Providing Support for the Ladegårdsåen Daylighting Project

Abstract

This project provided Miljøpunkt Nørrebro, an environmental agency in Copenhagen, Denmark, with communication tools to gain long-lasting support for the Ladegårdsåen Daylighting Project, which seeks to reduce traffic and pollution and add green space to Nørrebro by daylighting the canal and constructing a traffic and stormwater management tunnel underneath. The team simultaneously compiled extensive research on similar projects and analyzed real-time pollution sensor data in order to form a benefits report and dynamic visual display. After gaining community feedback using a public survey and charrette, the team presented the sponsor with a benefits report and accompanying presentation along with a recommendation for the installation of a speedometer-style dynamic display in Nørrebro.

This project report is the culmination of research and development of methods to provide support for the Ladegårdsåen Daylighting project. This was prepared for Miljøpunkt Nørrebro and the faculty of the WPI Copenhagen Project center. For more information, please contact the team at norrebro-dk14@wpi.edu.

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Copenhagen is Denmark's capital and economic center, and is known throughout the world for its environmental initiatives. This project focused on Nørrebro, the most densely populated of Copenhagen's ten districts. In recent years, the city has experienced short, but heavy rainfalls called "cloudbursts", which have dropped over 160mm of precipitation in about 3 hours. The most recent one was on July 2, 2011, and it caused the city over 6 billion DKK in damage (Jensen, 2012). Over the last century, urban development has taken away natural land that would be able to absorb the rainwater and has replaced it with asphalt and concrete, which are detrimental to floodwater management. This urban expansion in Nørrebro has also caused an increase in traffic, which has led to higher air and noise pollution levels in the area. In order to solve the problems currently plaguing Nørrebro, Miljøpunkt Nørrebro, an environmental organization in Copenhagen, has proposed the Ladegårdsåen Daylighting Project, which will manage stormwater, reduce traffic and pollution, and increase green space in the neighborhood.

The daylighting project targets the Ladegårdsåen, which is an underground river located in Nørrebro. The process of daylighting involves taking a river which was previously underground and bringing it to the surface. Until the 1900s, the Ladegårdsåen was the center of the neighborhood and the residents used it for bathing, cooking, and recreational purposes. In 1897, the city of Copenhagen directed the river into a pipe and paved over it to make room for the city's rapidly expanding population, creating Ågade and Åboulevard (Ruddy, Hassan, Anglin, & Higgins, 2012). The route serves as the primary mode of through-traffic in Nørrebro, as 60,000 cars drive through these roads every day. Miljøpunkt Nørrebro is proposing the Ladegårdsåen Daylighting Project as the solution to the problems currently facing the district. The plan is to remove Ågade and Åboulevard, bring the Ladegårdsåen up to the surface and make it a canal, construct a traffic and stormwater management tunnel below the canal, and develop the surrounding land into a park (Ruddy et al., 2012). The proposed tunnel is modeled after the Stormwater Management and Road Tunnel (SMART) in Kuala Lumpur, Malaysia.

Project Goals and Objectives

Miljøpunkt Nørrebro has had difficulty obtaining approval for the project due to concerns voiced by politicians about the costs and whether there is public support for the project. The team's goal, therefore, was to help Miljøpunkt secure long-term support for the project by making two items apparent: that the air pollution in the area is detrimental to a point where people need to take, and that the Ladegårdsåen Daylighting Project can solve the problems currently facing Nørrebro. This project accomplished this with two deliverables: The Benefits of Daylighting the Ladegårdsåen report and presentation, and a Visual Display Recommendation.

Background

Projects similar to the Ladegårdsåen Daylighting project include the Central Artery/Tunnel in Boston, Massachusetts and the Cheonggyecheon Daylighting project in Seoul, South Korea. The Central Artery was a system of four highways that joined and ended at Boston's Logan International Airport. To beautify the city and clean up traffic

Figure 1: Satellite image of Ågade and Åboulevard (Google 2014)

congestion, Boston began to deconstruct the Central Artery in 1994 and create a tunnel that would be easier to navigate than the complex network of highways from before. The project went several years longer and cost billions of dollars more than originally anticipated, plagued with setbacks throughout construction. However, after the project was finished in 2007, there was 15% less carbon monoxide, and traffic congestion during peak hours was reduced by up to 75% (Massachusetts, 2014). In 2007, Seoul, South Korea finished daylighting its historic river, the Cheonggyecheon. The river was originally the reason for placing the capital at Seoul, but the city converted it into a sewer during South Korea's post-war development in the 20th century. When the city removed the road and highway built on top of the sewer and exposed a cleaner, restored river, the municipality developed the area as a major attraction for tourists and residents alike (Lee & Anderson, 2013).

