the dataset. After all, a key component in narrative visualizations helping to subtly guide the reader towards what the author wants them to see. Looking at our project specifically, we received a huge amount of data from SGA and had to take the time to understand it all so we could choose what we wanted and did not want to show.

In the visual representation layer, we see how the dataset transforms into the front-end visualization. This layer holds the creative and aesthetic portion of the narrative but is limited to human perception abilities. For example, showing a pie chart with different shades of gray as the colors may be difficult to distinguish and will be detrimental to the visualization as a whole.

All titles and descriptions of a visualization will be found in the annotations layer. This layer plays a key role in clearly directing the user's attention to a specific aspect of the visual. It

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<sup>11</sup> (Segel & Heer), 2

also can add some explanation for visuals that might not be immediately understandable. Here is where titles, reader comments, and suggestions will be added or omitted.

Lastly, the interactivity layer is where the user will have the ability to play around with the dataset and perhaps even be subtly pushed to view certain subsets of data. This layer plays a crucial role in gently guiding the reader to certain insights. It also serves as a way to engage the reader making them stay on a site longer and extract more information out of the dataset.

#### *3.2.2.4 Narrative Techniques*

This section will discuss the five main narrative techniques or rhetoric that should be considered when creating a narrative visualization: information access, provenance, mapping, linguistic, and procedural. Once a genre is chosen and a structure is outlined, the next logical step is to start constructing the back-end dataset and front-end visual(s).

The first rhetorical technique is information access. This technique falls under the data layer and involves the creator deciding what data to represent. Here is where the omission of data will be found as well as metonymy, a technique that is used to average, cluster, bin, or aggregate data to help focus the audience on a certain area of data. Using a MySQL database like the one that SGA provided this could include creating views and queries that amass all of the information needed from various tables.

The next technique is provenance rhetoric, which helps establish the credibility of the author. This can be done through citing data sources or additional references, noting exceptions to help eliminate bias, labeling any uncertainty, and identifying the visualization's designer. This

is especially important rhetoric to follow because a visualization needs to be not only clear and concise but also accurate and credible.

The third technique is mapping rhetoric, which is the manipulation of information presentation from data to visual. There are several ways to accomplish this, the first of which is obscuring which comes from introducing noise into a representation. For example, an author might make elements of a visual very small or very big to emphasize a point or a bias. Using redundant or similar data can also help reinforce this. Another way to help manipulate the presented data is through contrast, which can add layers of perspective on an issue that has not already been clearly stated or portrayed. Lastly, grouping data by size, position, or color can help point the reader towards certain subsets of data and help them mentally group data.

Found in the annotations layer, linguistic-based rhetoric is another important visual technique. Here, an author can use typographic emphasis such as font bolding or italicizing to enhance certain importance. The use of irony is also encouraged as it helps engage the reader but uses the question to imply its inverse. Since most people appreciate irony and respond well to juxtaposition, it can be used to the author's advantage by drawing attention and causing the audience to think about a statement's implications. Lastly, individualization can be used here to directly address or appeal to the user as an individual to make them feel more connected to the narrative, and thus more likely to support it. One way to do this in our case is to appeal to the individual student viewing our page by referencing their personal \$316 SLF.

The last rhetorical strategy, found under the interactivity layer, is procedural rhetoric, or a feature(s) to show the user how to interact with the visual and understand its purpose. Here an author can anchor certain animations or suggestions to the visual to help guide the audience.

Employing a way to filter out data can also help the user drill down and focus on certain datasets. By using all of these rhetorical techniques properly, an artist can create an effective and appreciated narrative visualization that appeals directly to their intended audience.

### *3.2.2.5 Understanding Narrative Visualization Codes*

There are certain cultural, perceptual, cognitive, and psychological lenses that guide a user's interpretation of a particular representation. These codes are cultural, individual-level, textual, perceptual, and aesthetic. Failure to follow these principles can turn even the best thought out narrative visualization into a misunderstood failure:

1. Cultural codes can be best described as social norms and wider beliefs of a culture that a designer can target to suggest a particular interpretation.
2. Individual Level codes differ from person to person but evoke an emotional response. This can either be avoided to prevent backlash or strategically integrated to evoke a response favoring the visual.
3. Perceptual codes involve human visual perception tendencies, like common fate and closure.
4. Textual codes deal with the subtle placement of text within a presentation such as placing a title at the top center or top left of a presentation.
5. Aesthetic codes involve the style of the presentation and help the user determine the quality of the visualization. For example, contrasting colors and minimalist techniques can make a visualization more attractive and more desirable to explore.

### 3.2.3 Visualization Validation<sup>12</sup>

Data has very specific needs to be properly visualized. Most ways to visualize a data point will be inefficient or entirely wrong, which is why an informed designer is required to create a working visualization. Afterward, it is important that a validation process is used to prove the correct techniques were used. We can use this to show that students will learn from our website and find flaws for future iterations.

The validation process described by Munzner provides both high-level and low-level validation.

Figure 13 shows the four levels described here. At the highest level is domain validation. This is affirming the

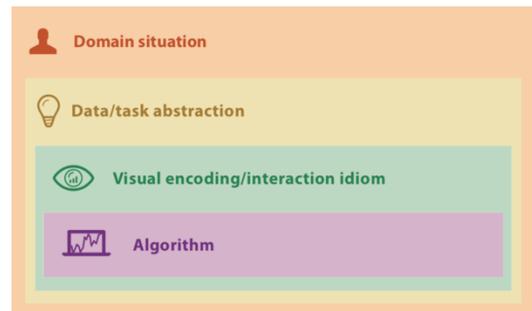


Figure 13: Levels of Validation

speculated problem needs to be solved. At this step, Munzner suggests surveys, interviews, and observing users in real-world settings. Abstraction validation is checking if the visualization solves the problem. The process suggested here is to observe the users while using the system and document how their behavior changes. The next level is idiom validation. This is ensuring that the chosen idioms are the most effective at expressing the given data. Research on visualization practices and expert reviews are ways to validate this step. The last level is algorithm validation. This is proving that memory usage and performance are agreeable. This is verified by analyzing algorithm complexity, performance, and memory requirements. For our project's purposes, this is not a primary concern since we are working with a relatively small dataset.

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<sup>12</sup> (Munzner, 2014)

### 3.3 Popular Visualizations with Descriptions

This section will give a brief overview of several popular visualizations that we hope to incorporate into our site and will describe the purpose and use cases of each.

#### 3.3.1 Sankey Diagram<sup>13</sup>

The Sankey Diagram is a type of visualization that is most effective when showing flows or break downs. Figure 14 shows an example of a Sankey with data taken from “Estimates of Global Bilateral Migration Flows by Gender between 1960 and 2015”<sup>14</sup>, an article that explains migration patterns from the nineteen sixties until five years ago. The data points are color-coded by region and show migration patterns from left to right. This Sankey diagram supports interactivity, which highlights the country of interest upon

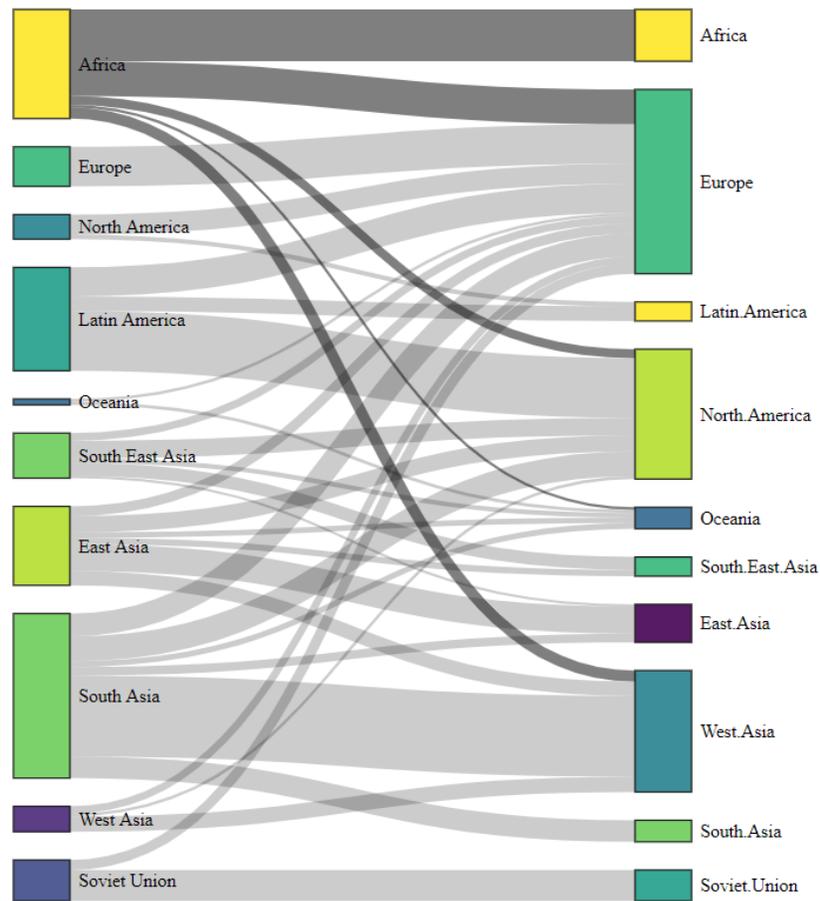


Figure 14: Migration Patterns Sankey Diagram

mouseover. In this case, Africa is the country of interest. From looking carefully, we can see that slightly less than half the population of Africa stayed, while the rest migrated to Europe, North

<sup>13</sup> (Sankey diagram – from Data to Viz, n.d.)

<sup>14</sup> (Abel, 2017)

America, Oceania, and West Asia. This type of visualization is very engaging, as the mouse-over animation is fun, and the slight bolded color makes it easier to trace all of the migrations. A visualization like this could potentially fit well with SGA’s data, as it would show the flow from the original budget, to the three budgeting categories, and subcategories of clubs.

### 3.3.2 Sunburst Diagram<sup>15</sup>



Figure 15: Professional State Evolution Sunburst Drilldown

Sunburst diagrams are known for representing the hierarchical structure of data. They are made up of several layers of rings, with inner rings representing higher-level data, and outer rings representing lower levels. Figure 15 shows an example sunburst of the professional state evolution of a set of people. While this type of visual is

very aesthetically

pleasing, it may also not be the easiest to read and understand. Due to the nature of the size, labels and other textual help are difficult to produce, so the majority of the visual relies on interactivity.

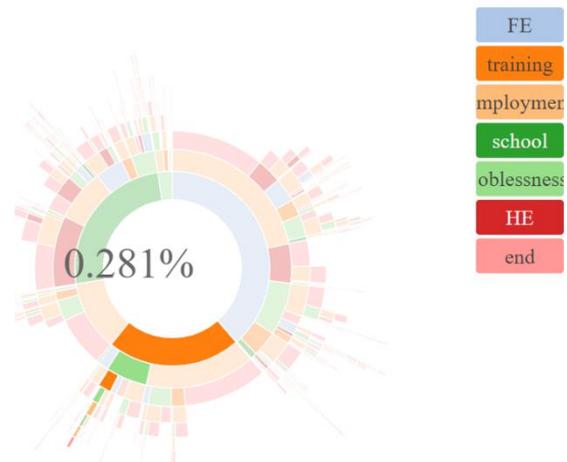


Figure 16: Professional State Evolution Sunburst

Figure 16 shows what this sunburst looks like

with a mouseover down to the deepest level of a subset of the data. This type of visual can be used to represent SGA’s data because, like the Sankey Diagram, this represents flows and levels

<sup>15</sup> (Sunburst – from Data to Viz, n.d.)

of data from large categories to smaller subcategories. A major challenge, however, will be finding a way to make the amount of data we have readable on this scale.

### 3.3.3 Radar Chart

The Radar Chart is a two-dimensional plot that displays “one or more series of values over multiple quantitative variables. Each variable has an axis, all axes are joined in the center of the figure.”<sup>16</sup> A polygon is superimposed over these axes. Each of its vertices lay on an axis to mark the variable’s value.

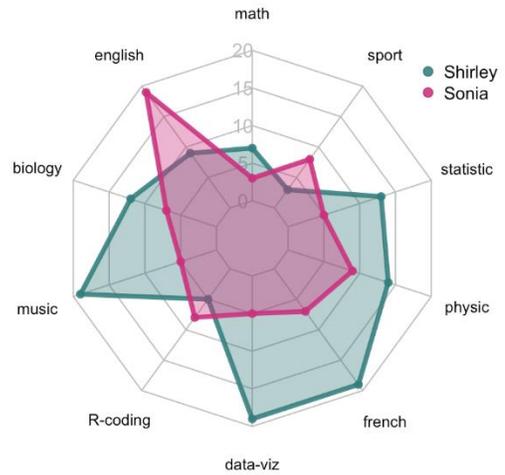


Figure 17: Grade Evaluation Radar Chart

This type of visualization helps display many values at once, and it prevents clutter better than commonly used alternatives. Polygons can be overlapped on the same chart to compare multiple objects at once and show direct comparisons, though sometimes more than two polygons can quickly get confusing. This can be utilized to make object commonality and differences especially noticeable.<sup>17</sup> Figure 17 shows a comparison between two students’ grades, and one can quickly see that Sonia has better English, sport, and R-coding grades while Shirley outpaces her everywhere else. The disadvantages of this chart include difficulty comparing individual lengths due to the circular layout of the chart. For example, it is difficult to tell just

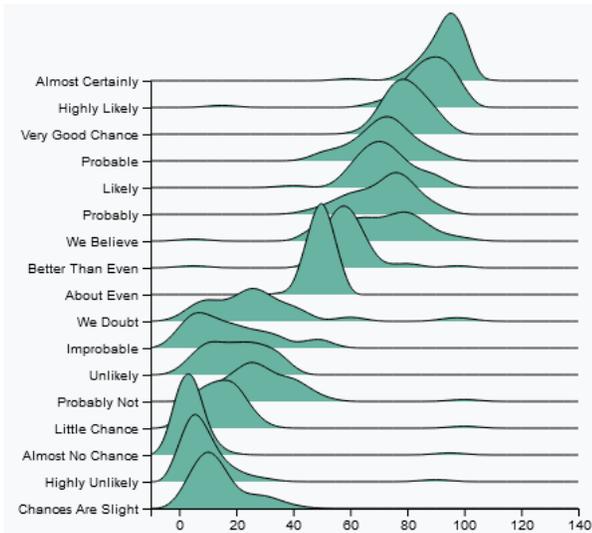
<sup>16</sup> (Holtz, The Radar Chart and its Caveats)

<sup>17</sup> (What is Radar (Spider/Web/Polar Bar) Chart?)

how much higher Sonia’s English grade is than Shirley’s. Additionally, this chart may yield an “over-evaluation of differences”<sup>18</sup> since larger values produce a disproportionately large polygon.

### 3.3.4 Ridge Chart

The Ridge Chart goes by many names including Ridgeline Chart and Joy Plot as well. The original name of Joy Plot came about when data visualization designer, Henrik Lindberg wanted to plot the peak time of day for people partaking in various sporting and leisure activities. He designed this plot to act as a series of data presented by a cross between a histogram, density plot, and time series to show peak times when people were doing these activities.<sup>19</sup> Eventually,



the name was changed to Ridge/Ridgeline charts after realizing that the inspiration for the name joy plot had a dark meaning.<sup>20</sup> The ridge chart can show more than just time along the x-axis, Figure 18 shows a chart closer to what an SGA visualization would look like. Having each ridge be a different club category, with the x-axis acting as

Figure 18: Ridgeline chart example in D3 (Holtz, Basic ridgeline plot in d3.js, 2019)

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<sup>18</sup> (Holtz, The Radar Chart and its Caveats)

<sup>19</sup> (Kosara, Joy Plots, 2017)

<sup>20</sup> (Wilke, 2017)

the active member population for clubs in that category.

### 3.3.5 Lollipop Chart

The lollipop chart can best be described as a bar chart with additional styling and functionality, used to describe categorical data. Some of the elements of this chart used to convey information are the length of the bar, color of the lollipop, the size of the lollipop node, and the design of the lollipop icon. All these elements can be used to represent a measurement of data. Figure 19,

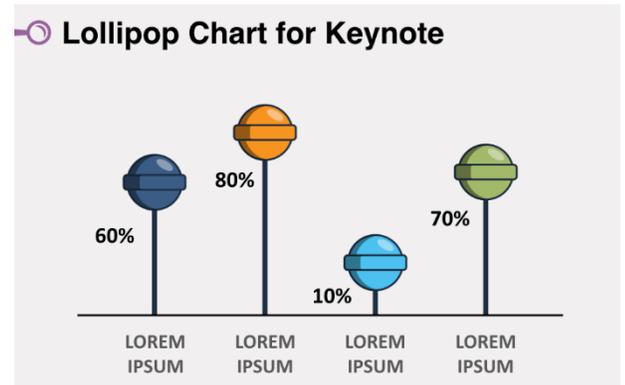


Figure 19: Sample Lollipop Chart

taken from the *Tableau Playbook*<sup>21</sup>, shows what a lollipop chart can look like, highlighting differences in color and height to represent different types of categorical data.

A lollipop chart could be a useful visualization to represent SGA's data by showing the budget for each club. You could also color code the lollipop head to its corresponding club category or change the size of each lollipop head based on how many members are in each club.

## 3.4 Case Studies

In our background research, we sought out several other similar projects looking for both successful and unsuccessful budget data visualizations as well as general storytelling

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<sup>21</sup> (Recnac, 2019)

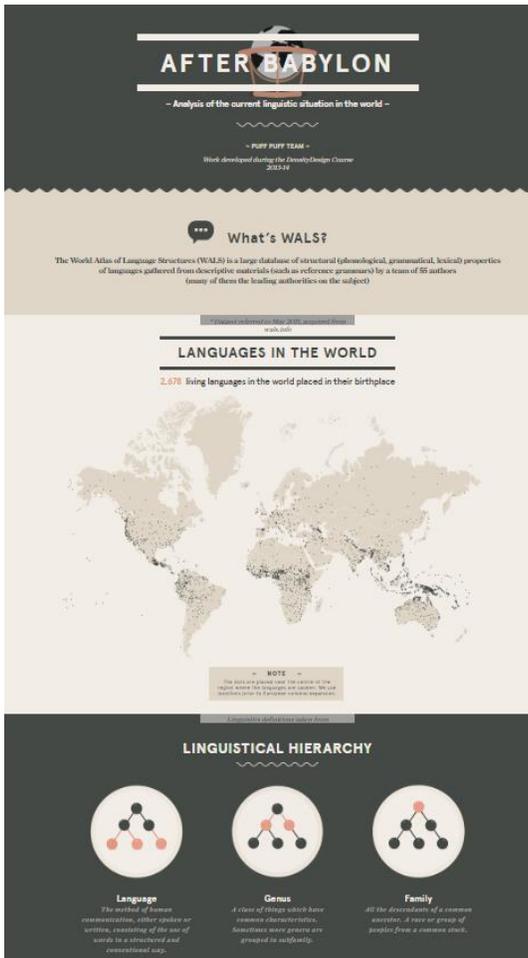


Figure 20: After Babylon Homepage

visualizations. One of the first ones that we found particularly successful was called After Babylon and was a look at the current linguistic situation around the world<sup>22</sup>.

Some parts of this visualization and site that we liked included clear data presentation and intuitive design. There was a consistent color scheme and design plus the different colored sections provided a breakup of the overall page in indicated to the readers how parts of the site should be grouped. Additionally, there was a good mix of interactive and static visualizations broken up by animated pieces and areas of explanation of the data.

Next, we found an article titled “What’s really warm world” showing through data visualization how different factors have affected climate change and global warming<sup>23</sup>.

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<sup>22</sup> (Team, n.d.)

<sup>23</sup> (Roston, 2015)

### Compare and Contrast

Putting the possible natural and human causes of climate change alongside one another makes the dominant role of greenhouse gases even more plainly visible. The only real question is: What are we going to do about it?

