Creating Infographics for the Comparison of Bike Share Programs

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ABSTRACT The Parsons Institute for Information Mapping (PIIM) and Luca Nitschke, a visiting scholar from Aalborg University, Denmark, conducted a collaboration project in which a series of information graphics were developed regarding conditions of use for available bike-sharing programs. The program was limited to selected cities within the United States. Those who access the results of this effort, presented in the formats of both poster(s) and interactive models, will be able to quickly learn and compare the select programs, analyze causalities of certain conditions, and project how certain problems can be solved. In order to develop these tools the team obtained data across multiple vectors, created standards based on analyzing the data, and created a resultant "scoring system" that could be universally applied. These uniform metrics were then visualized in order to convey the findings and rendered through the poster and interactive formats. This article includes the process of what the team went through to achieve the goals, the article focuses on the research methods and design.

INTRODUCTION

The Parsons Institute for Information Mapping (PIIM) is a research, development, and professional services facility within The New School, New York City. PIIM's mission is to advance the field of Knowledge Visualization through academic, NGO, government-partnership and industry-partnership pursuits. In the Fall of 2014, staff of PIIM initiated a collaboration project with Luca Nitschke, a research fellow and a master's degree student attending Aalborg University, Denmark. The team chose to create infographics which enable comprehensive comparison of quality and conditions of urban bike-sharing programs within the United States. The objective was to investigate bike-sharing programs across multiple cities of the US and present the outcomes through a poster, as well as web interface. Jihoon Kang, Associate Director of PIIM, served as the project lead and art director; Luca Nitschke led data collection and analysis; Janet Chan, a BFA candidate of Parsons School of Design served as a designer within the team.

METHODOLOGY

The impetus for this project grew out of the desire to understand parameters regarding the Citi Bike bike-sharing system in New York City. To set up a baseline by which to consider such metrics an approach was developed to compare the bike-sharing programs across eleven US cities. The intent was to create a standard to initiate comparison for improvement, and to provide reference for public debate. This initial idea progressed during our brainstorming sessions respecting the presented outcome of analysis and comparison through five category ranges of US bike-sharing systems and their characteristics. Those meetings formed the central part of project development and entailed the discussion of useful and feasible data to collect, which cities will be included, as well as the actual data analysis and scoring process.

In addition to Citi Bike in New York City (NY), we chose ten other systems across the United States for our analysis. The full list included: Divvy in Chicago (IL), Capital Bikeshare in Washington, D.C., Hubway in Boston (MA), Denver B-cycle in Denver (CO), NiceRide Minnesota in Minneapolis (MN), Bay Area Bike Share in the San Francisco Bay Area (CA), Austin B-cycle in Austin (TX), Houston B-cycle in Houston (TX), CoGo Bike Share in Columbus (OH), and Bike Chattanooga in Chattanooga (TN).

In order to provide a comparative overview of the bike-sharing landscape in the United States, parameters were created that could be applied to cities that had bike-share systems that vary greatly in range of size and areas serviced. We included small systems (Houston, Chattanooga, Columbus, and Austin), medium sized systems (San Francisco, Denver, Boston, and Minneapolis) and large systems (Chicago, Washington, and New York City). An important factor regarding the choice of a system was that we set a minimum time of operation, one year, as a bar to inclusion. This allowed us to be assured of a year's worth of data. Additionally, the sufficiency and availability of data was another criteria for selection.

Our selection includes some of the oldest systems in the US (Washington, Minneapolis, and Denver), and also quite recently opened systems (Austin, Columbus, Chicago, New York City, and San Francisco). This
The collaborative team set the goal of creating a poster and interactive presentation of infographics about urban bike-sharing programs of the US.
Diversity is necessary to give a complete view on bike sharing in the United States and portrays different steps in the development and different types of bike sharing. Unfortunately, the constraint of making our work presentable on a poster that addresses each of the specific issues for every city selected, meant that some systems could not be considered, as every parameter (data-wise) could not be ascertained.

Data Collection
The data collection was carried out through an online research and direct e-mail correspondence. The online research concentrated on searching for available open source data provided by the system owners and operators on their respective websites. Other sources for data were statements from the system owners and operators through their official communication channels (e.g. Facebook, Twitter), third-party blogs and websites (e.g. online newspapers), as well as scientific and governmental publications.

In principle, the online research aimed to collect all possible available data. However, this was followed up by direct contact of system operators and contractors in order to fill in all the “missing” data. Of ten contacted operators, five responded with all of the requested data.

We then organized and processed the data in order to make equivalent parameters for our analysis. Due to not-insignificant differences in the availability of data among different systems, and that fact that not every system operators, or city authority, wished to share or were able to provide data, we had to adjust our initial categories. Another reason for not including some variables in this analysis was the ambiguity of some data regarding its collection and accuracy (e.g. miles travelled and carbon offset).