Traffic causes air and noise pollution, both of which cause health problems in high quantities over long periods of time, and causes approximately 4,000 deaths annually in Denmark alone (Glaser, Madruga, Gridwold, & Krag, 2013). Air pollution consists of carbon dioxide, nitrogen oxides, carbon monoxide, heavy metal pollution, and particulate matter among other airborne substances expelled from engines. This pollution can enter people's airways and lead to inflammation and exacerbation of pre-existing conditions such as asthma or COPD, among other respiratory and cardiovascular diseases (Brunekreef & Holgate, 2002). Noise pollution comes from the sounds of cars driving by and sometimes honking their horns. Noise pollution increases stress, leads to lack of sleep, and can even be detrimental to childhood development. Psychologically, noise pollution can aggravate pre-existing mental and emotional health problems. The psychological stress can have physiological manifestations, primarily increased blood pressure, increased cholesterol, blood glucose levels, and hearing loss, compounding with the consequences of air pollution (Bronzaft, 2002).

In order to determine the most appropriate method of making Nørrebro's pollution problem visible to the community, the team conducted research on visible displays. Visual displays are communication platforms that utilize symbols and colors to display information in a manner that a viewer can easily understand. Dynamic visual displays are displays that update and present new material in real time. These displays offer additional benefits to those of a standard sign or picture. The ability to get a person's attention and to increase comprehension of the presented information is often the fundamental reason one would use real-time display. These dynamic displays are typically utilized in digital mediums such as electronic signs or phone applications due to the ability for constant connection to both the internet and the consequential incoming display information.

Methodology

The ultimate goal of this project was provide to Miljøpunkt Nørrebro with methods for gaining public support for the Ladegårdsåen Daylighting Project. The project accomplished this with two objectives, which the team completed in parallel throughout the duration of the project. The first was to build a comprehensive research case

Figure 2: The team surveying at Nørrebro's Rundel

supporting the Ladegård Daylighting project by providing concrete evidence of the benefits associated with the project. The group's second objective was to make the current state of pollution in Nørrebro visible by designing a dynamic display that will be accessible to the public through recommended communication platforms.

To build a case for the Ladegårdsåen Daylighting Project, the team conducted extensive research on projects similar to the proposed solution. There is no example of a project that contains all of the components of the Ladegårdsåen Daylighting Project, but there are projects related to parts of the proposed project. The team compiled several sources including books, reports, and peer-reviewed papers that connected to the various aspects of the daylighting project. In addition to researching, the team conducted the Nørrebro Pollution Awareness Survey to collect information on the public's knowledge of traffic pollution and their opinion on the daylighting project. The survey also asked participants about where they might want to see a visual display of pollution in Nørrebro. This question fed into the recommendation to Miljøpunkt Nørrebro for the design and location of the dynamic visual display.

To design a dynamic visual display that educates the public on the current state of pollution in Nørrebro, the team researched examples of apps, widgets, websites, and signs that display real-time information, and looked into the guidelines and standards on the design of pollution displays. The team decided to create a visual display that can be used with any communication platform, depending on the amount of funding that Miljøpunkt Nørrebro is able to obtain. In designing the visual display, the group had to evaluate the real-time data it would display, which is from pre-established pollution sensors around Nørrebro. The group was able to access the sensor data and gain an understanding of how to format it so that the public can easily understand it. In order to display the pollution levels, the team chose the Common Air Quality Index (CAQI), which is the air quality measure used throughout Europe (CiteAir, 2012). After creating three visual pollution display options by researching pollution design standards and previous examples of real-time displays, the group then took the design options and held a Community Feedback Charrette to aid in selecting the final design. A charrette is used to quickly create design options while simultaneously providing input from the community. It creates a dialogue between the community and the designers, which allows for smaller design feedback loops, and a better reception of the proposed solution from the community (NCI, 2014). During the charrette, the team asked participants design they preferred the most and where they would like to see a dynamic sign with a visual display installed. After collecting this information from 40 people, the group chose the final design and communication tools and made a recommendation to Miljøpunkt Nørrebro.

Data and Analysis

In order to develop a research case for the Ladegårdsåen Daylighting Project, the team researched previous projects and assembled the