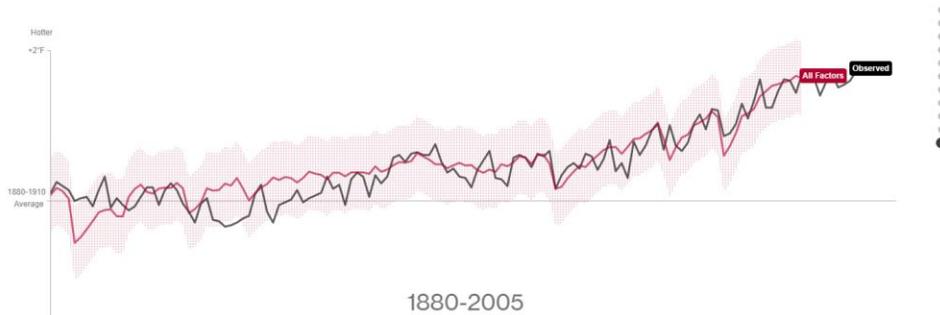


Figure 21: Climate Change Scrollytelling

This site includes one static graph whose contents change over time as you scroll through the site and more of the overall story is revealed. Seen in Figure 21, the scrolly telling is well done, interactive, and easy to comprehend. We liked that there were explanations for each section and that the visualization was mostly user-driven. Most importantly though the data, while could be controversial, is presented in an unbiased way and it leads the user to form an opinion rather than pushing it at the user the minute they visit the site. This is something that we took note of because our data is financial data that could potentially be controversial and we as the creators hope to present it and let users from there form their own opinion. Finally, another visualization that we viewed was one regarding carbon emissions in the past present and future and was created by Kiln.it<sup>24</sup>. As a group, we liked this visual a lot and it heavily influenced our early design mockups.

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<sup>24</sup> (Kiln.it, 2014)



Figure 22: Climate Change: Artistic Rendition

Shown in Figure 22, this visualization was more artistic than any we had seen before, showing carbon emissions through dots that grow and float into the sky as they are produced. It also was able to visualize a lot of country data in a bar chart race type of way. Even though a lot of country data was represented the visualization did not feel cramped at all and it was still quite readable, which made us realize that we would need to accomplish something similar given the sheer quantity of data that we were trying to show. We liked the interactivity of the toggling tabs showing different sets of data, and we also felt that the animations added a ton to the overall visualization. The idea of this animation, as I mentioned before, influenced early design ideas and while some of the animations were beyond our skill set we still tried to bring the idea of presenting serious/boring data in a fun and engaging way. In the process of finding successful visualizations and sites, we also came across many visualizations that we found ineffective and similarly learned things that we wanted to avoid in our site. One example of this was an NFL

data visualization done by FiveThirtyEight that showed the strength of an NFL franchise over time<sup>25</sup>.

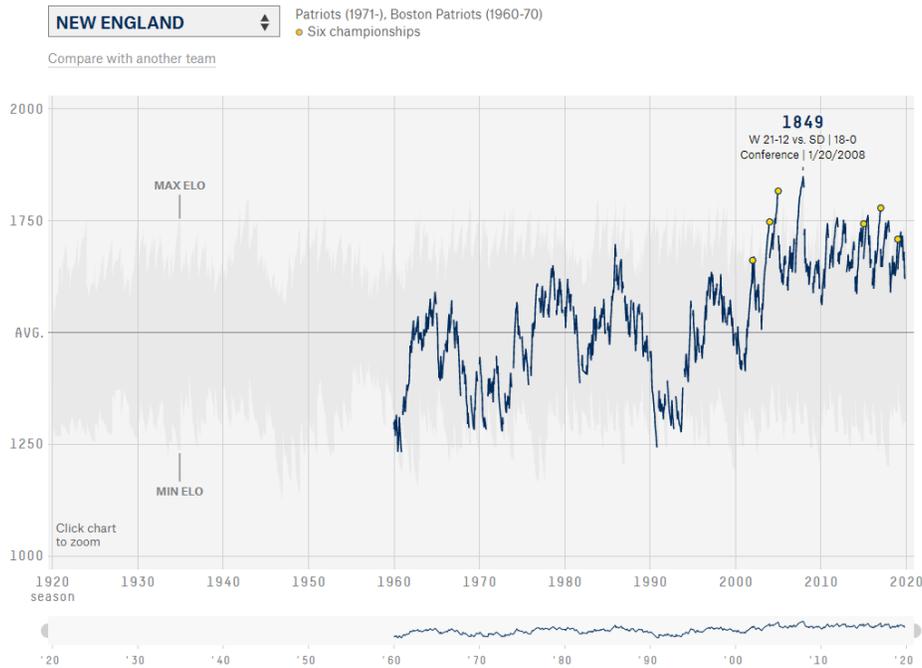


Figure 23: NFL franchises over time

Shown in Figure 23, the main visualization itself was impressive but we found it difficult to navigate with the lack of direction given, and a lot of the really interesting features (like team comparison) were easily overlooked by users. It relied on a lot of prior knowledge since acronyms and legends for the graph were missing making the y-axis confusing. Furthermore, the site featured a very bland color scheme and layout. It looked ‘clean’, but it bordered into boring.

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<sup>25</sup> (Fischer-Baum, 2020)

A final visualization example that we looked at was created by the US Federal Reserve and included various visualizations about things like household net worth and debt<sup>26</sup>.

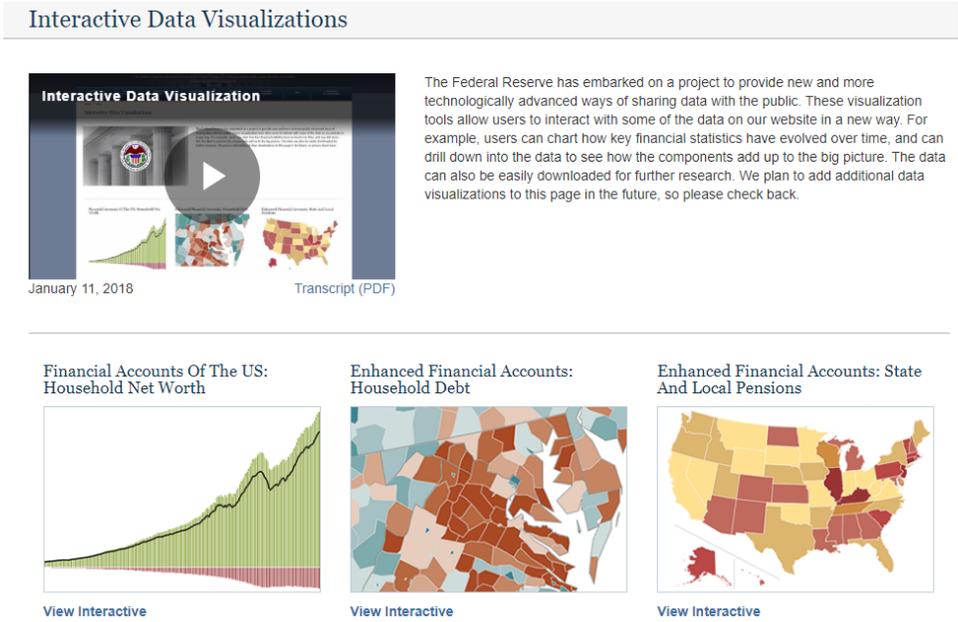


Figure 24: Federal Reserve Homepage

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<sup>26</sup> (Governors, 2018)



Figure 25: Federal Reserve Household Net Worth

The site itself is somewhat boring and the homepage is quite busy with users having to take an extra step to click and find each visualization. This data is presented mostly via location with some well-done heatmaps and also an interactive bar chart, the information is interesting and could tell an engaging story if presented correctly. The issues here lie mainly with the organization of the site itself. Again, there is a lack of explanation about the data where one is needed, and the initial page does not lead users right to the visualizations. Once users get to the interactive graphs even those have some organizational issues. The bar chart over time in particular has many ways for users to interact with the chart but the interactivity options are scattered at the top bottom and right making it hard to know what to focus on. The date range options rely on users inputting a year in the format of ‘2010:Q2’ which could cause some issues and also the menu of interactivity on the right hides a lot of further features. After clicking on an option on the right like ‘Assets’ two more options appear and even further those options lead to

even more. This functionality though is hidden away and there is a strong chance that a regular user will not reach these options, even though they provide helpful information. That said though this example was important for us to see because it showed financial data on a large scale and presented us with a couple of different visualization options that we could use in the future while also helping us learn about the importance of layout within a site.

Through looking at all of these different visualizations we were able to narrow down what we liked and did not like and thus inform our choices moving forward. Some features that we responded well to included: user interactivity with visualizations, intuitive data, sites that required no technical skills or knowledge to understand and read, a consistent color scheme and design, topical colors, and clear sections making it easier for readers to digest the information piece by piece. Just as important as finding pieces that we did like was finding things that we did not like. Some of those included: sites that were too technical, sites that were boring and had no element of fun, lack of explanation about the different pieces of a site, and plain white color schemes. This case study research helped us to build our own preferences for what we wanted to include in our site and it also showed us what works and what does not work as far as data visualizations are concerned. This information was invaluable in moving onto prototyping our site and influenced many of our design choices.

## 4 Methodology

The following methods will describe how our team was able to increase financial transparency within the Student Government Association by developing a data visualization website that shows a breakdown of the student life fee among other important visuals.

### 4.1 Working with SGA's Data

After gaining access to SGA's financial data we had over 25 tables worth of data to not only understand but also manipulate in such a way that we could use it for our website. This process involved a lot of research as well as help from our SGA contacts. We first had to understand the meaning of the data, what it represented, and how it was handled by SGA and after that, we were able to use this knowledge to seek out the most important data to show on our site.

#### 4.1.1 Understanding SGA's Data

To gain a better understanding of what SGA intended with their financial transparency goal, our first method was to conduct interviews with several of their key members. Our meetings included members who are directly involved in SGA finances as well as the president. In these interviews, our team inquired about the student life fee, the breakdown of the overall budget, how they manage their data, and their expectations for the site.

In our first meeting with SGA, we discussed the database structure. They revealed that they were currently using Microsoft Access, a relational DBMS that employs user interfaces

(instead of code) to manipulate data. Our team wanted to find the best possible database for SGA to use so we researched several common database managers to see if Microsoft Access truly fits their needs. Nevertheless, our research proved to be redundant seeing as, before we could present our findings, SGA decided to move forward with a MySQL database accessed through MySQL Workbench. The transition occurred during our project, so the Access database had not been completely imported into the MySQL database. To mitigate this problem, SGA suggested we reference the Access database when needed, but pull data from the MySQL for our visualizations. As time went on, they completely switched over to the MySQL database and we were able to interface with just that which was much easier for the creation and usage of the backend of our website.

The second meeting was with the SGA finance team. Our goal was to understand the terminology they use within the database, their budgeting process, as well as their hearing process. In this meeting, we were able to ask more informed and directed questions because we had already had time to review the initial ACCESS database. During this meeting, we also received access to the WPI-SGA-Financials GitHub repository where there was some useful information including many SQL queries that could isolate specific information within their data. By learning about their data and how to access and use their database, we would then be able to connect real and live data to the back end of our visualizations.

#### 4.1.2 Manipulating SGA's Data

Once we fully understood the meaning and complexity of the data we were receiving, we then went about manipulating the over 25 tables worth of data into usable formats for our site. A lot of the data in the MySQL Database given to us from SGA wasn't formatted in a way that was

useful for the visualizations we were planning on using. We planned to use our prior knowledge of creating views and queries as well as implementing an express server for API calls that connected our backend to the database. These combined, allowed us to access only the data we truly need which include the Student Life Fee table, bringing together the pieces of the overall SGA budget, club membership numbers, and finally the yearly club budgets.

## 4.2 Assessing Current Knowledge of the Student Life Fee

In this objective, we aimed to survey the WPI undergraduate student body. We did this in order to understand the current awareness of the SLF and gauge their level of interest in learning more about it. To do so, we gained IRB approval for a google forms survey. Figure 26 shows a portion of the survey. The questions we asked included:

- What class are you a part of?
- Are you or have you been involved in SGA (Student Government Association)?
- Have you ever heard of the Student Life Fee?
- Do you feel like you know how the money raised by your student life fee is being used?
- What do you think the 2020 Student Life Fee was?
- What do you think SGA's yearly estimated budget is?

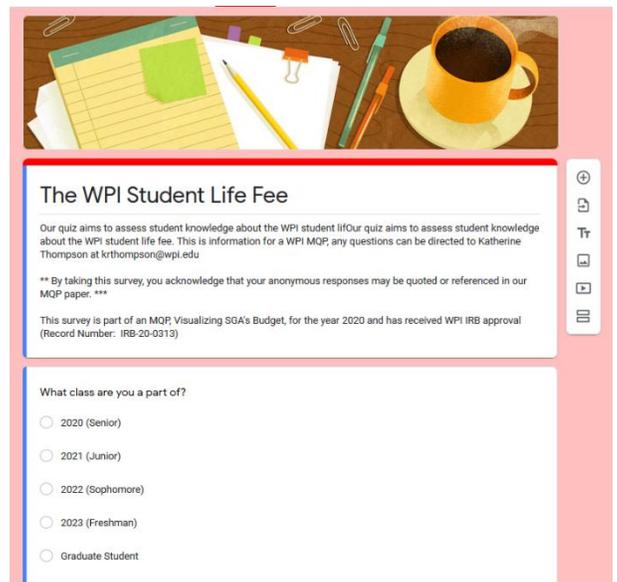


Figure 26: WPI Student Life Fee Survey

- About how many undergraduate clubs (including club sports) do you think WPI has?
- Do you know the resources available to WPI students to see where your Student Life Fee goes?
- Would you be interested in having a more easily accessible and aesthetic way of seeing a breakdown of your Student Life Fee?
- Is there anything else you would like to learn about your student life fee or SGA's budget? (if no please leave blank)

By asking these questions to the student body, we can hopefully learn who our audience will mostly be and what they would like to see. With this information, we will be able to tailor our narrative to one that best fits the needs of WPI's undergraduates.

### 4.3 Creating Design Mockups



Figure 27: SGA Financial Infographic

breakdown of the budget but also see where their personal contributions were going. We also

In this objective, we created design mockups to show what we wanted our website to look like. We were heavily inspired by the SGA Financials website and the original static infographic that they provided shown in **Error! Reference source not found.**

Before doing anything else our group brainstormed together what we were hoping to show on the site. These conversations solidified the fact that we wanted people to be able to not only view the overall

were all united on the idea of animation and interaction. Initially, many designs were done using paper and pencil seen in **Error! Reference source not found.** before moving to software-based prototyping seen in **Error! Reference source not found.** Once we made this move to software we used [www.figma.com](http://www.figma.com) as our mockup software and were able to map out all of our titles, textual areas, and visualizations to the most effective positions. After doing further background research, deciding on the tools we were going to use to create the site, and learning more about those tools' capabilities we refined our initial paper and pencil mockups to create more feasible prototypes in Figma. Also, we made some quick graphs using both R and Flourish to have an idea of what our visualizations might look like and if we think they do a good job of conveying the data before we spent a lot of time making them using d3.

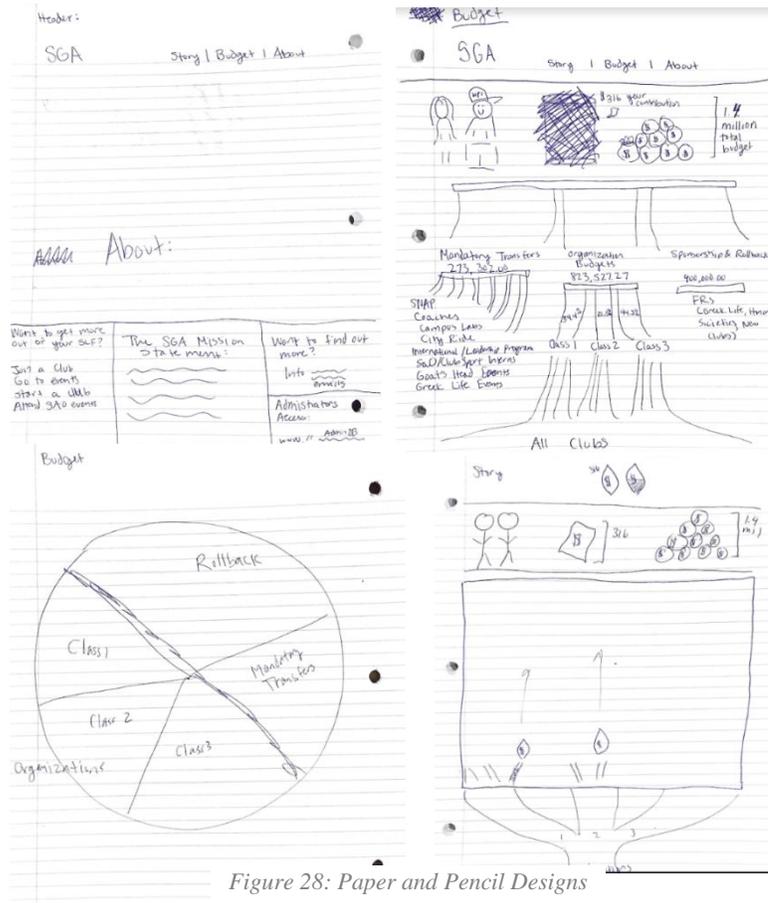


Figure 28: Paper and Pencil Designs

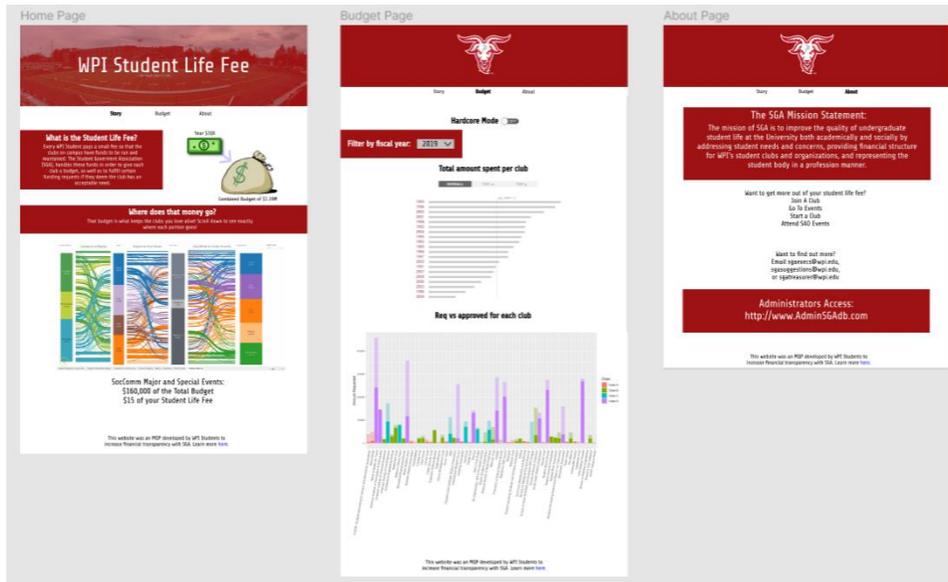


Figure 29: Figma Prototype

## 4.4 Creating the Website Framework

In this objective, we worked to create a frontend and backend of our website that could handle everything we needed it to. After much discussion, we decided to go with using Node.js and the Express library for the backend of the website, with the frontend being written in React.js

### 4.4.1 The Back End

Node.js and Express is a very popular combination to use for writing web apps and web servers. One of the benefits of having our website run on a node server instead of running statically on the web is the ability to write our API calls. This allows us to use a library to connect to a MySQL server so we could query for data in the SGA Financial Data MySQL database.

We wrote API calls to handle the queries to the SGA Financial Data MySQL database and returning the data to our web application for the fiscal year defined in a variable in our server file. One of the challenges of using a MySQL database with our web server is trying to keep it secure. We decided to have all of the server information, the hostname, database name, username, and password all in a separate 'config.json' file that our server file imports at the beginning to get the credentials needed to establish a connection to the database.

One challenge we faced when working on this project was that React.js has hot loading ability, and it not working while our node.js server ran. After tinkering for a while, and finding a blog post, we finally got our backend running while still being able to hot reload within react.

#### 4.4.2 The Front End

Our front end was created using React.js, an open-source JavaScript library created and maintained by Facebook. We first had to create the 3 pages: Story, Budget, and About (discussed further in section 3.5). This meant that we had to learn how to use a react library called "React Router". React at its base level is meant for single-page applications. This means that you have one page that dynamically renders content on it depending on the conditions it has at the given time. React Router provides more utility in that it can dynamically change the react components loaded within the webpage without changing the entire webpage at once, allowing a header and/or footer to stay on the webpage and just change the body content of it.

## 4.5 Building the Website & Visualizations

This section goes over the layout and design for the website. Once we understood SGA's financial data, we needed a structure to present it in a meaningful way. We designed three pages: the story page, budget page, and about page. To shape these pages, we paid close attention to our audience and their suggestions. We found that our audience either had no idea what SGA was or had only general knowledge but wanted more detail. We designed our pages to cater to both types of people. The visualizations we created were also carefully crafted for these pages to guide the user, keep them interested, and allow them an appropriate amount of freedom.