Data sets which could be collected for every analyzed system and which was chosen for the analysis were: 1) inhabitants of the respective city, 2) name of the system, 3) date of launch, 4) number of operating stations, 5) target number of bikes, 6) membership cost for annual and casual (one day) users, 7) service area in square miles, 8) average trips per year/season and 9) average trips per day.\(^1,2,3,4\)

Scoring
In order to allow a readily-ascertained comparison between the systems, a relational scoring system was developed based on five key characteristics: 1) system size, 2) costs, 3) convenience, 4) system area, and 5) activity.
In calculating these scores several steps had to be taken. From the data above six actual factors were developed (see Figure 2). These factors indicate different metrics of the respective bike-sharing system and allow an easier interpretation of the collected data for users of our reporting outcomes.

Each characteristic was derived from one or two of the above factors and/or system metrics as shown in Figure 3. The scores for costs and convenience were determined using two factors each, giving them equal weight. In practice this lead to taking the average of the two separately determined scores for each factor.

For determining the relational score for each characteristic, the collected data and calculated factors were divided into ten ranges and scored from one to ten (see Figure 4). The ranges were oriented against themselves to form high/low ranges. In other words, no “gold standards” were determined and no optimum scores were created, as this would have brought us far more subjective determinations.

**DESIGN APPROACH AND OUTCOMES**

The goal of this collaborative effort was to produce a poster and web-based interactive presentation. Prior to the design phase, we completed all prerequisite tasks, i.e., data collection, data analysis, information classification, and scoring. The design team was then tasked to tell compelling stories with the data and scores. In order to keep the visual storytelling relevant and effective, we first defined our primary target audiences. We thought of the demographic group that might benefit the most from consuming our presentations and representations of the collected data. We decided to focus on two groups: policy-makers and the actual bike renters. Continuing our discussions (and debates), we decided to focus primarily on informing those who rent bikes. From this we established a primary target audience group: 20–30 year-old urban citizens with an emphasis on active lifestyles.

**VISUALIZING DATA**

The presentation was divided into two sections to keep the storytelling effective: 1) geographical overview, 2) information “cards.”

The geographical overview provides a quick snapshot of where the select programs are located within the US. Each program has been visualized with spider diagram for a quick comparison. Through this multivariate data presentation, the viewer can obtain the scores of the five final areas: Cost, Convenience, Coverage Area, Activity, and System Size. The juxtaposition of the geographically linked multivariate graph is designed to help viewers rapidly gain knowledge on performance.

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**Figure 4:** Example showing the development of the scores. The ten score ranges are oriented at the existing data and translate the obtained values into a relational score.
Figure 5: This is the top portion of the poster, consisting of a juxtaposition of multivariate graphs and the vs map.

Figure 6: Radar charts of scores for the Citi Bike program (of New York City) and the Capital Bikeshare program (of the Washington D.C. metropolitan area).
scores and allow them to compare the scores of the programs. We expect this overview also attracts the viewers as we learned strong graphic assets like maps and charts can easily and immediately drive viewers’ attention.

We expect those who view the poster to begin questioning and analyzing the causes and effects of the scores (see Figure 6). As an example, the Citi Bike share program scored high on the convenience attribute. This is because there are many bike stations within the service area. If one station is empty with bikes, one can easily walk one or two blocks to find another bike station to locate an available bicycle—this is convenient for many bike renters. The same program, however, scored low in the Area category. Why? New York City consists of five boroughs: Manhattan, The Bronx, Brooklyn, Queens, and Staten Island. As of 2015, the service area of the Citi Bike program only covers the Midtown (south of Central Park) to lower neighborhoods in Manhattan, and some parts of Brooklyn (see Figure 7). We expect this program will score higher once they expand the service area.

Unlike Citi Bike, the Capital Bikeshare program in Washington D.C. scored high on Area, but low on Convenience. As shown on (see Figure 8), this program covers entire Washington, D.C., as well as its neighboring cities in Virginia and Maryland; the coverage is expansive. However, the bike stations are spaced far apart from each other. Getting from one station to another (or simply walking home from a station) means that the Capital Bikeshare scores low on Convenience. Installing additional bike station will help Capital Bikeshare earn additional points for the Convenience category. This is exactly how we want viewers to utilize this poster. We want them to observe what is happening from the data visualization. We want them to analyze what is causing the positives and negatives. Finally, we want them to think deeper about what can be done to improve the condition.

The geographical view consists of high-level information and overview, which engages the viewers. The engaged viewers, of course, will look for in-depth information on individual programs. This is why we added cards showing the specifics of each program such as: the title of the bike-sharing program, location (city and state), date of establishment, coverage area map, size (total number of stations, number of bikes, annual members, coverage, average number of stations within a square mile), cost (cost for annual membership, cost per one square mile), activity (inhabitant per bike, trips per bike per day, total trips per day). In addition, we added remarks for both positive and negative factors. For example, we found that Citi Bike had the highest number of stations per square mile among all select programs; this is labeled as the positive remark. On the flip side, the Citi Bike offers the highest annual membership cost among all select program that we studied; this fact is highlighted for the viewers to note.