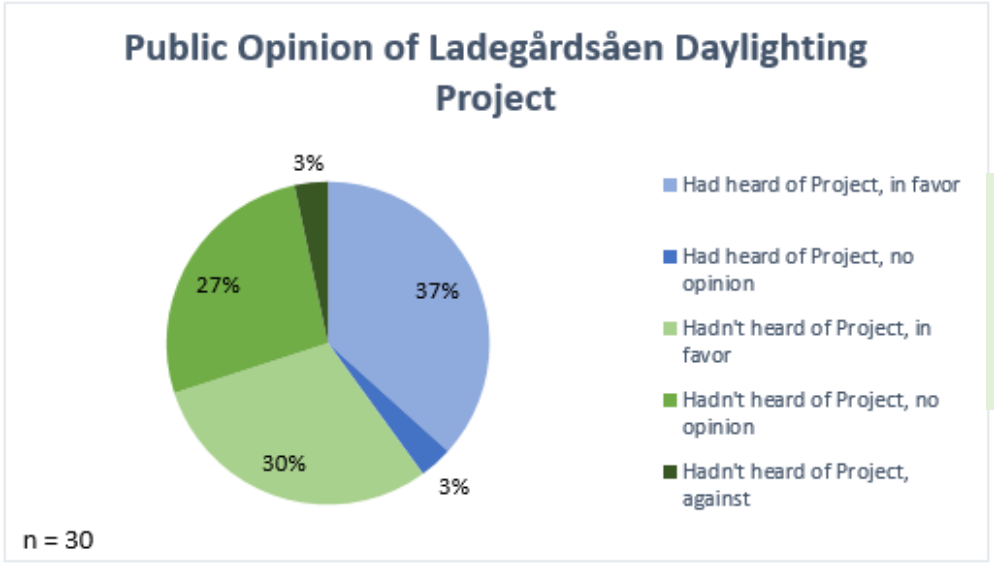


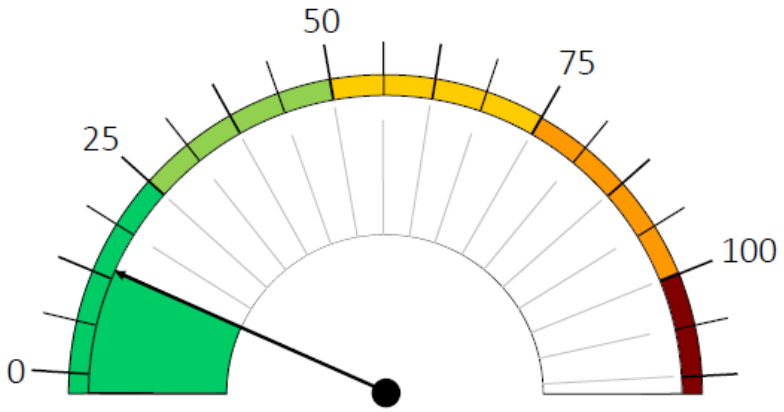
Figure 3: Graph of the public opinion of the Ladegårdsåen Daylighting Project

information into a full-length report detailing the benefits of the project. The team used studies on building tunnels, daylighting rivers, removing roads, and developing parks, and the effects of all of these on the local environment. As pollution reduction is one of benefits of the daylighting project, the group conducted the Nørrebro Pollution Awareness Survey to assess the current public knowledge of the pollution levels in Nørrebro. The survey also asked people their opinion on the Ladegårdsåen Daylighting Project, so that the team could determine the existing level of support for the project. Figure 3 shows that 67% of the respondents were in favor of the project, and only 3% were against it. The team synthesized the research and the survey data in order to develop the Benefits of Daylighting the Ladegårdsåen Project report, and then condensed the report into a presentation for Miljøpunkt Nørrebro's use.

The team developed three visual display options, taking into consideration the CAQI color regulations. Before selecting a final visual display or communication tool, the team conducted the Community Feedback Charrette. From the results of the charrette, the most popular design was the Speedometer Display, shown in figure 4. The Speedometer Display is the most appropriate because the display is meant to address the issue of traffic pollution, and speedometers directly relate to vehicles. As pollution increases on the CAQI scale, the needle moves up, and the information section that corresponds to that range is highlighted. The user/viewer can read what that level of pollution signifies and why it is unhealthy. Charrette participants also informed the team that the ideal communication tool to utilize with the display is a dynamic sign, followed by an app.

Recommendations

The team provided Miljøpunkt Nørrebro with the Benefits of Daylighting the Ladegårdsåen Report, the Benefits of Daylighting the Ladegårdsåen Presentation, and the Visual Display Recommendations report. The group recommended that Miljøpunkt Nørrebro use the benefits report when seeking funding and support for the Ladegårdsåen Daylighting Project. Miljøpunkt Nørrebro should use the benefits presentation when educating community members and potential project sponsors. The team recommended using the Visual Display Recommendation to try to obtain funding to make a dynamic sign using the Speedometer Display. If they cannot get funding for a sign, they should try to create an app instead. With these recommendations, the team hopes that Miljøpunkt Nørrebro will be able to gain long-lasting support for the Ladegårdsåen Daylighting Project.



Very Low	Low	Medium	High	Very High
0 to 25	25 to 50	50 to 75	75 to 100	> 100

Figure 4: Final mock-up of communication tool

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