Additionally, we identified the need for a CSS framework. It would save us a lot of time by providing a consistent CSS design without needing to write it ourselves. After looking into a few frameworks, we decided to use Bulma. It is free, open-source, responsive, and has a sleek, modern design.

### 4.5.1 Story Page

The story page was designed to be the home page of our website. This is where we introduce SGA and the SLF, as well as give quick general information. Anyone who visits this page has the opportunity to learn about SGA at a high level. As mentioned earlier, some of our audience is not interested in financial details. This page presents them with only the most important information. A short video that overviews the page is provided for those who do not want to read.

The content on this page tells the story of SGA's budget and the student life fee that comprises it. We break down the budget into high-level categories and identify which parts of

the WPI community are affected by each. We also show the evolution of the SLF and how it compares to other colleges. Finally, since this is the first page the WPI community will see, this is where we decided to put our most impressive visualization. This visualization is built to provide an overview of where each student's student life fee goes while being visually pleasing.

#### 4.5.2 Budget Page

The budget page is constructed to satisfy those in the WPI community who are interested in seeing financial data and low-level details. Club organizers and SGA members are examples of people who would find this page helpful. The visualizations on this page are designed with much different intentions than those found on the story page. Here the user is given much more freedom to explore, and we provide lower-level data to inspect. This includes individual club budgets and memberships.

#### 4.5.3 About Page

The about page simply displays the SGA mission statement and shows how to contact SGA for further questions.

## 4.6 Assessing the Effectiveness of the Visualizations

In this objective, our team aimed to evaluate the effectiveness of the visualizations we made to understand whether or not our visualizations were impactful and shared valuable insight. This would be achieved by demonstrating our website and sending out an anonymous survey to both the student undergraduate body and SGA. Figure 30 shows what this survey would look like and the questions asked in this survey would include:

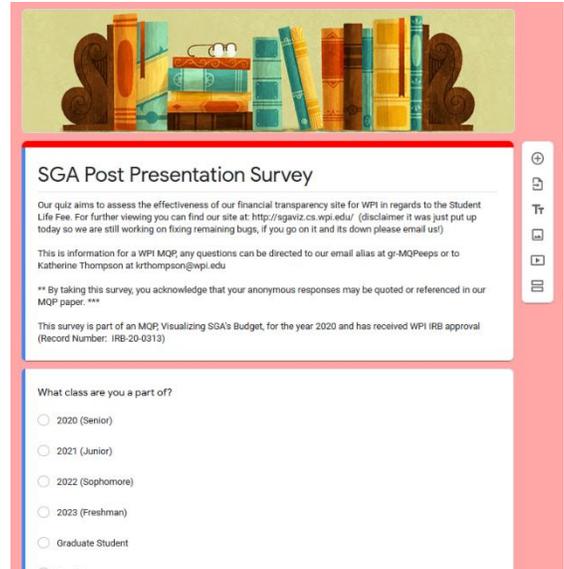


Figure 30: SGA Post Demonstration Survey

- What class are you a part of?
- Are you or have you been involved in SGA (Student Government Association)?
- Had you heard of the Student Life Fee before viewing our website?
- Do you feel like you knew how the money raised by your student life fee was being used before viewing our site?
- Do you feel like you know how the money raised by your student life fee is being used after viewing our site?
- What do you think the 2020 Student Life Fee was?
- What do you think SGA's yearly estimated budget for 2020 was?
- Do you believe that currently there are adequate resources to help students see where their Student Life Fee goes?
- Do you feel like you learned more about SGA finances through this site?

- How likely are you to use this site in the future?
- Do you have any further feedback for our team about the site or about our project itself? (if no please leave blank)
- Are there any visualizations you did or did not find particularly helpful?

## 5 Results

### 5.1 Working with SGA's Data

Our first method aimed to prepare for the creation of our site and to do this we spent time fully understanding and manipulating SGA's data. The process helped us to seamlessly move to the development phase with a good handle on what the data means. This step was especially important to us because we wanted to accurately convey the information and properly tell the story of the SLF.

#### 5.1.1 Understanding SGA's Data

Throughout our project, we were in frequent communication with SGA about their data, expectations, and needs from this project. That said though the first two meetings we had with key SGA representatives proved to be the most helpful in fully understanding their data and how it plays into a larger picture (see D.3 Sept 6, 2019 SGA Meeting Minutes). Our first meeting our main takeaways were mostly what SGA's expectations were. As a group, they had been wanting to do something like this for a while and excited about our proposal. They explained to us the high-level differences between Mandatory Transfers, Budgeting, and Funding Requests/Sponsorships all of which can be found in our Background sections. They detailed their process of club classifying and grading and also pointed us in the direction of resources and bylaws to increase our knowledge of SGA Financials. After this, we talked a little about expectations and SGA mentioned that they were interested in interactivity and maybe a pie chart. In response, we promised that we could give them a whole lot more than a pie chart, and this is

something we delivered on. After this first meeting, and in preparation for the next, we did initial look throughs of the data and read up on the bylaws and processes that SGA has in place. We found that the data was not in the optimal formats for our purposes, seeing as important information was scattered in different unconnected tables, and we knew that we would need to make some changes for our purposes. This led us to the second meeting where we had a lot more questions specific to the data and how to integrate it with our proposed project. This meeting was very informative and we learned the ins and the outs of the appeals process, how unspent money is rolled back year to year, how funding requests are added into the overall budget, and about SGA's goals to fully standardize all of their data. We also found out that the SLF is paid in two parts, one in the fall and one in the spring, and how they plan yearly spending reflects this. Finally, with all the information in hand, and after more question filled emails to SGA, we were ready to start utilizing the data and molding it to what we needed for our site.

### 5.1.2 Manipulating SGA's Data

After the second meeting, we were directed to reach out to IT Services and were given our access credentials so that we could view the data using MySQL Workbench. These credentials gave us the ability to create/delete tables, data, and views. The data could be accessed on-campus Wi-Fi or through a VPN which later after online learning started IT Services also helped us set up. Through understanding the data via many meetings with SGA we learned what data was important, what could be omitted, and what we wouldn't be able to show via our project. First, we found all the numbers that corresponded to the SGAC Financial infographics and did some double checks making sure we were confident in finding the same numbers as them ourselves. We also created categories for the different clubs which were: Sports, Academic,

Music and Arts, Religious, Extracurricular, Cultural, Awareness, and Community Service. After this, we created several views that would aggregate the specific data that we were interested in.

The ones that we made were:

- Categories Club Membership: number of clubs per year in each category
- Categories Total Budgets/Financial Transparency: both show yearly total budgets, but Total Budgets shows the category of the club and Financial Transparency shows membership numbers
- Club Total Budget: All of the club's total budgets and categories
  - Yearly Club Total Budget: aggregations of all club totals to get one overall yearly total
- Complete Funding Request: an aggregation of all the funding request information
- Financial Transparency:
- Liability: Showing Liability which is SLF Income – Budgets – Mandatory Transfers – Sponsorship, created using a query found on the SGA GitHub page
- Mandatory Transfers Total Budget: shows amounts for everything that falls under this budget subsection
  - Yearly Mandatory Transfers Total Budget: aggregates all the numbers in the Mandatory Transfers Total Budget to get one yearly overall value
  - Operating Account: subsection of the Mandatory Transfers that fun SGA and the SAO, this view aggregates the spending associated with this

- Other Budget: The third section of the overall budget that uses values from Club Budgets and Mandatory Transfers to find what is leftover, Liability and Sponsorships/Rollbacks falls under this and pulls from the Liability view
- Total Budget: pulls from the Club Budget, Mandatory Transfers, and Other views to create an overall total budget year by year
- Total Life Fee Budget: pulls from the SLF fee to calculate income from student life fees, used to double-check values from Total Budget view

With all of these views, we then were able to use our node express server and API calls to feed the data into the front end of our site. Our views are purposely designed to be inclusive of all fiscal years and then in the server, we provide an easily changeable variable that sets the fiscal year. In this way, people should be able to easily update our site year to year. We have 10 API calls that each return data from the SGA database in a JSON format. From here we can, through code, manipulate the data received as needed. One thing to note though is that as we manipulated and worked with the data, we found a couple of places where data was incomplete or missing. There are several places where data is 'Not Provided', 'NA', or just blank. On top of this many club membership numbers, because they are self-reported, are not accurate, and have not been updated in the past couple of years. Furthermore, we found that not all clubs receive a budget so while our site visualizes the 125 organizations funded by the SLF, we do not show information on the other 134 that are without a budget.

We were given a lot of SGA's data and spent time making sure that we were correctly representing it and showing the story of the SLF, while also figuring out what we could omit

without detracting from the story. Also, we spent a decent amount of effort making sure that we were able to access the right data in the format we needed while also pinpointing areas in the data that were lacking. Overall, we spent the time on this stage of the project to make sure we knew the data well enough to explain what the SLF is. We wanted to make sure that our viewers walked away knowing that they each pay \$316 every year to this fee, knowing how much the SGA budget was, and also knowing that their SLF’s all come together to create this budget. Also, we hoped that students would be able to see all the clubs, organizations, and student services WPI offers and through this understand exactly what value their personal SLF has on the student experience here.

## 5.2 Assessing Current Knowledge of the Student Life Fee<sup>27</sup>

Gaining IRB approval for our anonymous SLF survey took much longer than anticipated, therefore we were able to send out the survey only two weeks before the ECDR project deadline (see Appendix C: Surveys for full screenshots on the survey questions and responses). We sent this survey out to a variety of fraternities, sororities, and club members and ended up getting around 90 responses. As Figure 31 shows, we had a decent spread of responses between all classes with a slight concentration in juniors and seniors.

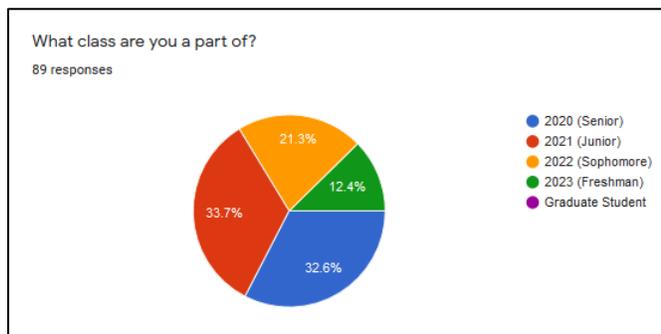


Figure 31: SLF Survey Response Demographics

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<sup>27</sup> (Survey, The WPI Student Life Fee Survey (IRB-20-0313), 2020)

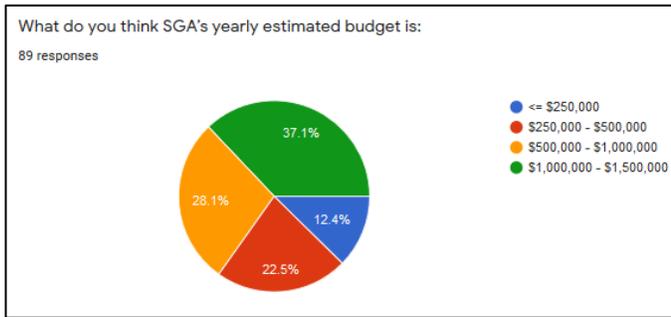


Figure 32: SLF Survey - SGA's Yearly Estimated Budget

Among all these respondents, 84.3% were not involved with SGA and 85.4% were familiar with the term “Student Life Fee”. However, only 12.4% were confident that they knew where their student life fee went.

Also, only 62.4% were able to correctly guess that their student life fee (\$316) was between \$100 and \$400. Figure 32 shows how most respondents incorrectly guessed SGA's total budget comprised of everyone's SL.

Lastly, the majority of respondents (79.8%) are not aware of any resources available to WPI students to see where the SLF goes and 97.8% of respondents would like to see an easily accessible and aesthetic way to view the SLF.

Our last question was open-ended and asked respondents if there is anything that they would like to learn about their student life fee. Some interesting responses that we had not considered included:

- “If students wished that the student life fee was changed or used differently, is there a way for student voices to be heard about this?” (Anonymous Respondent)
- “It would be cool to have a feature where you can see if you are utilizing all of your student life fee (i.e calculate the approximate ‘club budget per person in the club’ for each club and see if the clubs someone is involved in on-campus correlate to how much they pay)” (Anonymous Respondent)
- “The process by which clubs ask for portions of the SGA budget and the process by which the budget is split up.” (Anonymous Respondent)

Based on these responses, the need for a way to aid students in understanding where their SLF goes is highly desired and useful. As far as the open-ended responses go, due to the lack of response time with this survey, all we can do is recommend these responses for a future iteration of this Major Qualifying Project.

## 5.3 Creating the Website Framework

The website is made of the backend in Node.js and the frontend in React.js, this allows us to control the full stack of our application.

### 5.3.1 The Back End

After deciding to use Node and Express to build our backend, we created our API calls to create specific queries. Towards the end of the project we realized that to make our project maintainable for the future, we had to change all of our queries to use a variable at the beginning of our server file that defines the fiscal year. We also discovered that we needed a separate configuration file for the MySQL credentials to be saved so that we could make our repository public while not making the credential's public. We created a config.json file to store all the

```
{  
  "host": "  
  "user": "  
  "password": "  
  "database": "  
}
```

server information: the hostname, database name, username, and password, shown in Figure 33. Our server index.js file then imports the config file to establish the connection to the database.

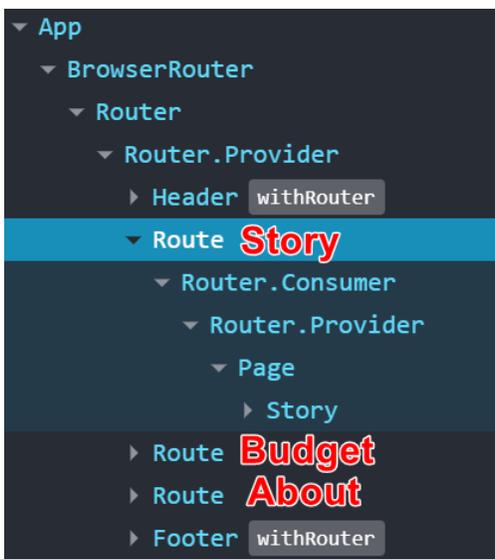
Figure 33: Structure of the config.json file

Our biggest challenge with making the full stack of the website work was the way react works with hot reloading and servers. React handles servers much better when the application is

fully built and not running in the hot reload development mode. But building the application takes over a minute each time, and it didn't make sense to build it every time we needed to test a change while being able to use the server to use our APIs. We ended up finding a solution on the Twilio blog on how to run a node server that a react application can still access in hot reload mode.<sup>28</sup> The main changes this brought was the addition of 'nodemon' which automatically restarts the server if any changes are made, and 'npm-run-all' which allows both the react developer mode with hot reloading and the node server to run at the same time. That way we can use our APIs while changing code live in React.

### 5.3.2 The Front End

We used the Facebook developed "create-react-app" command-line tool to build a basic React application to start our project which we can build on top of.<sup>29</sup> Then using React Router,



we added our three pages to our application, presented in between our header and footer component. Figure 34 shows the component tree for the web application from the default state of being on the Story page.

Figure 34: The component tree of our React Application

<sup>28</sup> (Nash, 2018)

<sup>29</sup> (Create a New React App, 2018)

### 5.3.3 Documenting the Website

For each component, we wrote documentation before the component declaration so that 'jsdoc' would find the component and generate a page of documentation for it. We also added a link to our documentation in the footer of the website below the link to our GitHub repository so that it is easily accessible by anyone who wants to read it without diving too far into our codebase. An example of the generated document file for our multi-select component, `Select.jsx`, can be seen in Figure 35.

Class: `Select`

`Select()`

Component for showing a multi-select list of options to pass as data to child components.

Constructor

`new Select()`

Properties:

Name	Type	Description
<code>options</code>	array	The options for the multi select component to show.
<code>children</code>	element	The child element(s) to have in the Select component to pass the selected options as props to.

Source: [components/multi-select/Select.jsx, line 58](#)

Figure 35: The generated documentation for `Select.jsx`

### 5.4 Building the Website & Visualizations

After creating design mockups and deciding on the website building tools, we would use, we began developing the site itself. Our CSS framework, Bulma, kept the design consistent and

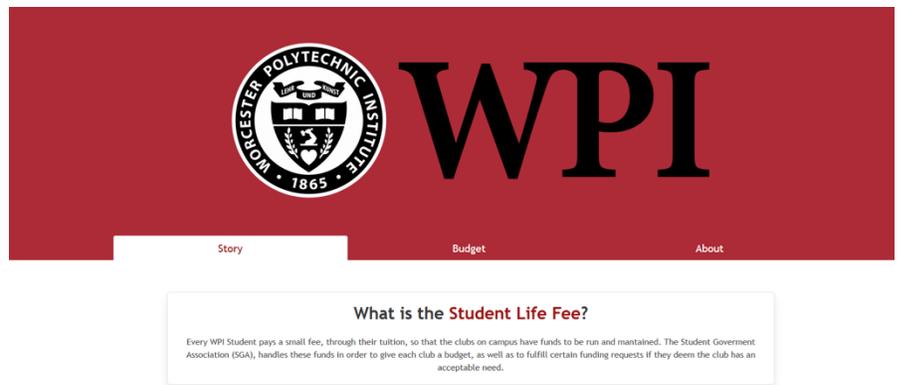


Figure 36: Header

responsive to resizing. We started by creating a simple header with the WPI logo and tabs to navigate the three pages. Although we referenced our mockups, the tools provided by Bulma

avored a slightly different design. Figure 36 displays our header. Underneath the header, the “What is the Student life Fee?” container is an example of a Bulma “box” that can be seen used throughout the pages of our site. Next, we created a footer to wrap up each page with a summary of our project and a link to our GitHub as well as documentation.

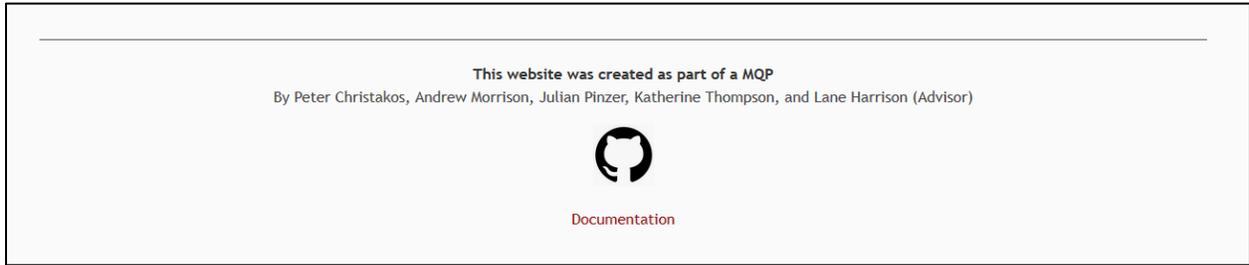


Figure 37: Footer

### 5.4.1 Story Page

The story page is split into four sections. Each section is clearly defined by a change in color, and all of these sections come together to convey the story of the SLF and given users the base knowledge that they need to understand what the data means.

#### 5.4.1.1 Story Page Section One

The first section, shown in **Error! Reference source not found.**, is quite basic. It describes the student life fee and has a short, embedded video that overviews the page. The video is light, fun, and inviting. It introduces the user to the idea of SGA and the SLF in an easy to consume way.

Hopefully, it will draw people in, pique their interest, and cause them to proceed to the rest of our site.



