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Implementation of the Dutch Biking System In The United States
Subject: Portsmouth NH

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IMPLEMENTATION OF THE DUTCH BIKING SYSTEM IN THE UNITED STATES

Subject: Portsmouth NH

Written By: Linda Freeman
Advised By: Noele Lee
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Abstract

This thesis explores the feasibility of implementing the Dutch Biking System in the United States, focusing on Portsmouth NH as a potential candidate for such infrastructure development. By analyzing the history of bicycles, the Dutch biking system, and the American biking system, the study aims to establish the need for enhanced biking infrastructure in the U.S. The research outlines a comprehensive implementation plan based on cost considerations and project scope, with a long-term vision spanning several decades. Key stakeholders, including civil engineers, communications specialists, and data analysts, play crucial roles in designing, promoting, and evaluating the biking infrastructure. The study also considers policy changes, public awareness campaigns, and data-driven metrics to measure the success of the project. Through qualitative analysis of Portsmouth's current bike lanes and interviews with experts, the thesis highlights the town's readiness for embracing a Dutch-style biking system. The anticipated benefits include improved safety, reduced greenhouse gas emissions, and enhanced community satisfaction. Overall, the research underscores Portsmouth's potential to lead the way in sustainable transportation solutions, with implications for other U.S. cities looking to prioritize cycling infrastructure development.
Introduction

The Purpose of This Study:
The purpose of this study is to analyze the history of bicycles, the Dutch biking system, and the United States biking system to establish a need for bicycles in the United States. This history is then taken into a modern context by analyzing the feasibility of implementing a Dutch style biking system within the United States. The subject matter for analysis will be Portsmouth NH - a small town in NH. The research is intended to present an outline for such a biking plan, an analysis of public opinion on said plan, and the possible outcomes of said plan.

How the Project Deals With My Major:
As an International Business major I deal with understanding different cultures, international policies, and global differences in regards to business. This project gives me the opportunity to take this knowledge and apply it to understanding such differences involved in implementing a system that is originally European.

Acknowledgements:
So many people helped me throughout this process to create this plan. A very special thank you to my thesis advisor Noele Lee, without whom the thesis never would have come to fruition. It was her first year advising a thesis so there was a strong learning curve for us both. I am so thankful for her pushing through any struggles we faced and propelling the process forward to the finalized product. An additional thanks to those who aided in finding and developing my research: Wendy Pothier, Patricia Condon, and Gorkem Turgut. A final thank you to the IRB team who allowed the research to be done by ensuring ethical considerations are followed.

Thesis Statement:
The current infrastructure of Portsmouth makes it a viable candidate for the implementation of the Dutch biking system and the benefits that the town will reap such as better health for its citizens and increased housing capabilities due to not needing cars, will make the implementation worth the upfront cost.
History of The Bike:

1. Evolution of Bicycle Design
An innovative man by the name of Baron Karl von Drais invented the first bicycle in 1817 to help farmers who had to kill horses to feed their families during a cursed Summer when snow fell during July. The goal of helping farmers wasn’t met as it was wealthy men in Europe who endorsed and utilized the product. This design was then improved upon in the 1860’s by machinist Pierre Lallemont who added cranks with pedals to the design. He obtained a U.S. patent for this device but during the time it took to do so Parisian manufacturers had already started mass production on them. (Vivanco, Page 27). When the bicycle was first created in 1817 it didn’t have pedals. Instead it resembled the training bikes we know today in which a person's legs hang at either side and they propel themselves forward by pushing off of the ground. This first design also lacked brakes, making it a great safety concern. (Vivanco, Page 27). In 1871 many of the issues experienced were fixed with a new model called the “High-Wheel Bicycle” which had rubber tires making it easier to ride. (Vivanco, Page 29).

