

Undergraduate Thesis Prospectus

Eswatini Footbridge Design

(technical research project in Engineering Systems and Environment)

Vision Zero in Oslo: A Radical Transition to a City without Cars

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem

How does infrastructure influence communities?

The built environment greatly affects people's lives both physically and socially, for better or for worse, whether they realize it or not. Carmel, Indiana, cut traffic fatalities 90 percent by implementing over 130 roundabouts in the city, but in Texas the deficiencies of their power grid were exposed when a winter storm left millions without power (Dorfman, 2020; Hillman, 2021). More than just physically, infrastructure can impact communities socially in ways that last for generations. When the interstate highway system was built in the 1950s and '60s it was often routed "directly, and sometimes purposefully, through Black and brown communities" (King, 2021). Deborah Archer says this "cut the heart and soul out of thriving Black communities," and "separated White and Black communities" (2020). Some of these communities have still not recovered from the choice architecture that caused these setbacks and divisions. How can communities become more aware of the infrastructure around them, how it affects them, and how they can play a greater role in impacting those designs?

Eswatini Footbridge Design

How can a bridge be designed to be built and maintained by a community of farmers and industrial workers in Eswatini?

Maphoveleni, Eswatini needs a footbridge built over the Mtilane River due to patterns of major flooding. There is a currently a log bridge spanning the river, but it has no railings, does not reach high enough above the river, and becomes very slippery when wet. Six people have been injured trying to cross this bridge in the past three years.

Working with Engineers in Action (EIA), a team of eight students will design a footbridge to allow access to schools, markets, and healthcare for the nearby communities. The scope of work includes structural design, drawing plans, creating a construction schedule, and building the bridge. This is a technical group project in the Engineering Systems and Environment department under the advisor Jose Gomez. Team members include Haley Dues, Gabi Jennings, Jack Smith T, Jose Castro, Kathryn Wagner, Mackenzie Beavers, Yamal Andonie, and myself.

The team will complete online courses from EIA to learn about bridge design, construction, and project management. After completing these courses, a subset of the team will use AutoCAD Civil3D and Microsoft Excel to calculate the required dimensions of the bridge for the given site location, as well as design the bridge and create the construction drawings. Other members of the team will focus on aspects like fundraising, project management, and the construction plan. By the end of the project, the team will have a complete set of drawings for the bridge, as well as a construction plan and cost estimates for the project. All of this needs to be completed while remembering all materials need to be locally sourced, and the local people will be building and maintaining the bridge. Some team members and EIA staff will travel to build the bridge alongside the local communities and teach them to maintain it. If successful, these communities will have a safer, more sustainable bridge to connect them to the surrounding area.

Vision Zero in Oslo: A Radical Transition to a City without Cars

How has Oslo redesigned its city center to make it one of the most bike-friendly cities in the world?

Can injuries and fatalities as a result of car crashes really be eliminated? In many countries, these are seen as unavoidable side effects of transportation, but in Norway, many believe elimination is possible. Vision Zero was adopted in Norway in 2002 to strive to end all traffic fatalities, and now it has some of the safest roads in the world. In 2015, Norway's capital city, Oslo, made its own changes to shift to a people-centric transportation model, completely banning cars from its center by 2019 (Hartmann & Abel, 2020). To do this, 60km of bike lanes were added, prices for parking around the city have been greatly increased, and street parking spaces were replaced with sidewalks or flowerboxes (Bliss, 2018). Many cities in the world are unable (or unwilling) to make such drastic changes as these, so how did advocates of a city redesign succeed in pushing for these changes in Oslo, and in the process make it one of the most bike-friendly cities in the world?

Participants include proponents of the changes, including advocates of safer transportation within the city (Kvanvik, 2021), reducing environmental impact (MDG, 2021), pushing public transit over private vehicle transport (Grøtting, 2021), and improving cycling facilities and safety (Syklistene, 2021). These advocates' motives vary, and researchers have studied some of these aspects like conflicts between bikes and trucks (Pokorny et al., 2017), truly reaching zero emissions (Rydningen et al., 2017), and how Vision Zero is being achieved (Hartmann & Abel, 2020).