Figure 38: Story Section 1

5.4.1.2 Story Page Section Two

The second section describes the student life fee in more detail with its goal being to show how it has changed over time. This section has our first D3 visualization. It shows the trend of the SLF since 2005. We decided to use a line chart here because the data was purely numerical and was showing a trend over time. Another

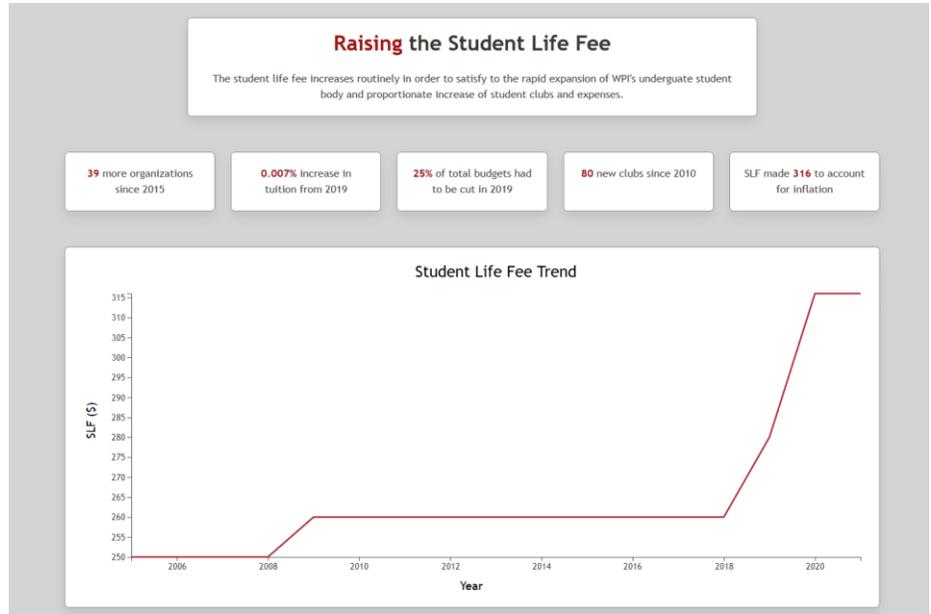


Figure 39: Story Section Two

design decision for this chart was for it to start at the lowest SLF value (shown in Figure 39 as \$250). This makes the change more noticeable. We found this appropriate since small changes in the SLF have a large impact on the overall budget.

5.4.1.3 Story Page Section Three



Figure 40: Story Section Three

After outlining the SLF in section two, section three's goal was to connect the SLF to SGA's budget. The first box compares the SLF with the total budget. The next three boxes show the highest-level categories of the budget. It concisely explains each category and shows how much of the budget they receive.

5.4.1.4 Story Page Section Four

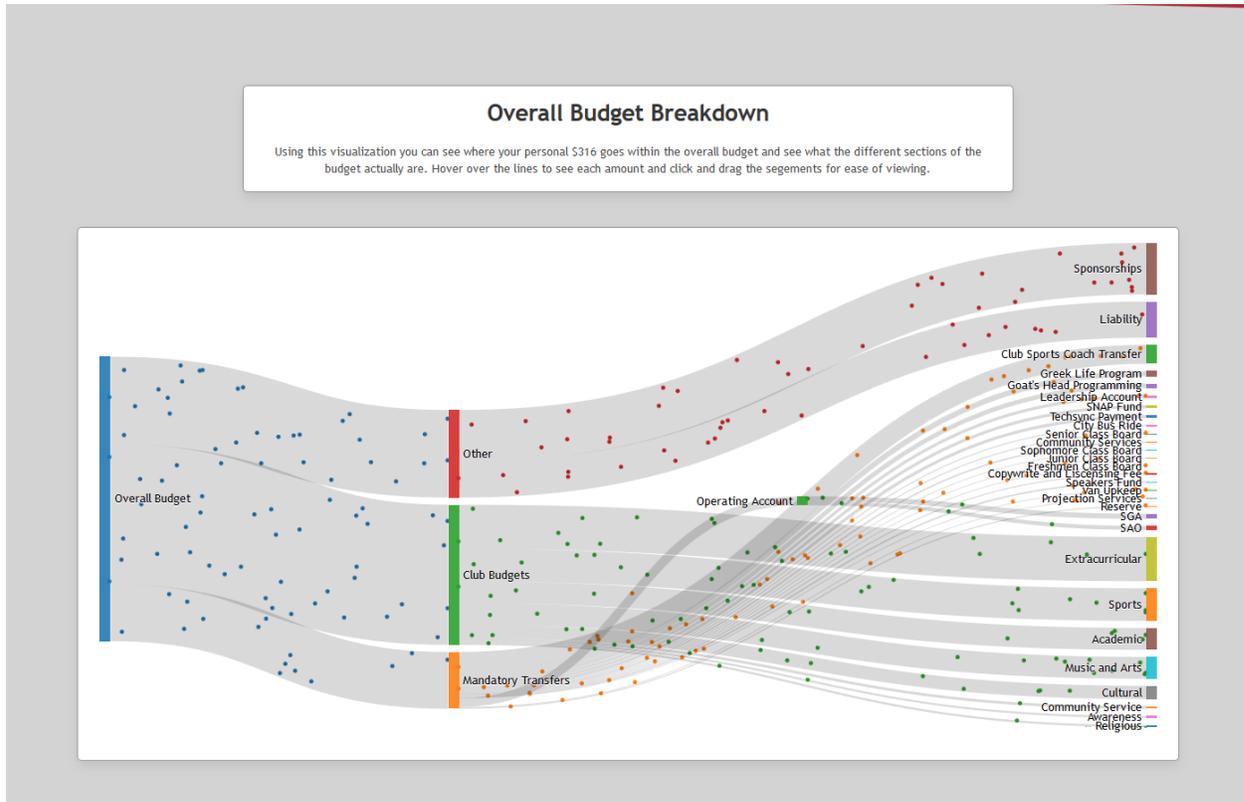


Figure 41: Story Section Four

The final section of the story page is our “WOW” factor. This is a Sankey chart. It is the most complex visualization we developed during our project. We were inspired by a series of Sankeys, with varying complexity, done by Elijah Meeks and wanted to incorporate it into our site. The Sankey not only has eye-catching animation, but it also has hover over information boxes giving concrete numbers, and additionally, its sections (via the rectangular colored boxes) are moveable allowing the user to isolate the sections they care most about. Sankey diagram's main purpose is to show flow and with our data being broken down into multiple levels and sublevels, this idea of flow lent itself well to what we were trying to visualize. On top of that Elijah Meeks in an article for Medium asserted that the “Sankey diagram is one of the most readable of the complex data visualization methods” and readability is an important part of the

accessibility of our site <sup>30</sup>. In short, the Sankey is a perfect fit for this page because it draws the user's interest with animation, gives them fun interactivity, and shows the flow of the overall budget to each category.

### 5.4.2 Budget Page

The budget page is comprised of three sections and is meant for users who want to dive even deeper into how SGA allocates their budget. This page provides users with more opportunities to interact with the site and learn more about how their money plays into the bigger picture.

#### 5.4.2.1 Budget Page Section One

The first section of the budget page mimics the first section of the story page. Firstly, we wanted to show the user how the budget has changed over time. In Figure 42, the budget trend is shown by the line chart. The value of 2021 highlights one of our worries. The database contains a 2021 value, but it is currently zero. Since the data is connected directly to SGA's database, if there are inconsistencies or unfinished data between years, for example, it could have confusing effects on our charts.

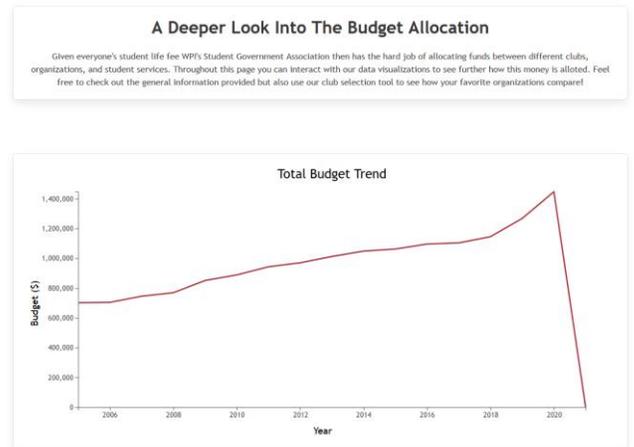


Figure 42: Budget Section One

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<sup>30</sup> (Meeks, 2017)

5.4.2.2 Budget Page Section Two

This section is devoted to showing the budget in the most depth with the most freedom and interactivity. Figure 43 shows the default view of this section. On the left, there is a search bar that allows the user to choose which clubs they want to see and filter out the others. The tabs on the top right are four different visualization options the user can choose from. Under the tabs is a box that describes the visualization. Below the description is the visualization itself.

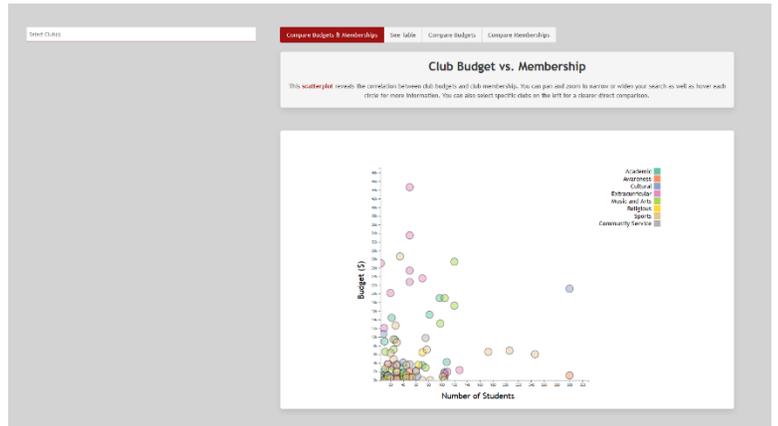


Figure 43: Budget Section Two

The default view is a scatterplot comparing club membership to their received budget. We wanted to compare these two values for club organizers to get an idea of how much money they should receive, as well as to give club members an interesting way to compare their club to others. A scatterplot is the best choice for this data since it is numerical with no connection between data points or time scale. Furthermore, when no clubs are selected, the plot shows every club in the database as seen in Figure 43. Lastly, we added color to the points representing the club's category. We added this so users could find trends between club category and membership/budget at WPI.

The second tab, shown by Figure 44, is a table of the selected clubs, or all clubs if none are selected. We used the Tabulator library to create the table and make it interactive. The intention of providing this is for users to see actual numerical values and even use the numbers for their purposes. We also added a column that shows how much of the SLF, per student, goes to each club. For example, ACCESS got \$0.12 out of each student's \$316. This was suggested by students in our survey.

Name	Category	Budget	Budget out of the student life...	Members
ACCESS - Students advocating for c...	Awareness	\$530.00	\$0.12	35
Active Minds	Awareness	\$963.00	\$0.21	30
Actuarial Math Club	Academic	\$0.00	\$0.00	50
African Percussion & Dance Ensemble	Music and Arts	\$6,576.00	\$1.44	12
Alpine & Nordic Ski Team	Sports	\$28,651.67	\$6.25	35
American Academy of Environmenta...	Academic	\$125.00	\$0.03	15
American Institute of Aeronautics ...	Academic	\$14,443.41	\$3.15	22
American Institute of Chemical Eng...	Academic	\$1,746.00	\$0.38	40
American Society of Civil Engineers	Academic	\$9,374.00	\$2.05	27
American Society of Mechanical Eng...	Academic	\$0.00	\$0.00	29
Architectural Engineering Institute	Academic	\$2,974.43	\$0.65	40
Art and Design Club	Music and Arts	\$997.71	\$0.22	40
Association for Computing Machinery	Academic	\$4,200.00	\$0.92	108
Badminton Club	Sports	\$6,562.80	\$1.43	173
Biomedical Engineering Society	Academic	\$1,902.00	\$0.42	105
Brazilian Student Association	Cultural	\$575.00	\$0.13	40
Cheese Club	Extracurricular	\$1,955.00	\$0.43	109
Choral Association	Music and Arts	\$17,250.00	\$3.77	120
Christian Bible Fellowship	Religious	\$6,425.50	\$1.40	70
Club Soccer	Sports	\$7,065.00	\$1.54	77
		\$609,342.90	\$133.12	5755

Figure 44: Raw Data Table

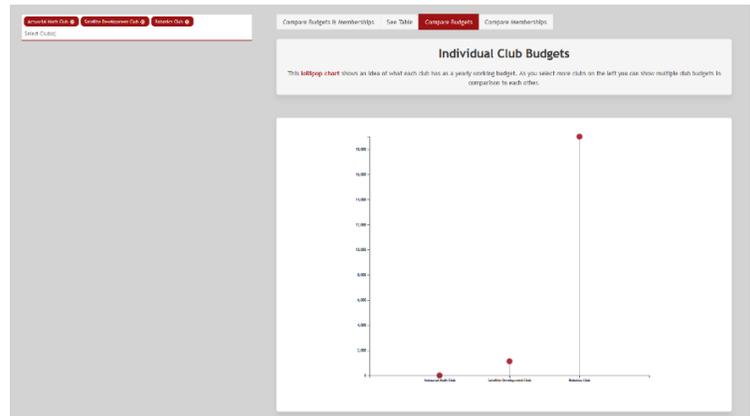


Figure 45: Lollipop Chart

Figure 45 displays the third tab. This is a lollipop chart that requires clubs to be selected. We decided not to show all clubs at once since it would be too cluttered to draw any useful information. This chart is similar to a bar chart in that it maps a numerical value to a categorical one. This is perfect for comparing the budget of each club.

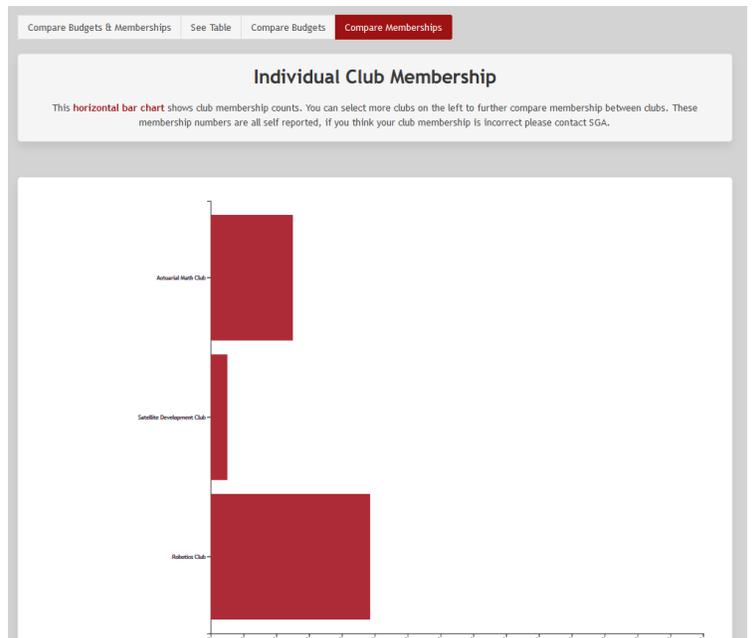


Figure 46: Bar Chart

Figure 46 shows the last chart on the fourth tab. This is a bar chart that compares club memberships. We chose it for the same reason

as the lollipop chart above, and it also requires clubs to be selected to be viewed for the same reason.

5.4.2.3 Budget Page Section Three

The final section of the budget page has two charts in it. The first is our sunburst chart seen in **Error! Reference source not found.** It is the only visualization created with Plotly.js. The Plotly library allows complex visualizations to be created much easier, albeit with less customizability. This chart is similar to the Sankey diagram because it breaks down the budget into categories. The second chart is a ridge chart for showing an in-depth view of club membership across club

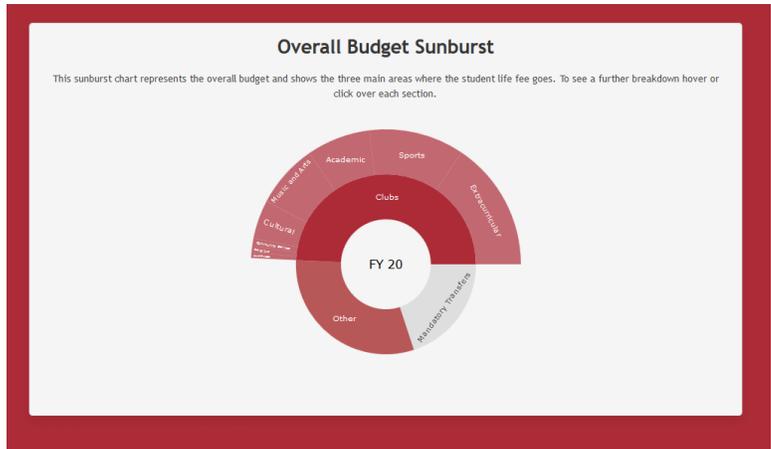


Figure 47: Sunburst Diagram



Figure 48: Ridge Chart

categories. Each line represents a category and the ridge corresponds to the number of clubs with that club membership value. For example, religious clubs usually have between forty and eighty members.

### 5.4.3 About Page

The about page shows SGA mission statement and gives contact information for further questions.

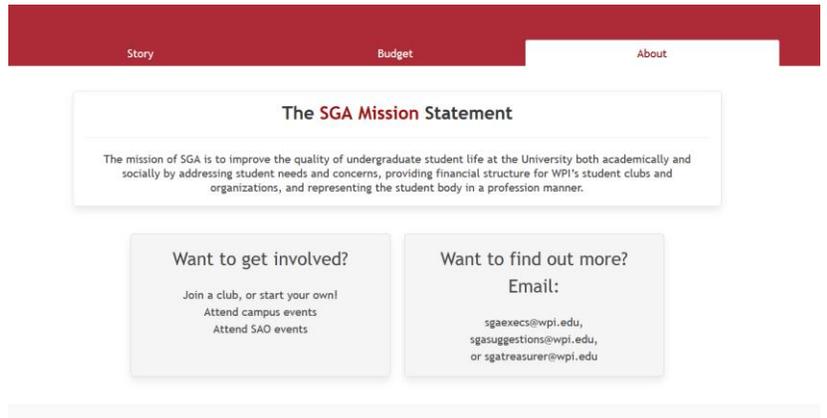


Figure 49: About Page

### 5.5 Assessing the Effectiveness of the Visualizations<sup>31</sup>

We were given the ability to present our MQP and demonstrate our website in front of SGA’s senate via a Zoom conference call. We received a lot of positive spoken feedback and sent out a survey to record the impressions we gave to

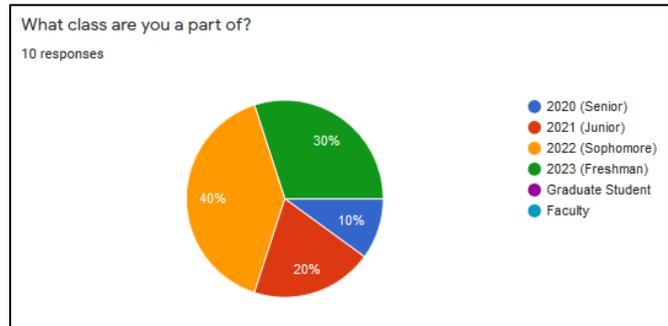


Figure 50: SGA Survey Demographics

all of SGA’s members. Ideally, we would have liked to send out the survey to all of our original respondents with a link to our hosted website, but due to time constraints we were unable to fulfill that objective (see C.2 SGA Questionnaire Survey for full screenshots on the survey questions and responses). Unfortunately, we did not receive that many anonymous survey responses from SGA’s members, but some useful responses will be outlined and explained.

<sup>31</sup> (Survey, SGA Post Presentation Survey (IRB-20-0313), 2020)

Figure 50 shows that our survey respondents were primarily made up of underclassmen. With this information, we can assume that many of the responses will be less knowledgeable of the SLF.

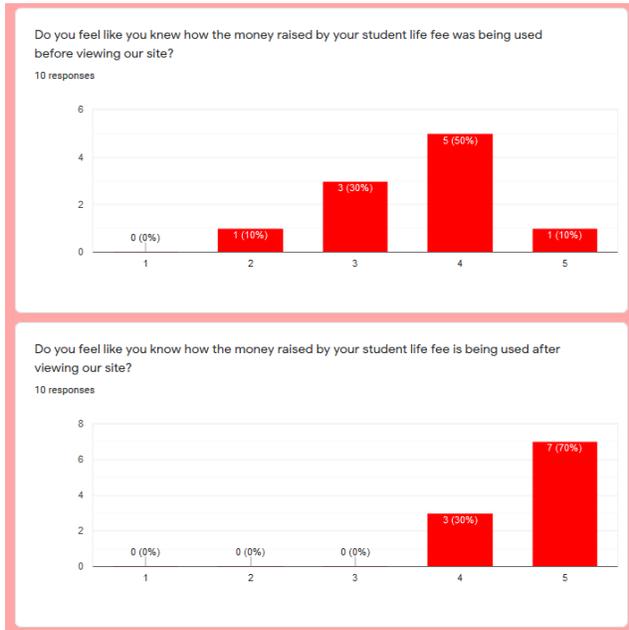


Figure 51: SGA Survey - Before and After Understanding of the SLF

Figure 51 shows the respondent’s understanding of the SLF before and after. The spread of responses show that most SGA respondents were fairly confident with their understanding of the SLF, and some were less confident. By the end of our 5-minute demonstration, 100% of respondents were very confident of their understanding of the SLF and 70% of those were extremely confident. This clearly shows that our

visualizations and narrative communicated important information about the Student Life Fee and where it goes. Another metric we measured was retention and we were able to determine this by asking how likely respondents were going to use this website in the future. 50% were extremely likely and 30% were fairly likely. This retention rate is good but ideally, we would like to increase this number to as close as 100% as we can get. We can do this by listening to some of the suggestions and feedback from the respondents.