2. Societal trends for increase and decreases of bike use
In the 1880’s the bicycle craze truly started in the United States. Bicycles during this time were associated with well-to-do men who were extremely manly for using bike’s. The second form of bike, the high wheeler, cost a typical person's month’s wages making it more of a device for America’s elite. The desire to ride as a social activity took off with the gain in popularity and soon bicycle clubs in cities were formed. These biking clubs formed during the 1890’s presented a double-edged sword. On one end it allowed people to socialize and feel patriotic in the freedom of travel. On the other hand it deepened the racial tensions at the time due to the biking clubs being segregated. (Friss, Page 45). New York served as a prime example of this as cycling was deemed an activity for white upper class men. Racism in NY was perpetuated through caricatures of degrading stereotypes of minorities riding bikes. This fed into underrepresentation of specifically black riders within the cycling industry at the time. (Friss, Page 61). Those put down by such a view: women, minorities, those of various ethnicities, those of various financial classes, etc. fought back by riding. With those previously kept from the bike’s use suddenly taking a hold of the biking system by storm, the bike lost popularity at the turn of the century. What was once considered elite was now something for the everyday man, thereby far from making it a desirable mode of transportation. (Friss, Page 73). The desire to utilize bikes as a popular mode of transportation didn’t come again after that until the 1970’s when the masses wanted to veer away from petroleum dependence for cars to a more independent and clean form of transportation. This rekindling of bicycle use through the 70’s and 80’s allowed bike’s to regain some of the rights to share the road that they had lost during the 40’s and 50’s with the car
boom. (Vivanco, Page 5). In the current day almost 70% of trips taken by car are under 2 miles, illustrating that people are reliant on cars over other forms of transportation. (Blue, 2013)

History of the Dutch Biking System:

The Dutch system comprises a 22,000 network of biking infrastructure of which the Dutch government spends $35 per Dutch citizen annually to maintain the system. (Bruntlett, 2018). In the Netherlands, as illustrated through the biking analysis of Amsterdam, the majority of travel in cities is done via bicycle. In Amsterdam there are more trips made by bike than by car where an average of 38% of travel is done by bicycle. (Vivanco, Pages 69-70). This importance of bikes in Dutch culture was not always the case.

As in other parts of the world, during the late 19th century bike’s were typically only used by the elite in the Netherlands. (Office of International Programs, 2019). Bike racing on streets was banned in 1905 by the Dutch Cycling Union. This helped to ingrain the idea in Dutch culture that everyday bike use is virtuous. (Vivanco, Page 72). It was during the postwar era of the 1930’s that bicycles became mainstream and the network of bike paths reached 870 miles. Hyperinflation in Germany made the purchasing of bike’s affordable and thus obtainable for the common man. Part of the bicycle becoming so ingrained in Dutch culture is due to its continued popularity into the 60’s, even with the presence of cars. With everyone and their neighbors utilizing bike’s in addition to the newly popularized cars in the 1960’s, the need for additional infrastructure became prevalent. (Office of International Programs, 2019).

Similarly within the United States, the use of bike’s fluctuated over the years. The trips made by bike ranged from travel being 75% by bike in 1955 to being 25% in the 1970’s. Although the preference for bikes has varied throughout the history of the Netherlands, the infrastructure has remained making it possible to travel all over the country with just a bike. A majority of this infrastructure was created during the biking low of the 1970’s with additional policy accompanying it to ensure rider safety. (Vivanco, Page 71). The fluctuations of popularity for the bicycle, unlike within the United States, did not last forever.

In the United States the vast amounts of land led to the popularization of cars as it provided a convenience to drivers, the Dutch however saw motorized vehicles as diminishing their quality of life and crowding the streets. (Office of International Programs, 2019). The desire for easily accessible and affordable public bikes originated with an outcry from the Provo, an anti-consumerist movement, who called for bikes to replace automobiles. Their solution was to leave free white bikes for anyone to use throughout Amsterdam. (Vivanco, Page 71). In 1965 the White Bike Plan was presented by Provo in Amsterdam that would be entirely free to the public. This plan was the start of the bicycle sharing system the Netherlands has utilized through the years. This plan was molded into the sharing system created by the Nederlandse Spoorwegen (Dutch Railway System) of OV-fiets (Public Dutch Bicycles). These bikes have provided a simple and affordable mode of transportation for decades. (Ploeger, Oldenziel, 2020).

The outcry of the Provo to steer away from automobiles was heightened by the death of over 400 children in 1971 from traffic crashes. These deaths, alongside the oil crisis in 1974 and
the economic recession in 1980, made it clear to Dutch citizens that a pro-car infrastructure that was estimated to cost 8 to 15 billion USD, was not in their best interest. Thus from 1976 to 1980 the Ministry of Transport set in place the Multiyear Plan For Passenger Transport which created the basis for the Dutch system we know today. This difference in infrastructure priorities can be visualized below. (Office of International Programs, 2019).