In the 1990s, the city of Strasbourg, France, implemented many of the designs Oslo is beginning to use. The city was "characterized by growing traffic-related problems," so planners began to "limit the number of private cars in the city" (Rydningen et al., 2017). They prioritized public transit riders, pedestrians, and cyclists. Parking fees were introduced, bike lanes were added, and the pedestrian zone was expanded. A significant shift from private vehicles to public

transit occurred, and cycling also became more popular. The historic, narrow streets which were unsuitable for vehicular traffic were converted to bike routes, and a city bike sharing system was introduced. According to the Copenhagenize Index of 2019, Strasbourg is ranked as the fifth most bike-friendly city in the world. In 2015 Oslo was not ranked, but that year it “made a commitment...to reduce car traffic and prioritize the safety of pedestrians, cyclists, and the environment” (Hartmann & Abel, 2020). Two years later it ranked 19th, and in 2019 Oslo jumped all the way to seventh. Oslo and Strasbourg differ in several aspects like population, climate, and culture, so how was Oslo able to implement many of the same changes as Strasbourg with such success, and what did they have to do differently?

Many people said that they were in favor of the redesign, but some may not have truly meant it. What people say they want versus what their actions are is a challenge that faces many projects like this. This inconsistency between attitude and behavior is known as moral hypocrisy (Kim et al., 2019). In their study of choice architecture on the preference for a pro-environmental hotel, Jungkeun Kim and his colleagues found decision mode to be a “critical factor that influences travelers’ preferences.” Factors like number of choices, default options, and choice verses rejection have a major impact on the decisions travelers ultimately make, regardless of what they say they want. Moral hypocrisy could have led to some residents in Oslo saying they wanted their city to change, but then choosing not to adapt to the changes, making them opponents of the redesign. How was infrastructure improved in a way that encouraged citizens to use the newly implemented systems instead of resisting the changes?

The way systems are designed influences how people live their lives. The idea of choice architecture says “there are many ways to present a choice to the decision-maker, and that what is chosen often depends upon how the choice is presented” (Johnson et al., 2012). People like to

think that choices are their own and that options are presented neutrally, but “there is no neutral architecture.” Miljøpartiet De Grønne (MDG, The Green Party) wants to use choice architecture to “make it safer and easier to cycle and walk” by adding better pedestrian and cycle paths. They also want to not just replace some current car infrastructure to make it more cyclist and pedestrian friendly, but “prohibit the construction of new car-based shopping centers” entirely (MDG, n.d.). How else have Oslo and other advocate groups used the concept of choice architecture to promote cycling and other modes of sustainable transportation?

Among the proponents of the city center redesign is Trygg Trafikk, a Norwegian advocacy that serves as a link between volunteer groups and road safety authorities (Trygg Trafikk, 2018). It promotes traffic education in schools and sharing information about traffic safety. Its website presents safety tips and information for different modes of transportation like walking, cycling, and driving. Kollektivtrafikk Foreningen (Public Transport Association) advocates for major changes in public transit, arguing that it “helps to facilitate alternative modes of transport such as walking and cycling” (Grøtting et al., 2021). And Syklistforeningen (The Cyclists’ Association) is a cycling organization that seeks “to accomplish political impact” towards the government (Syklistforeningen, 2020). Their efforts have led the Oslo City Council to invest NOK 673 million (USD 79.8 million) in bicycles in 2022, including “25 kilometers of new and upgraded bicycle infrastructure” (Giæver, 2021). With so many advocates with different agendas, has one of them been more important or influential in achieving success, or did it require a collective effort?

Answering these questions will require further research about the agendas of the participants in this study to understand what their interests are and how they operate. In addition, research in other areas related to choice architecture, moral hypocrisy, and their components will

be needed. It may also be helpful to find more cities and advocacies that have tried to implement similar changes to Oslo. Some cities of similar size may have had success, but what if their success came from a factor that Oslo is unable to implement due to their differing geography? Oslo's unique qualities will be taken into account, and advocacies' strategies will be examined closely.

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