When asked about general feedback, some highlighted anonymous responses included:

- “The site is very good, it is visually appealing, easy to understand, and easy to use. I think it’ll be a great resource for students to use to get more information on

the budgeting and what their student life fee is actually used for.” (Anonymous Respondent)

- “A lot of the information has always been available, just not easily understood by most students and usually too inconvenient to seek out. The data visualization on this site makes it so much easier to look at all this information and make it a hundred times more accessible! I'll definitely be using this site.” (Anonymous Respondent)
- “Making the charts interactive was a really great idea.” (Anonymous Respondent)

These responses show a lot of positive feedback for our project, reinforcing the effectiveness of the visualizations and narrative as a whole.

Lastly, we asked if respondents found certain visualizations particularly helpful or not particularly helpful. Some responses included:

- “The overall budget chart was very visually appealing and very informative without being overwhelming. The visualizations that I didn't really find helpful were the club membership ones due to the only fact that the numbers aren't entirely accurate and/or complete.” (Anonymous Respondent)
- “The comparisons with the clubs and the visual with the number of members in the club vs. the budget was very helpful.” (Anonymous Respondent)
- “I think the first one with how the student life has changed over the years was slightly misleading at first just because the y-axis does not start with \$0 at the origin which is not immediately evident. It just took a minute to realize that it

wasn't saying the student life fee has increased from almost nothing to ~\$300 in just the past few years.” (Anonymous Respondent)

Altogether, this feedback will be taken into consideration for future iterations of this project.

## 6 Recommendations

The following recommendations will detail how this project can be elevated in future years. We have created a solid foundation of financial transparency to help students understand the Student Life Fee, but there are many features than can be added to our project to help this initiative’s longevity.

### 6.1 Administration Tools

Our first recommendation revolves around improving upon our “Admin Tool” which we have created a foundation for. We created this tool in the hopes that we could use it to assist SGA in the updating of data on the MySQL server, but the timeframe prevented us from completing it. We believe that this would be a perfect extension to our MQP for a future iteration, and SGA has expressed interest in having a tool like this. Furthermore, having a meeting with SGA to discuss their needs and wants for a tool like this would be extremely beneficial to both parties. This discussion could elaborate on what data needs to be edited, how to best show the data, how to manage users and permissions, and having a plan to maintain the site.

The image shows a web form for data entry. At the top, there are three input fields: 'Enter Club Name' with the example 'ex. Cheese Club', 'Enter Requested Amount' with 'ex. \$10,000', and 'Enter Approved Amount' with 'ex. \$1,000'. Below these is a 'Submit Data' button. Underneath is a table with three columns: 'Club Name', 'Requested Amount', and 'Approved Amount'. Each column has a 'filter column...' dropdown. The table contains one row with values '0', '\$0.00', and '\$0.00'. At the bottom right, there are navigation buttons: 'First', 'Prev', '1', 'Next', and 'Last'.

Figure 52: Snippet from our Admin Tool prototype

## 6.2 Additional and Improved Visualizations

Our second recommendation would be to add additional visualizations that further show financial transparency. While our site is a good representation of what is happening with SGA financials, there is room to add visualizations that will provide further depth. We brainstormed ideas and created R charts as examples.

- comparison between clubs
- funding requests

One interesting path we did not get to explore on our site is comparing how much of their budget each club

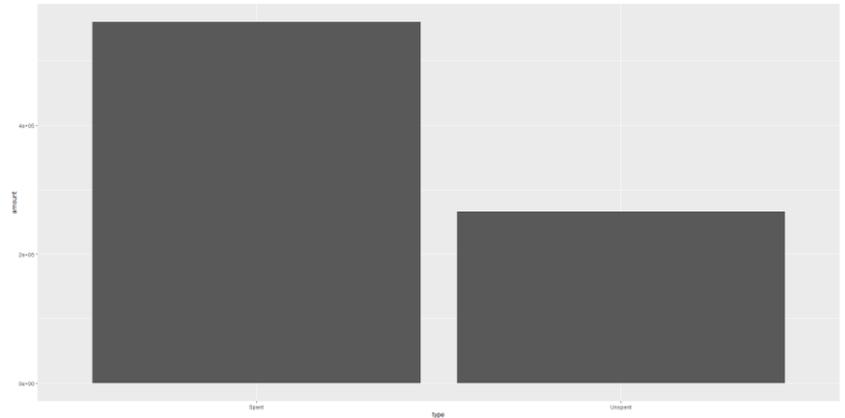


Figure 53: Spent vs Unspent

spends. Figure 53 is a bar chart using FY 19 data made with R. The left side is the total amount clubs spent, and the right bar is the cumulative money that was unspent between all the clubs.

This chart is simple, but it is immediately noticeable that there is a large amount of unspent money. This brings up many questions. What clubs are not spending their entire budget? Are

clubs allocated more money than they need? Is club spending simply not reported well? Figure 54 is another view of this data. It is a scatterplot of clubs with the x-axis being budget and

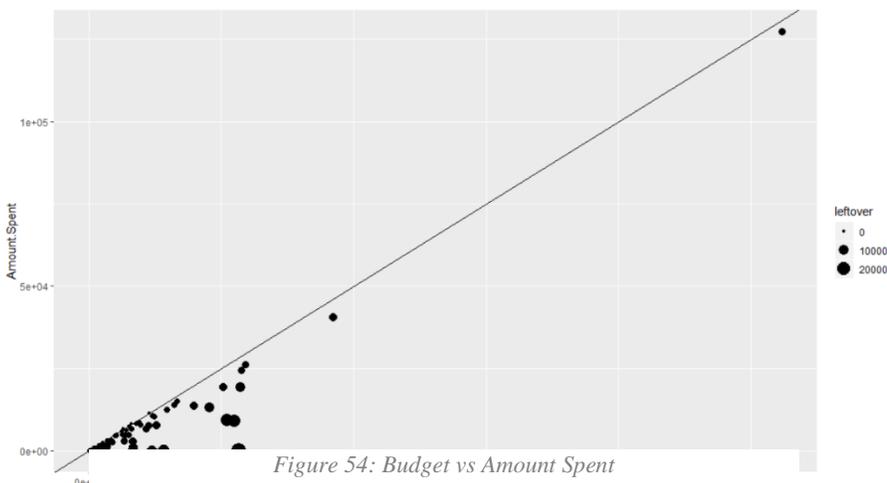


Figure 54: Budget vs Amount Spent

the y-axis being amount spent. The line represents spending all money in the budget (budget and amount spent are equal). To highlight this, the points are made larger with a more unspent budget. As one can see, there are quite a few clubs that fall well below the line having not spent their entire budget. This idea could be taken further by analyzing if clubs had a lot of unspent money received less the next year, especially since SGA has a process for monitoring this and providing less money to clubs when this happens.

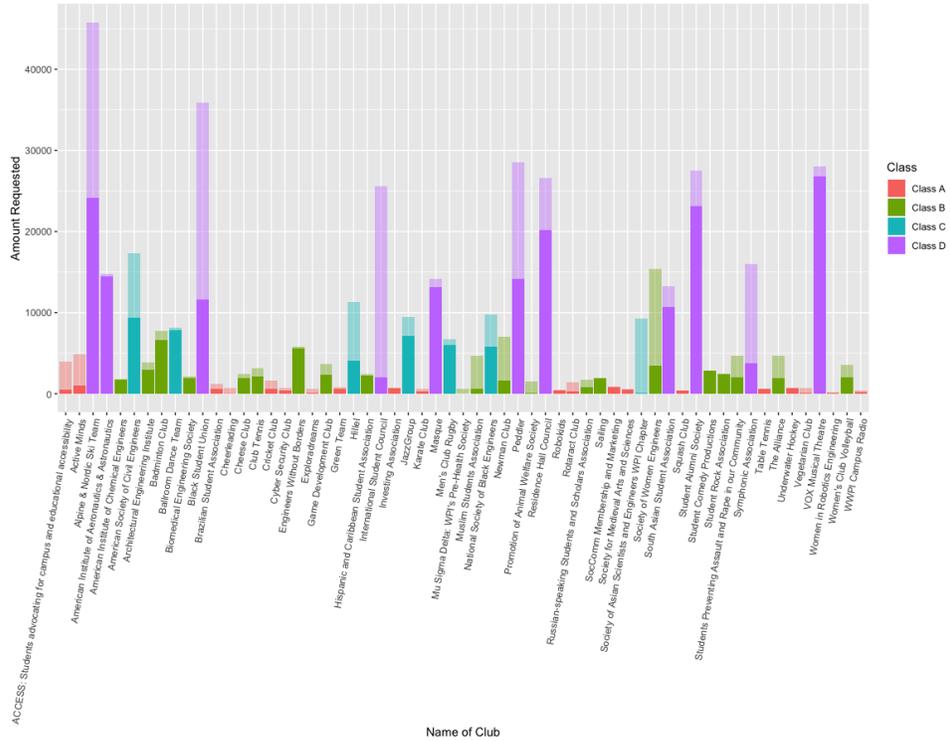


Figure 55: Requested vs Received Bar Chart

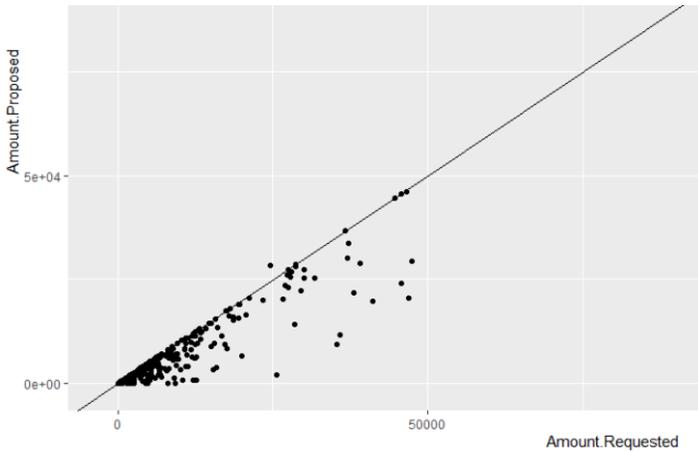


Figure 56: Requested vs Received Scatterplot

To dive even further into club budgets, a chart could compare the amount a club requested with the amount they received from SGA. Figure 55 is a form of a double bar chart also using FY 19 data. The faded region represents requested money that was not granted, while the solid

region is the received budget. It is fascinating to see some clubs request significantly more than SGA gives them. Why do these clubs request so much more? Did they receive significantly more

in previous years? On the other hand, this chart only displays clubs that receive less than they requested. Do clubs ever receive more than they ask for? Figure 56 is another scatter plot that compares requested on the x-axis with proposed (received) on the y-axis. The line represents equal values for both. Once again we see many clubs receiving less than they asked for. There is one club that is above the line. This means it received slightly more than it asked for.

One category of SGA's budget we would like to see explored in the future is funding requests. These are requests clubs make outside of their budget Figure 57 is a bee swarm chart that shows funding requests for every

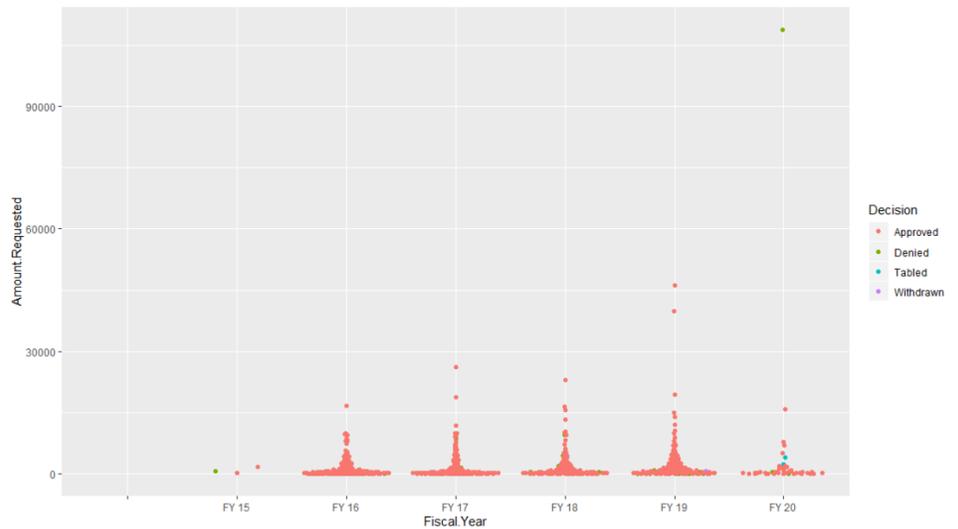


Figure 57: Beeswarm

year. This type of chart expands points horizontally when multiple points are in the same area. This prevents overlapping. The x-axis is fiscal year and the y-axis is the amount requested. The points are colored by the decision SGA made for the request. They can be either approved, denied, tabled, or withdrawn. One interesting point is in FY 20 where one club requested nearly one hundred thousand dollars, and it was understandably denied.

Another suggestion we received was displaying clubs' accolades or changes from year to year. For example, clubs with the largest budget or membership changes, or the largest funding

request granted recently. The main purpose of these kinds of charts would be to get students excited to come back to the website to see how their club has changed. Figure 58 displays the top ten largest budgets of clubs in FY 19. A chart like this could instill

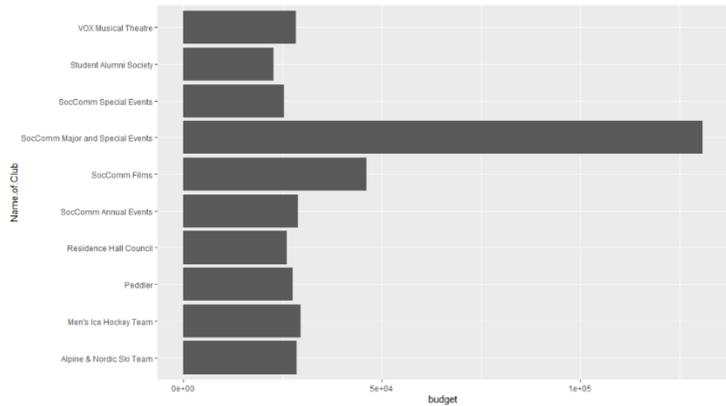


Figure 58: Top Ten Budgets

some healthy competition among clubs to improve, give them reasoning to ask for more, or show clubs that might be receiving more than the student body would like.

In our raw data chart, we calculate the amount of each individual's student life fee goes to each club. This data could be used in a stacked bar chart to show how much of a student's student life fee goes towards user-selected clubs, how much goes towards mandatory transfers and funding requests, etc. This will help students get a better idea of how their money is used and how much they are taking advantage of with their involvement.

Finally, we created some charts that we were unable to implement in the final site. Figure 59 shows a parliament chart. It is a fun way to show membership across many organizations. Figure 60 is a screenshot of a bar chart race. This type of chart is animated. The bars grow and shrink over time to show how the top

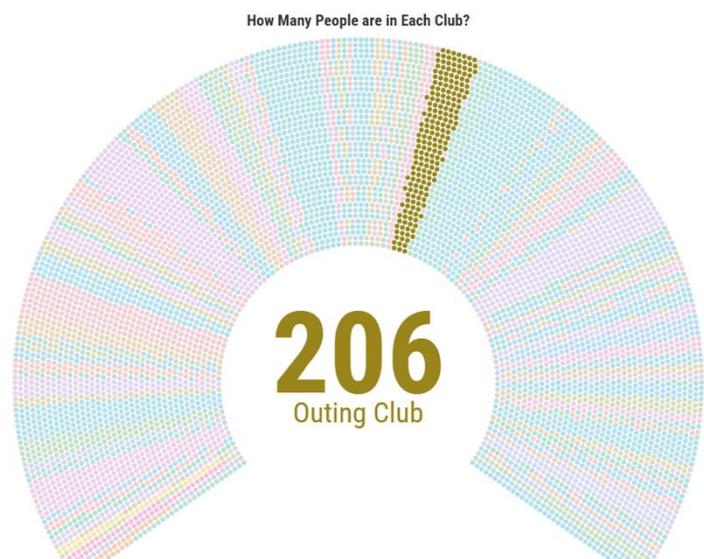


Figure 59: Parliament Chart

clubs’ budgets changed over the years.

This is another chart that is fascinating to watch and great for grabbing the user’s attention. Both charts were made with Flourish, a data visualization tool, and embedded in our site. Unfortunately, the embedded code was too slow and had to be removed. These charts could be recreated in D3 to potentially solve this problem.

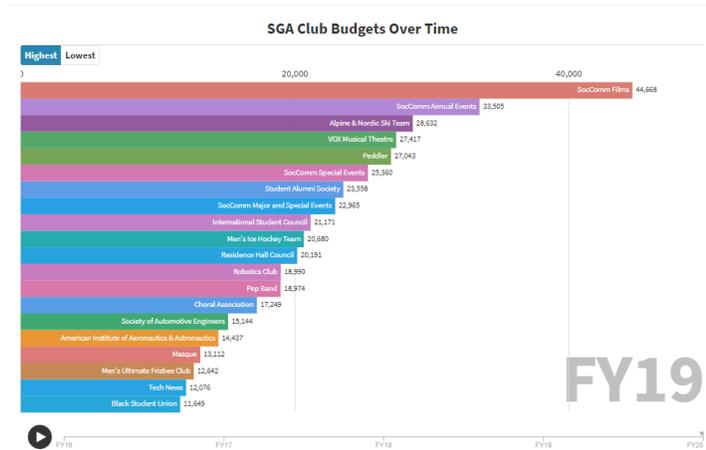


Figure 60: Bar Chart Race

### 6.3 Further Interactivity from Students

Long term the goal of this project is to be able to give students a voice as to where they think their student life fee should go. We want SGA to have this information to assist in their financial decision-making process, specifically about clubs and services that will affect all students. One idea that we think could be interesting is an allocation interface/game-like section of the site where each student can choose where they would want their \$316 to go between Mandatory Transfers and Club Budgets. Each student would need to use their WPI email and could only submit their opinions once. Furthermore, they would need to answer some demographic questions (what clubs are they involved in, how often do they go to big events, do they live on/off-campus, etc.) so that SGA could understand their bias when interacting with the site. This section of the website would look and feel like a game but in actuality the results

would be turned into survey data that SGA could then review and use to justify financial decisions.

If the actual game type section is too ambitious there could instead be a smaller version where students can give feedback about what they want from big campus-wide events. Maybe another game-like thing where they could design their 'perfect' on-campus event. This has the potential to be helpful for SGA because for big events like Homecoming, Herd Day, Founders Day, Big Show, etc. they have to always be thinking about whether all of WPI's campus would enjoy the event and whether students would want their SLF fee being spent in these ways. With this future improvement of our site it would take a lot of the guessing out of the process so SGA knows that they are funding events that students truly want to attend and participate in.

One final piece to this recommendation has to do with engagement. For this piece to be useful and have the impact that is needed, many students will have to interact with the site. Through word of mouth or campus-wide emails are fine, we recommend adding social media plugins to the site. If students can share with their various social media accounts (Facebook, Instagram stories, Snapchat stories, etc.) their 'game' results about how they decided to allocate their money or what their perfect big on-campus event was it would help incentivize other students to try it out as well. This is just one way to increase engagement and make sure that every student's voice is being heard.

## 6.4 Streamlining Database Access

Currently SGA's financial data is in the same database we modified and worked in for our project. We have created many views for our own specific needs but there is a need for more

to be created to show different aspects of the data and bringing data together. Having a cloned database where the data that SGA uses for everything isn't directly changeable is important. If someone accidentally writes a bad query for the SGA database while working on a future iteration of this project, there's a chance all of the data could be lost.