History of the American Biking System:

1. The Origins of bike use in the US
The bicycle began to gain popularity in 1868 when a popular traveling act began using it in their shows. The original “boneshaker” model quickly lost popularity in America due to it being uncomfortable to ride. (Vivanco, Page 28). When the bike first gained popularity in the United States ice rinks were turned into riding schools which gave people a safe flat place to ride. Before long people took their bicycles to the streets. This proved to be difficult due to the weight of the bike and the lack of safety measures made U.S. legislation ban them from the roads. (Vivanco, Page 28). Back in the 19th century bikes were deemed a recognizable vehicle which allowed courts to hold bike users accountable for the responsibilities associated with riding. This was also a crucial decision in the U.S. for if bikes weren’t deemed vehicles then either the laws for only vehicles on a road would have to change or bike’s simply would not be allowed on the road (Longhurst, Pages 25-26). Bike’s made it possible to ease the transition between carriages and cars in the 1890’s as they had already been declared to be vehicles, so a car could be given the same legal standing in statutory and case law. Bike’s thus essentially allowed a vehicle to be seen as a mode of transportation regardless of what powered it. (Longhurst, Page 47). As time went on the statutory law that bike’s once had a standing on began to heavily waver. In 1944 the definition of a bike changed from being grouped with automobiles and carriages to having a separate legal description. The description led the bike being seen as a device in a court of law instead of vehicle, which thus eroded their claim to public roads (Longhurst, Page 158).
2. Different Mindsets In The Country
A great source of comparison is an already existing bike infrastructure in the United States as it helps to identify the change in people’s mindsets. In Portland bike’s greatly affect the culture. Even when someone goes to move apartments, Elly Blue notes, an entire group of friend will come together by bike to help them move rather than using a car. (Blue, 2013). This type of change in mindset can be seen within university culture as well. Universities provide a great location for bike sharing services due to the large number of people in a small area. The institution itself can provide the service making bike use integratable with university systems. (Demaio, Page 47).

3. U.S. Car Culture and Short Shifts Towards Bikes
A large part of car culture in the United States was formed by public opinion in the 1950’s. The bicycle had very little popularity in the U.S. dating back to the 1930’s, so by the time the 50’s rolled around bike’s were pushed to the side and deemed toys for children. This ideology was cemented with the education for bike riding being provided only to America’s youth. (Longhurst, Page 155). This perception made it increasingly difficult to utilize bikes as a mode of transportation as even the interstate, unless there was no other route to be utilized, became limited to cars in the 1950’s. (Longhurst, Page 160). The prioritization of cars as a mode of transportation stands today with the largest number of registered automobiles being in the U.S. at an exorbitant rate of 250+ million. (Vivanco, Page 4). This focus on cars did change as time went on. Urban planning began to focus on promoting sustainability back in the 1990’s. This has allowed for ease of using cleaner methods of getting around such as bikes and walking because anything someone might need is close by. This change in set up has the possibility of longer lasting effects, due to change in infrastructure having the potential to influence the population, than the fads or reactions to crises experienced by bikes in the past. (Longhurst, Pages 233-234). This increased interest, outside of the sway of public opinion, can be due to the decreased costs experienced during the time. Starting in the 1980’s the production of bike’s was outsourced to other countries. This has grown in current day to 99% of U.S. bikes being created in Taiwan and China. This has made bicycle production into a global industry with the parts of each bike being produced in a different part of the world to reduce it’s cost. (Vivanco, Page 47). Given the ease of access to bicycles and the ability to reduce costs due to outsourcing it allowed the fad to catch on to people across the country.

Background For The Study

The Need For Change and the Reason For NH As The Subject:

1. American and Portsmouth obesity rates
When analyzing the age range of 10 to 17 within the U.S., including the District of Columbia as a location, New Hampshire has a medium level of obesity as the 33rd most obese state. At this ranking New Hampshire boasts a 15.2% level of obesity. When compared to the United States’ most obese State, West Virginia which has an obesity rate of 26%, this doesn’t seem particularly bad. (State of Obesity 2023). If this is compared on a global scale we see that somewhere like the Netherlands, which experienced an obesity level of 12.8% back in 2015, has a slightly lower level of obesity. (OECD, 2015). The close levels of obesity indicate that New Hampshire likely places a similar importance on health to that of the Netherlands. The similarity in health makes NH potentially more open to a system that would promote a healthier lifestyle.