**STYLE**

We initiated the development of style by identifying the primary target audiences: twenty-to-thirty year-old urban citizens with active lifestyles. Figure 9 is one of moodboards composed of a collection of images tied to this audience group: magazines, films, fashion, products, music, etc. We then analyzed the images to identify consistent visual approaches with the idea that this analysis would give us hints for our design approach.

![Figure 7: Stations of the Citi Bike system shown on a map.](image1)

![Figure 8: Stations of the Capital Bikeshare system shown on a map.](image2)
We created a conservative color palette to begin with, then added a few accent colors. When we selected these support colors, we aimed for an energetic mood representing the active lifestyle.

The poster demanded four classes for type selections: title, subtitles, labels, and text. For the title, subtitles, and labels we selected the display typeface “Intro”—its inline version was applied to the title. Selecting Intro as a display typeface helped to portray the contemporary, urban, and active mood that we intended. Yet, we applied this rather conservatively, as we did not want to overwhelm the viewer with the more “aggressive” aspects of the typeface as it can appear rather loud and quirky in larger size settings. The humanist sans-serif typeface Avenir in various weights was applied to text and some labels where we needed a highly legible type. Avenir and Intro tend to work well together visually as there are enough visual similarities to seamlessly blend these two; yet, they are adequately distinctive from each other to keep the resulting design interesting.

We utilized the top half of the poster to place the title and the US map with star graphs on a single column.

The details of each program organized by eleven boxes are placed on a four-column grid. There are smaller grids inside of each box. Following these grid system helped us turn complex contents into a comprehensive information presentation.

CONCLUSION
We are satisfied with our findings based on the initial research parameters and the ability to generate uniform comparisons despite variations in data received from the disparate bike-sharing systems. We consider these examples alpha-iterations. We are continuing the process, and collecting feedback, in order to generate a next iteration with the intent to publish through PIIM’s website. We will first present the outcomes to limited viewers in order to obtain feedback toward the refinement our design work.

Jihoon Kang, the lead of this project, has repeatedly stated that the ultimate goal of information design is to empower the viewer. His previous publications and public presentations bear this out. This project advances this goal for users and planners of bike-sharing programs. Those
who consume our presentations will clearly comprehend significant facts and figures regarding those bike-sharing programs. They will easily see what they get for each dollar they spend. They will also see whether or not their local program outperforms or underperforms relative to those available in other cities. The visualizations are designed to be intuitive and rapidly comparative. A key area is to determine deficiencies in each program in order to design for improvement.

The methods for data gathering, data research, data scoring, and design, were the key undertakings on the project. Many of the ideas can be readily applied to measure other public transportation types, such as: buses, subways, light rails, commuters ferries, etc. We are planning on expanding our methodology to incorporate a wider swath of public transportation systems because more presentations such as these generate the knowledge that empowers people—both users and makers.

**BIOGRAPHY**

Jihoon Kang is a communication designer and illustrator. He currently serves as Associate Director at the Parsons Institute for Information Mapping (PIIM), The New School, New York. His background experience includes creative and program leadership, project management, information design, Graphical User Interface (GUI) Design, and User Experience Design (UXD). At PIIM, he has worked on projects from the National Geospatial-Intelligence Agency (NGA), Defense Advanced Research Projects Agency (DARPA), US Department of Veterans Affairs (VA), Center for Disease Control and Prevention (CDC), Telemedicine and Advanced Technology Research Center (TATRC), US Navy, United Nations Development Programme, and Macmillan Publishers. He has taught design courses at Parsons School For Design. He also serves as a guest lecturer at Icahn School of Medicine at Mount Sinai, New York. He received BFA and MFA from Parsons School of Design, New York.

Luca Nitschke is a researcher interested in bike sharing and its impacts on the urban landscape. He is a master’s candidate at Aalborg University, Denmark in Environmental Studies and visited the Parsons Institute for Information Mapping from November 2014 until January 2015. His current interest lies in the political reasoning behind implementing a bike-sharing system and related struggles regarding the distribution of the urban landscape. He further holds a bachelor’s degree in Environmental Science from Bielefeld University, Germany.

**CREDITS**

Jihoon Kang: Project lead / art director
Luca Nitschke: Research lead
Janet Chan: Designer
NOTES

1 Data for U.S. cities was derived through the U.S. Census data. Some systems include multiple cities, which are also included in the total inhabitant number (Bay Area does not include numbers for San Jose (CA)).

2 The target number is the official number of bikes in the system. The number of actually available bikes, tends to be considerably lower, as bikes are being repaired or checked or their number is reduced due to weather events.

3 For the systems in Denver, Minneapolis, San Francisco (Bay Area), Austin, Houston, Columbus, Chattanooga, Barcelona and Paris the system area was determined using ArcGIS, station location data and buffering.

4 The average number of trips per day was derived differently for the systems. For most systems it was derived from the number of annual trips (respectively trips in twelve months). For New York City it was directly derived as an average of daily trips during one year. For San Francisco, Chattanooga, Minneapolis and Columbus the number is an estimation and for Denver the number was directly taken out of a yearly issued report by the system operator Denver B-cycle.