## 6.5 Improving Data

A final area on which we have recommendations is within the actual data itself. While the data cover a lot of areas there are still places where it is incomplete and lacking. There are two main sections of missing/incorrect data that we found:

1. Mismatch between the Organizations and Club tables: There is a Club Budget table with various information about all clubs who receive a yearly budget. This makes up 125 of the overall 259 clubs. Our site revolves around the SLF and where that money goes so we only visualize these specific clubs that get a yearly budget. As we were looking into SGA's data though we found that the Organizations table included data on all the clubs including the 134 clubs that do not receive a yearly budget (many of which receive money from member dues). Unfortunately, our site does not include these clubs in our visualizations, but we feel that they could be valuable to show in the future. Additionally, we think that in the future SGA should make one big table for all the clubs along with their two sub tables seeing as it can be confusing to find and understand both of them separately.
2. Nicknames in most tables: There are nicknames for most clubs which are very useful and more recognizable to students, but they are not found throughout the data, only in specific

places and it would be beneficial for them to be available everywhere. There are some instances where students only know clubs by their nicknames and not by their real names.

3. Incorrect membership numbers: Membership is self-reported each year to SGA and the Student Activities Office (via Campus Labs online), often clubs do not report which leaves the membership numbers either nonexistent or outdated from past years. This becomes an issue when creating data visualizations because even though we show the data as it is, it might not be the clearest representation of what is happening. We suggest that SGA improves its membership number collection and that SGA, and the Student Activities Office share their information for the most accurate data.

With these issues fixed and funding request data up to date future iterations of this project should be able to progress and begin showing the most accurate data with more thought-provoking visualizations.

## 7 Conclusion

WPI has a motivating and encouraging community with many diverse ways to be involved in clubs, organizations, and school-sponsored events. The budget for these activities is handled by SGA and comprised of the Student Life Fee. While it may be part of every undergraduate student's tuition, its purpose is mostly unknown to the WPI community. This issue was identified by SGA. They responded by making their goal to increase financial transparency for the fiscal year of 2020.

This project is designed to address SGA's goal and begin spreading awareness of the student life fee. To accomplish this, our team surveyed the undergraduate student knowledge of the Student Life Fee, created a functional data visualization website, and assessed the effectiveness of these visualizations. Our site is hosted on WPI's servers where all students and faculty will have access to it. Additionally, we developed the framework for an SGA admin database tool and published it on our GitHub repository. For future MQPs we have provided thorough documentation so they can properly maintain and expand upon our website. With this future cooperation, our data visualization website and admin database manager can be polished, robust, and effective tools in continuing financial transparency among all of WPI's student life entities.

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## Appendix A: Final Deliverables

### A.1 Link to our Project

Our GitHub repository for this MQP can be found on

<https://github.com/andrewrm98/SGAFiViz/tree/master/fi-viz>. Additionally, our website is

hosted on <https://sgaviz.cs.wpi.edu> and is only accessible on the WPI network. Like previously

mentioned in this paper, there is a 'config.json' file omitted from our repository that contains

sensitive information needed in order to connect to SGA's MySQL server. Contact our advisor

Lane Harrison ([ltharrison@wpi.edu](mailto:ltharrison@wpi.edu)) for more information on accessing this 'config.json' file. If

any of these screenshots are too small to view, please download the image.

# Appendix B: Final Website Screenshots

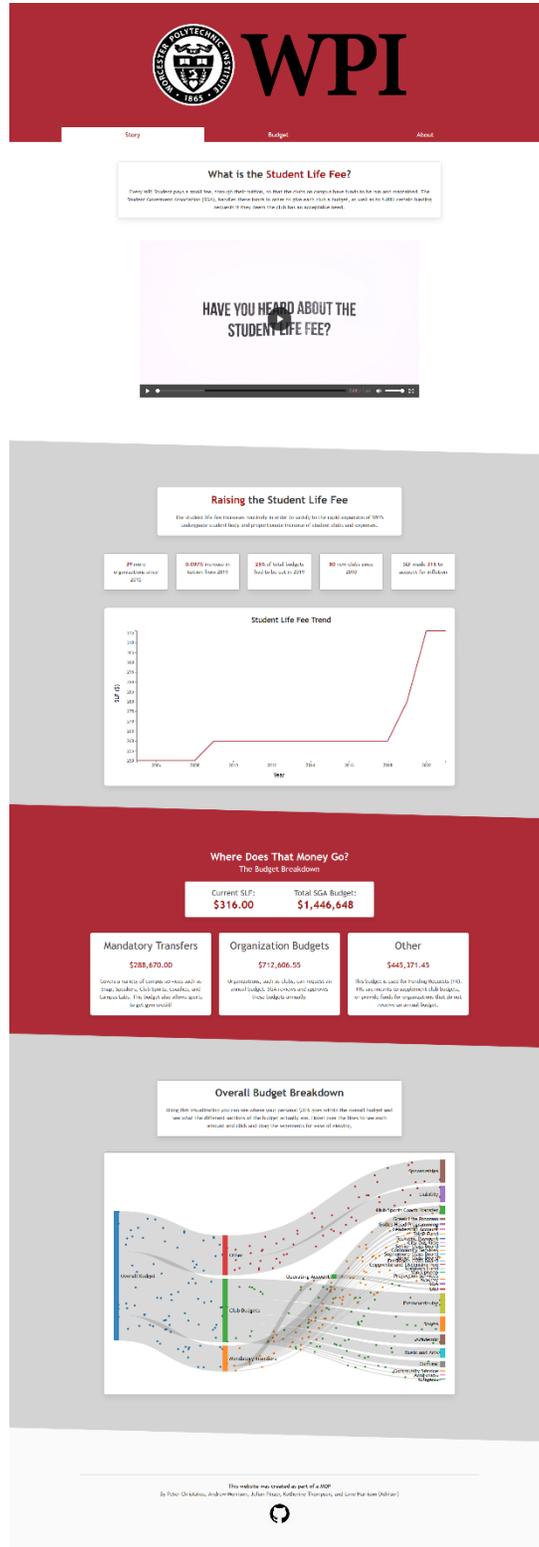


Figure 61: Final Story Page

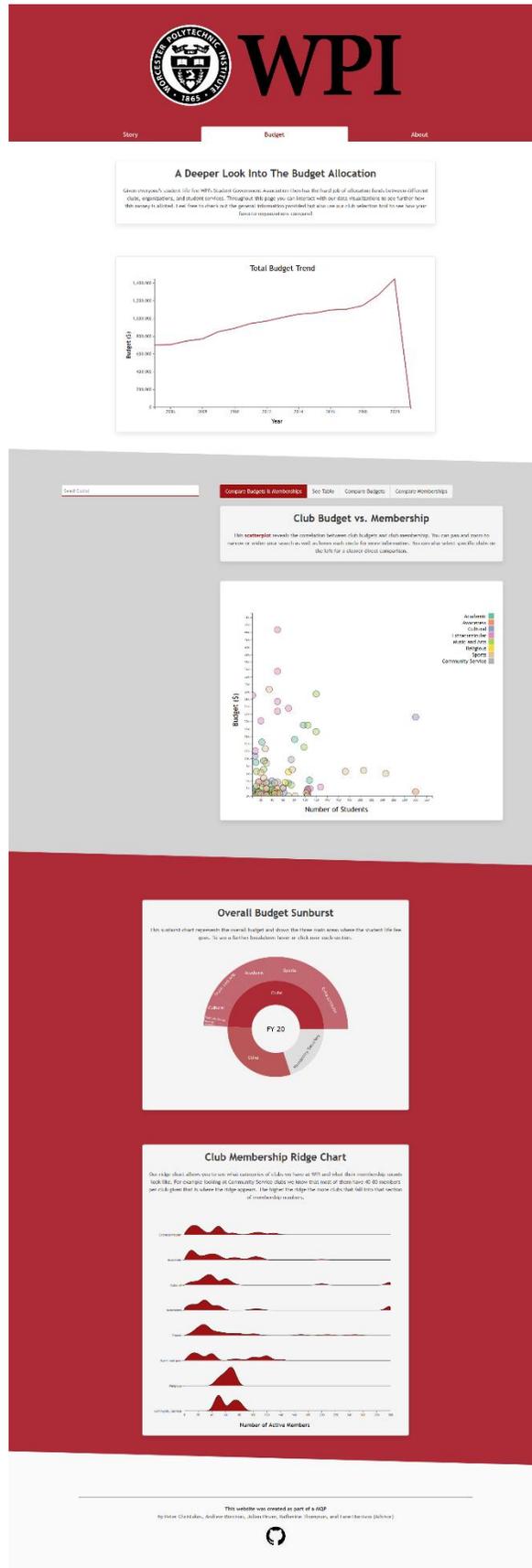


Figure 62: Final Budget Page



# WPI

Story

Budget

About

## The SGA Mission Statement

The mission of SGA is to improve the quality of undergraduate student life at the University both academically and socially by addressing student needs and concerns, providing financial structure for WPI's student clubs and organizations, and representing the student body in a profession manner.

**Want to get involved?**

- Join a club, or start your own!
- Attend campus events
- Attend SAO events

**Want to find out more?**

**Email:**

- sgaexecs@wpi.edu,
- sgasuggestions@wpi.edu,
- or sgatreasurer@wpi.edu

---

This website was created as part of a MQP  
By Peter Christakos, Andrew Morrison, Julian Pinzer, Katherine Thompson, and Lane Harrison (Advisor)



Figure 63: Final About Page

Home

# SGA Financial Data Visualization Website

## Abstract

INSERT ABSTRACT WHEN DONE

## Description

This is the repository for the SGA Financial Data Visualization MQP Team of 2019-2020. The team consisted of Peter Christakos, Andrew Morrison, Julian Pinzer, and Katherine Thompson. The advisor was Lane Harrison.

There are two parts of the website, the [React.js](#) frontend, and the [node + express server](#) backend.

## Instructions

NOTE: must have node installed on your computer

1. Start by running `npm install` in this directory

Home

### Classes

- AboutPage
- BarChart
- BudgetPage
- ComponentSwitcher
- ExampleSelectChart
- Footer
- Header
- LollipopSelect
- RawDataTable
- RidgeChart
- Sankey
- ScatterPlot
- Select
- SLFLineChart
- Story
- SunburstChart
- TotalLineChart

### Global

draw

Figure 64: Final Documentation Page

## Appendix C: Surveys

### C.1 Student Life Fee Survey

The link to our google forms containing the Student Life Fee Survey can be found at:

<https://forms.gle/vxjBg8kntQkNwipR6>. Full page screenshots are provided with the questions and answers for this survey. If the text is too small to see, please download this picture in order to read every question.

SLF

Questions Responses



### The WPI Student Life Fee

Our quiz aims to assess student knowledge about the WPI student life fee. This is information for a WPI MQI; any questions can be directed to Katherine Thompson at [kthompson@wpi.edu](mailto:kthompson@wpi.edu).

\*\* By taking this survey, you acknowledge that your anonymous responses may be quoted or referenced in our MQI paper. \*\*

This survey is part of an MQI: Visualizing SGA's Budget, for the year 2020 and has received WPI IRB approval (Record Number: IRB-20-0213)

What class are you a part of?

- 2020 (Senior)
- 2021 (Junior)
- 2022 (Sophomore)
- 2023 (Freshman)
- Graduate Student

Are you or have you been involved in SGA (Student Government Association)?

- Yes
- No

Have you ever heard of the Student Life Fee?

- Yes
- No

Do you feel like you know how the money raised by your student life fee is being used?

1 2 3 4 5

I have never heard of this fee      I know exactly where my money is going

What do you think the 2020 Student Life Fee was?

- \$100 - \$400
- \$400 - \$800
- \$800 - \$1200
- \$1200 - \$1600

What do you think SGA's yearly estimated budget is:

- < \$250,000
- \$250,000 - \$500,000
- \$500,000 - \$1,000,000
- \$1,000,000 - \$1,500,000

About how many undergraduate clubs (including club sports) do you think WPI has?

Short answer text

Do you know the resources available to WPI students to see where your Student Life Fee goes?

- Yes
- No

Would you be interested in having a more easily accessible and aesthetic way of seeing a breakdown of your Student Life Fee?

- Yes
- No

Is there anything else you would like to learn about your student life fee or SGA's budget? (if no please leave blank)

Long answer text

Figure 65: SLF Questionnaire



## C.2 SGA Questionnaire Survey

The link to our google forms containing SGA Post Presentation Survey can be found at:

<https://forms.gle/M6hFCQzWeATxb4Z37>. Full page screenshots are provided with the questions and answers for this survey. If the text is too small to see, please download this picture in order to read every question.

SGA Post Presentation Survey

Questions Responses



### SGA Post Presentation Survey

Our goal is to assess the effectiveness of our financial transparency site for WPI in regards to the Student Life Fee. For further viewing you can find our site at: <http://open.wpi.edu>. (Disclaimer: it was just set up today so we are still working on being remaining bugs, if you go on it and its down please email us)

This is information for a WPI MGP: any questions can be directed to our email alias at [grm@wpi.edu](mailto:grm@wpi.edu) or to [rahman@open.wpi.edu](mailto:rahman@open.wpi.edu)

\*\* By taking this survey, you acknowledge that your anonymous responses may be quoted or referenced in our MGP paper. \*\*\*

This survey is part of an MGP Visualizing SGA's Budget, for the year 2020 and has received WPI IRB approval (Record Number: IRB-20-0213)

What class are you a part of?

- 2016 (Senior)
- 2017 (Junior)
- 2018 (Sophomore)
- 2019 (Freshman)
- Graduate Student
- Faculty

Are you or have you been involved in SGA Student Government/Association?

- Yes
- No

Had you heard of the Student Life Fee before viewing our website?

- Yes
- No

Do you feel like you know how the money raised by your student life fee was being used before viewing our site?

1 2 3 4 5

I have never heard of this fee      I know exactly where my money is going

Do you feel like you know how the money raised by your student life fee is being used after viewing our site?

1 2 3 4 5

I have never heard of this fee      I know exactly where my money is going

What do you think the 2020 Student Life Fee was?

- \$100 - \$400
- \$400 - \$800
- \$800 - \$1200
- \$1200 - \$1600

What do you think SGA's yearly estimated budget for 2020 was?

- ~ \$20,000
- \$200,000 - \$300,000
- \$500,000 - \$1,000,000
- \$1,000,000 - \$1,500,000

Do you believe that currently there are adequate resources to help students see where their Student Life Fee goes?

- Yes
- No
- Maybe

Do you feel like you learned more about SGA finances through this site?

- Yes, I know a lot more
- No, I knew nothing and I still know nothing
- I already knew a lot so this site didn't change that
- Other...

How likely are you to use this site in the future?

1 2 3 4 5

Never      Often

Do you have any further feedback for our team about the site or about our project itself? (if no please leave blank)

Long answer text

Are there any visualizations you did or did not find particularly helpful?

Long answer text

Thank You!

We really had fun to see these sites in SGA, we hope that the students benefit with these great people throughout the project who have been a huge help, and we are grateful that you have helped make this project possible.

Figure 67: SGA Post Presentation Questionnaire



Figure 68: SGA Post Presentation Questionnaire Responses

## Appendix D: Meeting Minutes

### D.1 Initial SGA Meeting Minutes

1st View where is MY MONEY going:

Animation at beginning- showing how much we each put in

-show where MY money is going to each club

-like humble bundle- show where you want your money to go

-with the amount show where you want your money to go- This is the ULTIMATE goal, that student life fee dividing up goes to where student actually care

2nd View where is ALL SGA money going:

-money tree?

-showing overall where all the money is

---

April 19th is when new website launches

-link to the website (wordpress - student version)- working with Chris Tocci

-<https://wp.wpi.edu/sga/>

-<https://wp.wpi.edu/sga/student-life-fee/>

-they used google sheets, now using axis (access) database- its relational?

Just undergraduate budgets:

Mandatory transfers: snap, sao, etc. one time transfer (300,000)

Budgeting: yearly basis (800000)

Funding requests/sponsorship: whatever is left, allocated each week through financial board (extra)

Another board for graduate budgets etc. (maybe do stuff for them too?)

Different club classifications

-and even further (cultural, campus wide, fiscal, etc)

-further breakdown for what things are being spent on

-budget + funding requests

Spend tons of \$ on club sports- that can be its own thing

-simple and easy to read data (pie charts etc.) but then some more detailed graphics that are funky

-bylaws etc.

- financial 101 for all the treasurers
- also on campus labs
- bylaws for funding requests
- posted on techsync!

Interactive - like this club vs. this club  
4-5 quick stats for each club

Storyboard and initial designs  
React? -some good libraries

- 
- Website?
    - Financial data, Student Life Fee, other data, how much can we get and how much is from wpi?
    - Also adding other info, maybe more in depth about what committees are doing what, some interesting ideas that people want to know are being talked about
    - Some info: is someone redoing their real website?
  - If we are doing this with Lane are going to need to incorporate some sort of data vis?
  - Stats about money, stats about how many people are in clubs, look at success of clubs vs. numbers vs. money
  - <http://letsfreecongress.org/>
    - Julian is learning d3 rn, but many different types of data vis software
    - D3 is javascript
    - <https://medium.freecodecamp.org/learn-d3-js-in-5-minutes-c5ec29fb0725>
    - <https://davidwalsh.name/learning-d3>
    - <https://www.codecademy.com/learn/learn-d3>
    - UDEMY: <https://www.udemy.com/courses/search/?src=ukw&q=d3>

## D.2 Aug 30, 2019 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson  
**Moderator:** Julian Pinzer

### Important Item Summary:

Lane wants us to research MQPs, other financial visualization websites (good and bad), send our Github link to him, set up a call to John Stasto of Georgia Tech, and research different databases to develop a pro-con list. Some way to contact Lane easily like Slack. Also, we should work on staying as organized as possible.

- Latex template
  - HTML for pdf papers
- Lane has a MQP starter kit
- Focus on HCI components to make sure people want to use the new systems and they are intuitive
- Read 3 MQPs?
  - Lane has one he likes, it's about vulnerability visualization
    - Smoothest MQP for writing
- Minutes and agendas in one folder with links??
- Lane would like to see some examples of visualization websites, and what we think is good and bad about it
- Send github invite to Lane
- John Stasto Georgia Tech
  - Website was too public
  - Set up a call through Lane to get the story of how they did it so well (too well)
- Urban Institute
  - Transparency for the US government
- Figma - web design tool
- Lane wants to keep something on the block
  - Start with biweekly and meet as needed
  - He liked projects where we do 15 minute google hangouts and doing quick feedback throughout
    - Instead of meeting, send our work along so he can look at it
- Slack?
- A short term thing would be to get a good look at what this data is
  - How is it stored, what are the rights, and then we can think of solutions
- MySQL might be the way to go
- Do a pro con analysis of different databases
- Modernizing the process
  - Get test users
- A way for people to connect things like R and tableau
- Prototype in R
  - R for Data Science - read the first five chapters

- Observable Notebook
- Present the data as neutrally as possible and let other people come up with the story
- Good documentation and illustration for how it works
- Our project is providing an interface for SGA
- Buffer time for unknown problems so we don't go into D term
- Keep cool details like their goal for this year is financial transparency in a text file so we don't forget them

Overall Outline:

**A Term-** Data Structures, Getting data from SGA (what do we actually want to use), Mock-ups and prototypes of visualizations, Research of visualizations, talk to WPI IT about hosting website/database, start the research portion of the paper

**B Term-** Implementation, integration with the website, visualizations, add to paper, constant talking with sga about what they want

**C Term-** Testing, finalizing, MQP paper, presentation

**D Term-** let's hope not

Current To Do:

- ~~Set up our weekly meeting times (2 times a week?)~~
- Set up (biweekly? Meetings with sga people)
  - Ask them to show us around the data
- Set up (biweekly? Meetings with Lane): Monday or Friday
  
- ~~Make sure everyone is registered~~
- Get access to supposed database!!
  - Right now there is a static Access File
  - They are trying to create the ability for live updates and secure a server on it
  - Is this the best idea? Are there better ideas for hosting data?
  - Start thinking also about how our application will access it
  - What data do we have, what more do we need?
- ~~Set up repository (GitHub? gitlab?) - SGA FiViz~~
- Basic cs set up, download needed software, IDE, etc. decide on what we will be using (this will probably change)
  - What are the best tools for data visualizations
- Research budget visualisations, what works well and what doesn't for a broad range of organizations
  - Try to find what georgia tech did
  - <https://www.urban.org/aboutus/our-funding/financial-overview>
  - <http://ieeevis.org/year/2019/welcome>
  - Also find some academic papers
  - Document this all! We will need it for our paper later on

Questions on current SGA Data:

- With more research chat with sga about what they want and what we want to provide
- More logistics with sga, how are we going to be integrated into their website
- What is a class (Class A, B, C, D)
- What is a club grade (A, B, C, NR)

## D.3 Sept 6, 2019 SGA Meeting Minutes

**Participants:** Julian Pinzer, Katherine Thompson, Peter Christakos, Andrew Morrison, Kevin, Steph

- MySQL gated behind WPI
  - Using WPI credentials to access the database
- Give people view only access
  - They like view only vs admins
  - Right now they give copies of data in a spreadsheet :(
- Christine Sherry? - faculty advisor
- Appeals checkmark - clubs have the ability to appeal (did the appeal get approved, for how much?)
  - Can appeal the first full two weeks of D term
    - Often have people come after the two weeks, but it's already closed and there's nothing they can do
      - Senate has to approve the budget as a whole
- Classes are a fiscal category (if you spend 50% you get a NR)
  - If they use not enough money, or too much they get a poor grade
    - Use too much money, their budget gets suspended and they have to pay back the money
- Miscommunication when clubs don't put in their expenses
- Any money not spent gets rolled back (usually see about \$130k)
- Funding accounts table is a WIP
  - How we get the student life fee transfer
  - SGA operating account, speakers fund, etc
  - Sponsorship is where the funding requests come out of
- They get a different portion of the student life fee during the fall and spring
  - Student life fee is paid in two parts
- Look at past FRs to see if they have asked for it before, if it was accepted or denied, and if it was used or not
  - This helps so they are not wasting money on clubs that don't use it
- Get about 200 funding requests per year
  - Give a presentation about why they need money
  - Most get passed
- Executive budget for emergency situations
- F, S, E - three different kinds of funding requests
- Reclassification vs reallocation
  - Clubs can ask to reclassify to get a different budget

- Ask for reallocate existing funds to a new or different event
- Mandatory transfers go to things like coaches, campus labs, SAO employees, SNAP
- Goal of access database is standardization
- Email steph or kevin to talk about hosting the website, we want to link to our stuff

Random Kath Notes:

- after two week period-that weekend appeals board changes
- class is financial class aka 0-1000
  - can't judge these budgets
- NR if under spend or over spend (overdraft)
- basically they loan money to these clubs-reimbursement
- class 1-3 important they get budgets handed out in august
- frs are for unexpected things
- money clubs don't spend gets rolled back
- don't get entire student life fee at once, get one in fall and one in spring
- they want a document to export as well with the visualization

Overall Outline:

**A Term-** Data Structures, Getting data from SGA (what do we actually want to use), Mock-ups and prototypes of visualizations, Research of visualizations, talk to WPI IT about hosting website/database, start the research portion of the paper

**B Term-** Implementation, integration with the website, visualizations, add to paper, constant talking with sga about what they want

**C Term-** Testing, finalizing, MQP paper, presentation

**D Term-** let's hope not

Questions on current SGA Data:

- With more research chat with sga about what they want and what we want to provide
  - Some way to input data? Interactive
  - How are the appeals set up/shown?
    - I saw the checkboxes
    - Who keeps track?
- More logistics with sga, how are we going to be integrated into their website
  - Our page on their site?
  - Our own site?
- What is a class (Class A, B, C, D but also 1, 2, 3)
  - Couldn't find the documentation
  - Can a club be class a but also 1
- What is a club grade (A, B, C, NR)
- Funding Accounts
  - Is this all the different \$ that SGA has broken down. Fall vs. spring transfers?
- How do people request funds, and why such a big difference between what they ask and what they get
  - What happens when a request is withdrawn or denied or tabled?
- How often is the amount approved/amount spent updated? Should we even be showing amount spent type details

- What is a reclassification vs a reallocation?
- Is the active member info taken every year?
  
- Access Database
  - Right now there is a static Access File
    - Will be the ability to input and have live updates with a secure server
  - Is this the best idea? Are there better ideas for hosting data?
    - Looking into mongoDB and other options
    - [Insert pro con list here](#)
    - Can migrate a whole access database somewhat easily
  - Start thinking also about how our application will access it
  - What data do we have, what more do we need?

## D.4 Sept 27, 2019 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

Moderator: Julian Pinzer

Secretary: Andrew Morrison

### Current To Do/ This Past Week:

- **Set Up and started with Figma**
- **Added a lot more to Budget Visualizations research document**
- **Started our Data Design Document**
- **WPI IT has decided to support the use of mySQL for this data and the migration will be complete before B term**
  - With WPI IT the opportunity to authenticate users based on WPI credentials, we can possibly dole out read/write admin access
- **SGA Meeting**
  - Very informative meeting and we took lots of notes:
    - <https://docs.google.com/document/d/1NswFK6LsP5sxeLGSHZ9nL5bYISyN8rYdypE1yj41ags/edit?usp=sharing>
  - SGA is using the database for storage and entry, we may need to export into a different format for data visualizations
  - Use a snapshot of the database to get visualizations working before setting up the pipeline for the entire database
  - Prototyping in R - Tidy R and DPlyR (second time he brought this up we should definitely try it) - static visualizations
    - Best tool for manipulating and transporting data
    - **Nadieh Bremer**
      - <https://www.visualcinnamon.com/>
    - **Sherly Wu**
      - <https://www.youtube.com/watch?v=S1PDU2Ckt5w>
    - **Giorgia Lupi**
      - <http://giorgialupi.com/>

- **Tulp interactive**
- **Moritz stefaner**
  - <https://truth-and-beauty.net/>
  - Interview Craig Shue about his minor application SQL stuff
- **Call with John Stasto of Georgia Tech**
  - Does Prof Harrison have their contact info?
  - OOctober 20th or 21st, remind lane!
- **MySQL dummy project to start familiarizing ourselves with the technology**

#### Comments on Data Design Document

- Cold hard design vs. cute, sharable design
  - Creative at the beginning and get into more serious data as you get further down
  - Our audience are WPI students so they understand data
- What are sessions going to look like? What do you want the experience to be?
- Show everything and then filter stuff out!!
- Scatter Plot over time for grades of clubs
- Hard to have humans read and compare data on a sunburst
  - Treemap and then look over and get bar chart
  - Treemaps are good for showing space filling, bar charts are good for comparing data
  - Bubble charts?  
[https://www.google.com/search?q=bubble+charts&rlz=1C1CHBF\\_enUS704US704&oq=bubble+charts&aqs=chrome..69i57.3035j0j7&sourceid=chrome&ie=UTF-8](https://www.google.com/search?q=bubble+charts&rlz=1C1CHBF_enUS704US704&oq=bubble+charts&aqs=chrome..69i57.3035j0j7&sourceid=chrome&ie=UTF-8)

#### Research:

- **Database research**
  - We made a pro/con list:  
[https://docs.google.com/document/d/1P\\_5hdlKnP6dr8pvUtgwCNNHmrzYPM7ar0vAw09RTAF8/edit?usp=sharing](https://docs.google.com/document/d/1P_5hdlKnP6dr8pvUtgwCNNHmrzYPM7ar0vAw09RTAF8/edit?usp=sharing)
  - Looking deeper into mySQL and its capabilities
- **Starting Budget visualization research**
  - [https://docs.google.com/document/d/1BuGTY6bHjgpDdxWr\\_irbGFabU-6hqa19zQAGrQCzqjs/edit?usp=sharing](https://docs.google.com/document/d/1BuGTY6bHjgpDdxWr_irbGFabU-6hqa19zQAGrQCzqjs/edit?usp=sharing)
- **What are the best tools for data visualizations**
  - Goal for this week's research
  - D3 is well known but is this best for us?
- **Visualizing Contextual Information for Network Vulnerability Management**

- Is this the MQP that Lane liked?

**What Do We Like:**

- Interactive colorful data that is very visual based
- But also some more technical data for those who are so inclined
- Sunburst diagrams
- Animations
- Tree “branching” out look
- Intuitive data
  - People don't need technical skills to read it, it's easy and understandable for anyone
- Color scheme and design - capture the users attention
  - Fun and inviting color scheme
- Scrollers make the data easier to digest piece by piece
  - We like the idea of Scrollytelling

**What Do We Not Like:**

- Too technical
  - An overwhelming amount of data all upfront
- Boring/static
- Plain white color scheme but also nothing too flashy or bright
  - Good in between
- While fun visualizations and ‘cute’ stuff is good, too much can take away from the impact of the data so that is a mixture as well

## D.5 Oct 28, 2019 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

Moderator: Julian Pinzer

Secretary: Andrew Morrison

Current To Do/ This Past Week:

- **Starting paper**
  - Working on intro and proposal
  - Need to work on background with research done last term
- **Admin Tools with real data**
  - We will be getting SGA feedback soon
  - Had it user tested by a lot of people in our class
    - We like tabulator a lot and will probably be using it!
    - Used a React framework for this and Chartist (which was meh)
- **My SQL access**

- Talk about data, format, and email giving us access
  - We have access to create tables, edit data, add data, etc.
  - We are thinking of having our own table with only what we think is necessary for the visualizations, so we don't have to sift through a lot of extra stuff application side
- Run by WPI, how can this help us with giving access and authentication
  - Because it's through wpi they can help give access to only wpi people with the right credentials and then we can check on our end
- **Continuation of R**
  - More visualizations
  - What data do we want: we've shown requested vs got by class, possibly showing the grades of everyone
    - At first we were going to show appeals but as these get added in the total approved for each club is updated so this should be updating our visualizations live
  - SGA is interested in simple infographics that can be made from the data to print out, maybe we could do this in R because all they want are simple 2d, printed out graphs
- **D3 examples**
  - Familiarization with the tool and very basic graphs this week

<http://vis.stanford.edu/files/2010-Narrative-InfoVis.pdf>

- Think about the structure of the story we want to tell
- Five Design Sheets methodology
- Figma for storyboarding
- Log of actions on database
  - Keep it forever
- Plotly for downloading? Flourish - for news
  - Best option is probably just to tell them to take a screenshot
  - They should be comfortable making their own analysis
- Plan for this term
- Can use memory in Node to store JSON files and have a function to update

## D.6 Nov 11, 2019 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

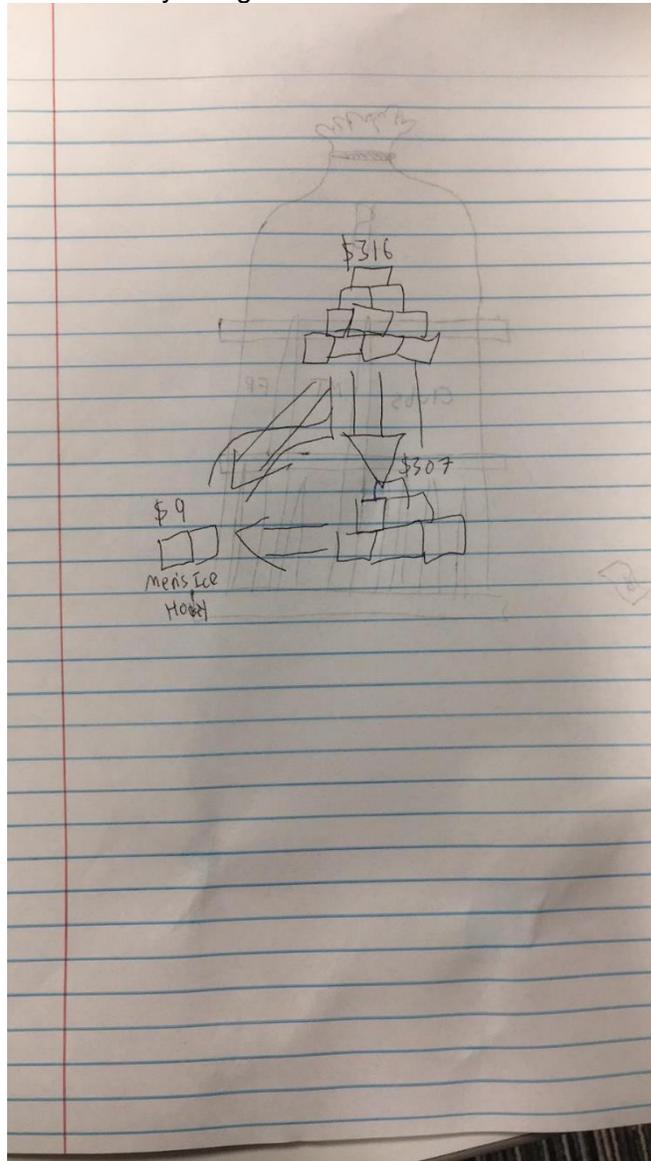
Moderator: Julian Pinzer

Secretary: Andrew Morrison

### Completed

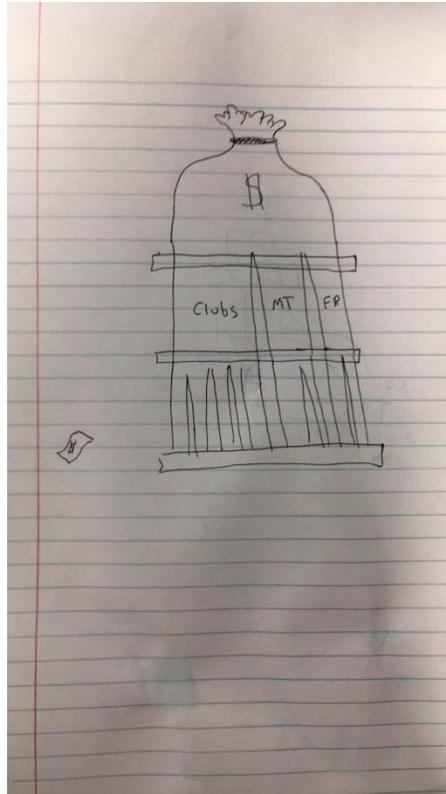
- Wrote the [introduction](#) and began edits

- Based off of story outlined by sga found [here](#)
  - Wants a priority list of what we want him to look at
- Outlined background
- Made several [R visualizations](#)
- Created a [website design](#)
- First attempt at making a sankey diagram
  - Using examples such as [this](#) and [this](#) to start
  - Try using Plot.ly as a place to start & rawgraph
  - Throw in a treemap since it might be easy to do in D3
  - Elijah Meeks
  - <https://bl.ocks.org/emeeks/e749224c89f82788cb18> - meeks sanky
  - <https://bl.ocks.org/emeeks> - meeks
  - [https://datavizcatalogue.com/methods/parallel\\_sets.html](https://datavizcatalogue.com/methods/parallel_sets.html) - parallel sets
- Brainstormed scrollytelling ideas



○

- Particle visualization
- D3 stack overflow and ThreeJS slack
- Send Lane outlook invite and the things we want him to read



### To-Do

- Create D3 visualizations
  - Simple ones like what we made in R, sunburst?
- Write background rough draft
- Edit introduction
- Finish initial website layout
- Improve sankey diagram
  - [Rawgraph](#), [plotly templates](#)
- Get started on scrollytelling idea

## D.7 Nov 25, 2019 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

Moderator: Julian Pinzer

Secretary: Andrew Morrison

### To Ask

- Prof Harrison looked at our intro and figma last week, what did he think?
- Possibly use [jekyll](#) to update website from markdown files
  - \_layouts, inputs, data
- [Triple E](#)
- Scope is getting large, we might want to scale things back
  - Start taking notes for a "future iterations" section in the paper
    - True we gotta take a chill pill
    - One way flight to chilladelphia
- Plan to sit down with people and interview them (good for making our paper longer)
  - We could also use google forms? - need irb approval for a survey
  - We could survey all the greek life orgs and interview sga members and other key people?

### Completed

- Simple start to the website with different pages
  - Decision to be made between base react js and next js
- Background outline
- Further organization and quality checks of the data we have
- Sankey start
  - Basic based off of meeks, adding in our own data slowly
  - Breaking down the data into one easily manageable piece

### To-Do:

- Turn the background outline into an actual background
- Start making the sankey our own
  - Our data, seeing how scalable this is, etc.
- Continue flesh out the website design: header, pages, etc
  - Trying to get it to a point where we can just plug in the visualizations

## D.8 Jan 31, 2020 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

Moderator: Julian Pinzer

Secretary: Andrew Morrison

### To Ask:

- Advice on our planned surveying?
  - He's about it, just update the IRB
  - For interviews, balance personal and professional
  - Find a few people to start with to practice with (non key players)
  - Capture what people say and reflect on it
  - How do we take this to the next level to help our research
- General thoughts about the diagrams?
  - Detailed below, make cleaner and prettier
- Should we still be setting the backend tools as a goal, is that ok as something to leave for the future?
  - Yes. Making the story is more important to help the project continue in the future for people to then work on the backend
- Are we on track? What happens if we need an extra term to put finishing touches and finish paper?
  - His schedule opens up in D term
  - Very realistic for us to finish in D term, most teams do
- We have the big boi visualizations with the sunburst and sankey, does he have any thoughts for the little boi ones?
  - We will probably use his class to work on some fun and creative ones :)
  - Search in Visualization paper
  - Funnel chart with search for a club
  - Bubble chart for club categories
  - Compare across clubs, see ask metafilter thing in slack
    - [http://projects.flowingdata.com/tut/linked\\_small\\_multiples\\_demo/](http://projects.flowingdata.com/tut/linked_small_multiples_demo/)

### Completed:

- Background Section
  - Will be sending to him to take a look at
    - He will start reading over them and printing them out for annotations in Feb
  - Go over main points? Maybe ask what he has seen in the past
- Good portion of the website set up
  - Show him and ask for feedback
  - Color scheme? Breakdown of the story/budget pages?
- A lot of work on getting the SQL view the way we need them

- One place where all the Total Budgets actually are with breakdowns for clubs, mandatory transfers, and other (which calculates liability and sponsorships/rollbacks)
  - We made our own breakdown of the clubs based on type that we are using now
- Sunburst diagram
  - Show him and ask for feedback yet again
- Sankey Diagram
  - Show him and ask for feedback again
  - Maybe better way to see dollar amount
  - Look and feel and colors make better
  - Nice theme
  - Tora Musner's Nested Model
- My fun video!
  - I hope he likes it because I like it a lot!!
  - Its \$10 ish for us to buy it without the watermarks but could there be better color scheme or music? Want to be sure before we spend \$\$ on it
  - Link: <https://biteable.com/watch/sgafiviz-2439134>
  - Training video for a project he did, lot of effort but the video helped a lot.
  - Make video shorter, some confusing terminology
  - More likely to view website with an explanatory video
- Starting the IRB process, Peter's certification and the survey we have made
  - Questions below about this process

To Do:

- More SQL work
  - We need to get the monetary values in a more usable form
- Survey
  - 1: Surveying general WPI public through the questions we already have seeing how much they already know
  - 2: Surveying uninformed people, having them look quickly at our visualizations and see what they get from them? Are they serving the purpose we want them too
  - 3: Surveying the SGA folk, do they think that it accurately represents where the money goes; will just changing the Fiscal Year be easy enough for them to keep this updated?

## D.9 Feb 13, 2020 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

**Moderator:** Julian Pinzer

**Secretary:** Andrew Morrison

Ask:

- What does he think about the parliament graph and bar chart race
  - Issue with the double reload
  - Data is static would need to be updated year by year, can we leave this for the future? Or should we do this now?
  - D3 implementation of bar chart race
    - Might be able to high jack and give credit to the author
  - Didn't say much about the parliament graph
- Show new video
- Show updated Stankey
  - New color scheme, and animation changes
  - I want to add some hover capabilities
  - Will be going on the Story page
  - Have something to help read it for un informed viewer
  - Has a grad student who is good at react and d3, he expects 1 week of work
- Show updated website design
  - What graphs on story vs. budget page?
  - "Looking pretty good"
  - Possibly make it in D3, add some annotations
  - Wants all our graphs to have a common theme
- There are a lot of data points that are "Not Provided" or some clubs with \$0 budget or minimal budgets, is it ok to group these/ignore them
- Proxy Error
  - Try making a test database
  - Driver issue (update java, jdbc)
  - Security permissions

To Do:

- Funnel Chart, Bubble Chart, ridge chart that julian is doing etc., membership charts
  - Ridge Chart- fine idea but maybe look at a tree map as well
    - Do people respond to this/do you learn something?
    - ZOOMABLE TREE MAP
- Survey - still waiting for IRB approval :(
  - Now that we have some visualizations lets chat with them!
  - But we do want to talk to people soon!
  - Prepare and worse case do it later
  - Evaluation: describe extent of involvement with SGA
    - Correlate with perception
    - What is the before and after of viewing our website
    - Are we affecting their plans in the future to get involved
      - Ask a before and after about this
- Throw sankey in the story page
  - React-d3 issues
  - He chuckled, and said he expects a week
- Finish redesigning the site & add footer
- Haven't talked to the SGA people officially but in class an SGA kid came over and saw what we are doing and was very excited, hopefully other people feel the same

- Potentially show the process of getting and asking for money with sga
- Aggregate chart to show the funding requests over time, how this changes over the year, click the year and design some kind of year that shows the first part and the second part of the year
  - potential comparison between what they start the year with and what gets approved
- Storytelling and vis, based on draft he sent
  - We are constructing a narrative, martini glass structure
  - Evaluation in multiple stages, domain tasks: raw comparison, part to whole comparison; visual encoding (tree map vs. sunburst, wrapped bar chart)
- Shoot for 40 references of stuff regarding d3
  - Different charts, evaluation, look and feel, storytelling
- D3 parliament chart
  - <https://github.com/geoffreybr/d3-parliament>
  - Try to make, can add our own interactivity
- Fix the line chart on the story page
  - Looks off, make more in line with other stuff
- Send him to our repo!

## D.10 Feb 27, 2020 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

Moderator: Julian Pinzer

Secretary: Andrew Morrison

Lane github: [codementum](#)

Dyr429: [Alex Dean](#)

### To Do:

- Pull and run on Mac
  - Andrew's issue is still bad, can Lane run it on his Mac? Or is this just and Andrew computer problem
- Name/Info of grad students who are good with d3 and React
  - Peter tried and has errors, I tried and get nothing at all
  - [Alex Dean: dyr429](#), Lane added him to our repo and we can reach out with questions now
  - Asked to maybe look at a repo and see if we can figure it out, cause this kid got a big boi deadline
- New line chart
  - More in line with styling of the others

- Getting rid of the parliament chart and keeping bar chart race, thinking about other charts
  - Ridge chart
    - Julian go off
    - Need some other way to show student involvement with clubs
    - **Talk to Alex as well**
  - Tree Map
    - Another potential way to show student involvement with clubs
    - What does he think?
    - Already made one for our data vis project
  - Making more smaller graphs
    - We have been focusing on big harder to create graphs, maybe it's time to make some smaller graphs to fill the space and show more info
- We will start formatting on the budget page
  - Thinking about keeping same formatting as other pages and have small blurbs on the side explaining the info
- IRB
  - This is taking so darn long
  - Does Lane have any experience with IRBs, should we follow up
- Next term planning
  - Adding more graphs and formatting budget page
  - IRB talking with people about the SLF and their perceptions
  - Speaking with SGA
  - Paper w/ plans for the future

## D.11 March 21, 2020 Advisor Meeting Minutes

**Participants:** Lane Harrison, Andrew Morrison, Julian Pinzer, Katherine Thompson, Peter Christakos

Moderator: Julian Pinzer

Secretary: Andrew Morrison

To Show:

- Updated Story page with the Sank
  - **He likes, slow animation, fix the title**
- Budget Page multiselect
  - Ridge, Lollipop, Radar
  - Ask for input about what else?
  - **Looking at ridge chart, keeps saying "interesting", but seems to think its a diff take on the classic radar; proposed vs. actual**
  - **Scatterplot - membership on x-axis, budget on y-axis, coloring based on classification**
  - **Throw the radar in supplemental materials and stuff to explore**
- What to do about mismatch of data, between Club Budgets and all organization budgets
  - **Way to represent them, even just list them**

- Talk about Paper
  - Do we have to use LaTeX or can we just use Word
  - Digging deeper into the data, membership, budgets, those with none, etc.
  - Talk about issues with the data in the paper
  - Talk about radar chart
  - 20-30 citations or more of good vis papers
- Ask about MQP virtual fair thing
  - Judges we chose - Lee (datascience) , Guo (mobile & ubiq), Charlie Roberts(webware), Whitehill(machine learning), Erinn Solovey (HCI), Jillian Smith
  - 5 minute video!
    - Intro, what is the problem, little bit of how, show the website, final evaluation
    - Very story like
    - Make it feel computer sciency ish, show off technical depth
    - Here's his <https://www.youtube.com/watch?v=Q0yOaDO-pSk&feature=youtu.be>
  - ~~Should we make a presentation~~
  - ~~Should we make a poster like normally is done~~
  - +Is this going to be interactive or will we pre record a site walk through
  - Ask we should reach out to SGA and present to them
- Timeline for the rest of the term
- Interviews are a no go
  - Still talk to SGA
  - Informal testing, super vague, no identifying details
- Can we get the money for that video
- Where to host website:
  - Write plan about how to get it deployed
  - Talk with SGA about integrating to their website
  - Talk with IT?
- PDF receipt of the biteable video just buy it

# Appendix E: Mockups and Sketches

**YOUR STUDENT LIFE FEE** **SGA**  
what you need to know

**FY 2019 \$280** **FY 2020 \$316** → **\$1.2 million\***  
\*Estimated \$1.4 in fees for FY2020

**MANDATORY TRANSFERS** FY19: \$273,302.00  
 - Club Sport Coach(es)  
 - Campus Life  
 - City Ride  
 - International and Leadership Programs  
 - SGA and Club Sport Interns  
 - Student Head Programming  
 - Student Life Programming  
 \*The funding enables club sport participants to receive grant credit.

**ORGANIZATION BUDGETS** FY19: \$813,527.27  
 Class One, Two, and Three organizations can request a budget for their events that are an annual cost. These items must align with our systems. For the purpose of this club and because of the annual approval through the funding request. Other categories of budgets can be seen below.  
 Class One (24.4% of Budgeted Funds): These organizations receive one-4 year of interest, like holding and ceremony to be held.  
 Class Two (25.3% of Budgeted Funds): This class includes a request for all club sports, administrative and non-administrative.  
 Class Three (14.3% of Budgeted Funds): Organizations that fall into the category provide programming and services open to all of campus.

**SPONSORSHIP & BOLLECKES** FY19: \$400,000.00\*  
 The sponsorship is the remaining SLF Budget after mandatory transfers and budgets have been allocated. Bollecke is any funds leftover from club budgets at the end of the previous fiscal year. These are similar to donations in the previous funding that can be allocated through Financial Board.  
 Funding requests are meant to supplement club budgets to provide funds for organizations that cannot receive an annual budget (Greek Life, Honor Societies, and other Clubs as a Financial Board). Funding requests are made by Financial Board.  
 \* This number is estimated at the start of every academic year; the final number is reported once Spring tuition has been finalized.

**FISCAL YEAR 2019 BUDGETING**  
 \$1.2 million AVAILABLE FOR ALLOCATION → \$1.09 million REQUESTED IN BUDGETS → \$296,700 REQUESTED BY MANDATORY TRANSFERS → \$1.39 million TOTAL REQUESTED → \$1.096 million TOTAL APPROVED

**SGA OPERATING BUDGET**  
 FY17: \$18,000.00  
 FY18: \$8,000.00  
 FY19: \$6,500.00

**STEPS FOR IMPROVEMENT**  
 Evaluating our budget needs.  
 Evaluating and restructuring our budgeting process.  
 Communicating with other SGA members in the community.  
 Improving communication with campus to be more transparent.  
 Reevaluating our policies and rules of funds.  
 Developing our resources and guidelines for transfers.

**RAISING THE STUDENT LIFE FEE**  
 39 more budgeted organizations, 0.007% increase to overall tuition, 25% of total budgets had to be cut in FY19, 80 new clubs, SLF adjusted to \$300 accounts for inflation.

**THE SGA MISSION STATEMENT**  
 The mission of SGA is to improve the quality of undergraduate student life at the University both academically and socially by addressing student needs and concerns, providing financial structure for WPI's student clubs and organizations, and representing the student body in a professional manner.

Header:  
SGA Story | Budget | About

Address About:

Want to get more out of your SLF?  
 - Join a club  
 - Go to events  
 - Start a club  
 - Attend SGA events

Want to work on changing SGA.  
 - Increase the quality of student life.  
 - Improve the quality of your SLF.  
 Representative requests: [www.sga.wpi.edu](http://www.sga.wpi.edu)

**THE SGA MISSION STATEMENT**  
 The mission of SGA is to improve the quality of undergraduate student life at the University both academically and socially by addressing student needs and concerns, providing financial structure for WPI's student clubs and organizations, and representing the student body in a professional manner.

Want to find out more?  
 Additional information and data will be posted on our website when it is completed later this year. Keep an eye out for its general release! **Get us your suggestions!**  
 Who should you reach out?  
[sga@wpi.edu](mailto:sga@wpi.edu)

**Budget**  
 SGA Story | Budget | About

\$316 your contribution  
 \$1.2 million total budget

Mandatory Transfers: 273,302.00  
 Organization Budgets: 813,527.27  
 Sponsorship & Bollecke: 400,000.00

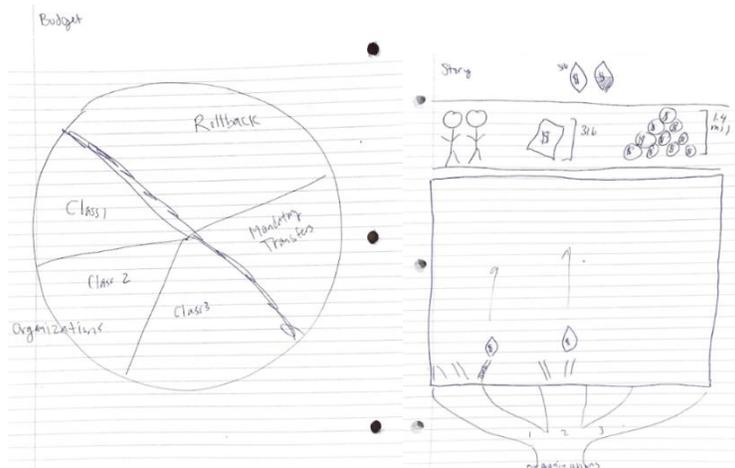
SGA: Coaches, Campus Life, City Ride, International Leadership Program, SGA/Club Sport Interns, SGA's Head, Sports, Greek Life Events

Class 1, Class 2, Class 3

ERS, Greek Life, Honor Societies, New Clubs

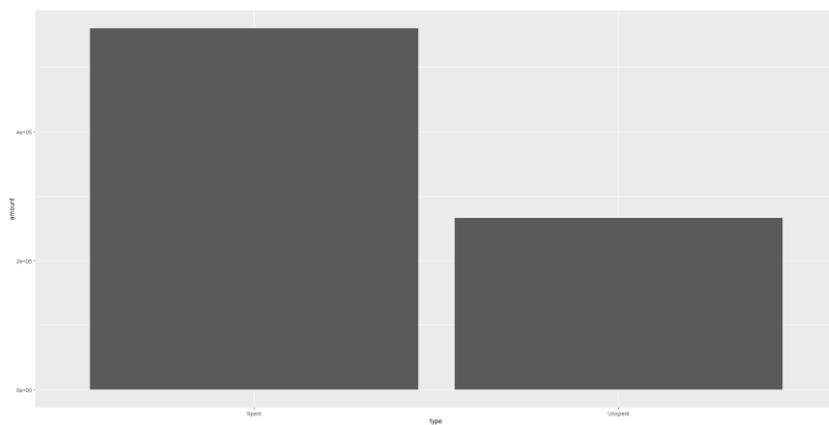
All Clubs

# Visualizing SGA's Budget 119

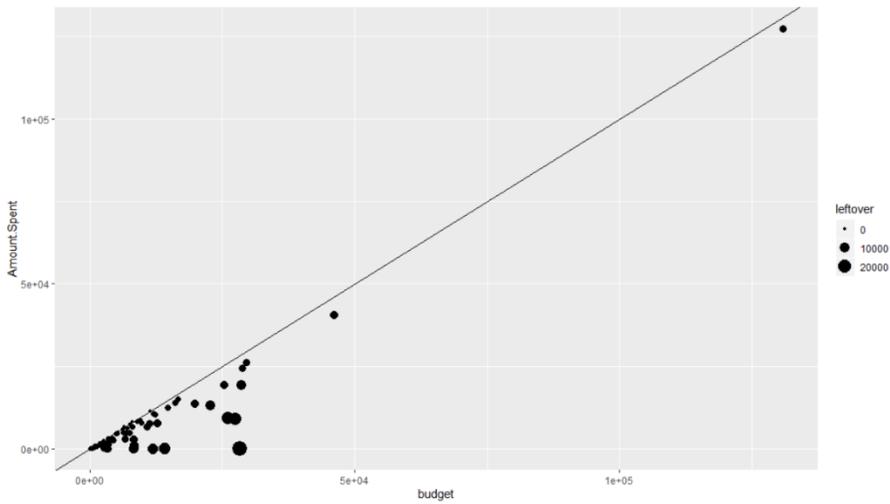
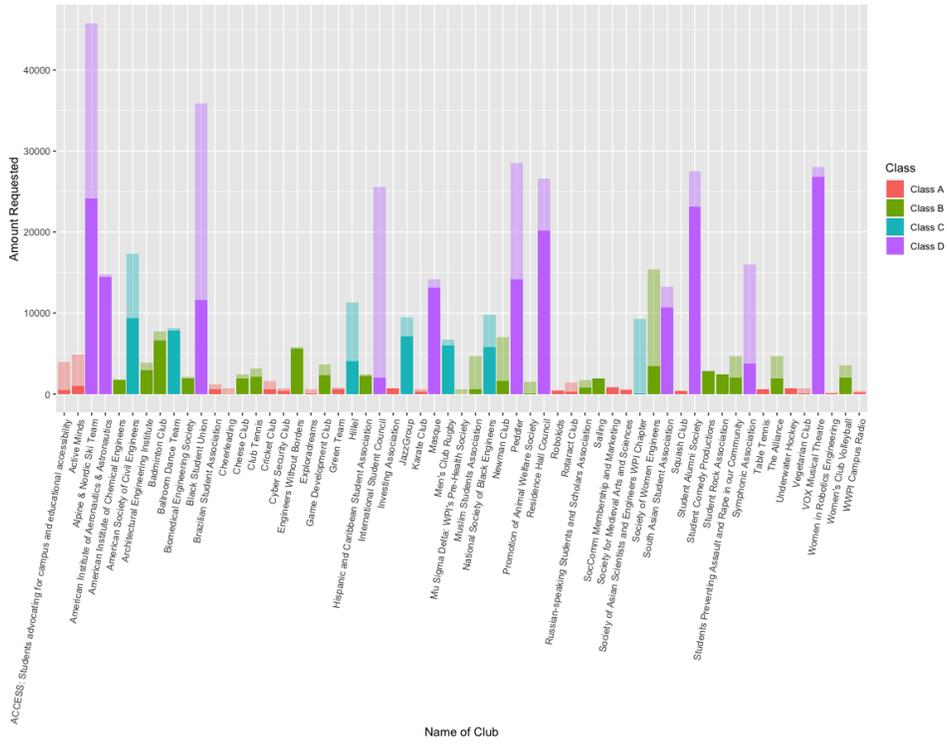


The image shows a screenshot of the WPI Student Life Fee website interface, divided into three main sections: Home Page, Budget Page, and About Page.

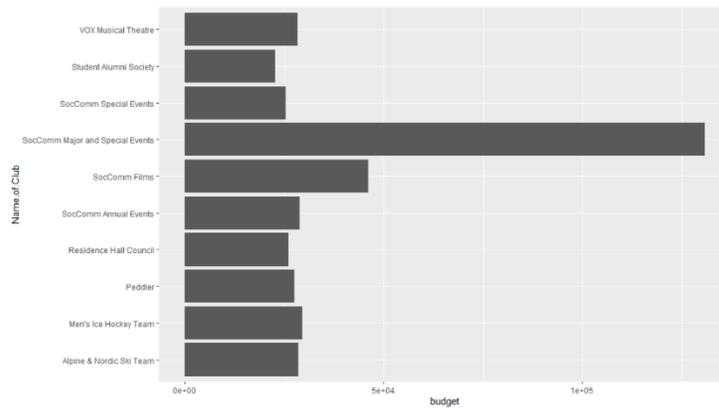
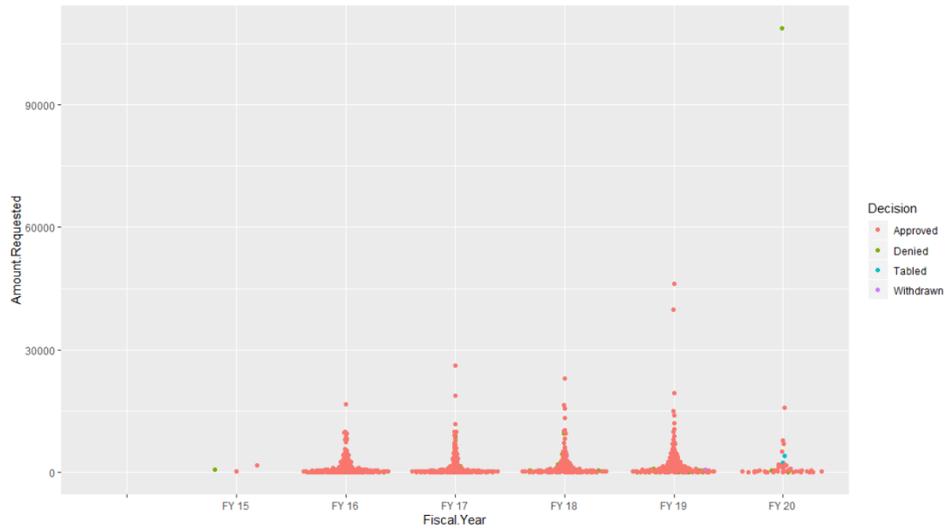
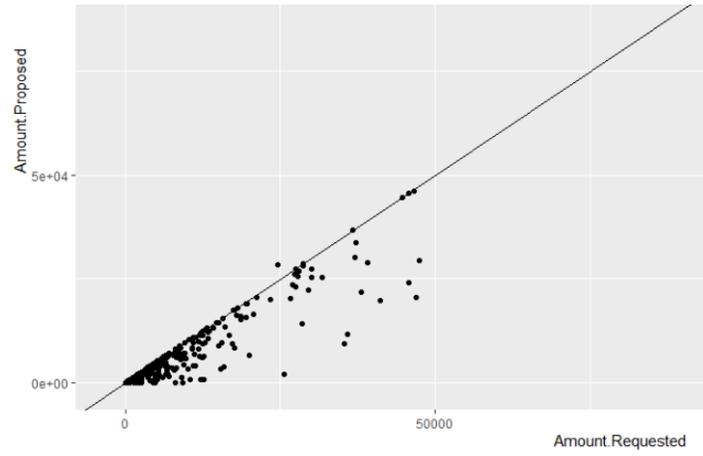
- Home Page:** Features a red header with the WPI logo and the title "WPI Student Life Fee". It includes a navigation menu (Home, Budget, About), a "What is the Student Life Fee?" section, a "Where does that money go?" section with a colorful bar chart, and a "See Common Major and Special Events" section.
- Budget Page:** Features a red header with the WPI logo and the title "Budget Page". It includes a navigation menu (Home, Budget, About), a "Filter by fiscal year:" dropdown menu, a "Total amount spent per club" bar chart, and a "Req vs approved for each club" bar chart.
- About Page:** Features a red header with the WPI logo and the title "About Page". It includes a navigation menu (Home, Budget, About), a "The SGA Mission Statement" section, and an "Administrators Access" section with a link to <http://www.AdminSGAib.com>.



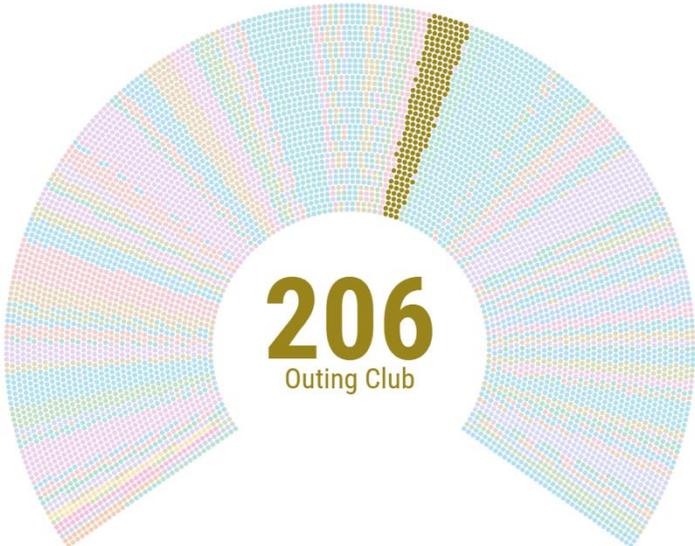
# Visualizing SGA's Budget 120



# Visualizing SGA's Budget 121



How Many People are in Each Club?



SGA Club Budgets Over Time