2. Environmental Concerns

Some wonder why they would bother to bike on a daily basis when they could simply drive as it is quicker. How could each of their individual decisions possibly make a difference? The answer lies in Martin Armstrong’s finding that New Hampshire tops the charts in CO2 pollution on a home to home basis. As visualized to the right, the homes in New Hampshire alone amount to 5.09 million tons of CO2 being added into our atmosphere annually. With the total annual CO2 emissions per home in the United amounting to a devastating 32.3 million tons. This means that in 2017, of the 50 U.S. states, New Hampshire alone accounted for 15.76% of the CO2 added into the environment from homes. (Armstrong, 2017). Individuals in New Hampshire are thus a large part of the environmental issues that the United States experiences today, meaning that in order to fix our environment, the everyday consumer in New Hampshire must change their actions. The State of New Hampshire’s Department of Environmental Services declared that as of 2022 the budget for CO2 in NH at a base level is approximately 3.84 million tons of CO2 per year. This is a reduction plan of 1.25 million tons of CO2 for the overall count of CO2 polluting caused by individual homes. This will only continue to decrease with the plan being that every year, until 2030 when it will be reconsidered, the base budget will be decreased by “118,725 tons” annually. (Department of Environmental Services, 2022). The government thus sees the consumer as one of the primary generators of CO2 emissions thereby indicating that they have a lot of power when it comes to changing the environment if they were to band together. Therefore a system, such as an extensive
bike infrastructure, that would reduce pollution is something that New Hampshire as a whole could greatly benefit from.

3. Public Opinion - The Environment
The issue at hand can be seen in the analysis above. That being said, having an issue present, without people believing that it is a real problem, will inevitably just perpetuate the matter. In Resources For The Future they assessed public opinion towards climate change and policies implemented or planned to lessen the effects felt by climate change. As seen in the figure to the left from this public analysis New Hampshire, alongside Rhode Island, had the highest percentage of people who believe that past global warming was caused by humans. With 91% of those assessed believing that past warming was caused by humans, it is clear that New Hampshire feels a high level of accountability for the environmental issues caused in the past. (McDonald, 2020). An understanding of the effects of Global warming is interconnected with an environmental mindset as the effects of Global warming are partially caused by the everyday consumer. The actions that increase global warming, such as burning fossil fuels and using cars, diminish everyday lift by increasing the atmospheric temperature every year until eventually a noticeable change in environment takes effect. An awareness of this issue is the first step to addressing the best solutions for it. With an issue such as this it can be easy to blame big businesses for the effects felt, but the everyday consumer does in fact play a part in adding to global warming. Even back in the 1980’s small amounts of chlorofluorocarbons (CFC’s), from refrigerators, were leaking into the environment causing more pollution and thus adding to the issue of global warming. By 1987 the Montreal Protocol took effect, with nations agreeing to gradually eliminate toxic substances. The degradation of the ozone layer from everyday consumer products such as refrigerators was thus addressed
at a global scale. (Houghton, 2009). With New Hampshire’s understanding of how the past has affected the environment and caused global warming it established accountability for the past, but how about for the future? Resources for the Future also assessed public opinion on the percentage of people who believe that warming will be a serious problem for the United States. New Hampshire continued on with their environmental mindset scoring in the top portion of the U.S. with 87% believing that global warming will cause issues for the U.S. in the future. This assessment illustrates that New Hampshire also has a forward-looking awareness of global warming. (McDonald, 2020). Without this type of backing for addressing environmental issues, implementing a biking system for the partial purpose of addressing environmental concerns would be far more difficult as the system would need to be funded. With 87% of New Hampshire’s population seeing global warming as an issue for the United States’s future, there is likely going to be a public willingness to address the issue. This can be done by starting with a reduction of CO2 produced by the everyday consumer. Global warming is primarily worsened through the emissions of greenhouse gasses such as CO2. In regard to the U.S. environment, the Environmental Protection agency (EPA) found that almost 20% of total CO2 emissions come from cars alone. (Austin, 2008). The need for change is thus prevalent in order to address the 87% of New Hampshire's population who believes that the United States will be affected by global warming. A possible solution to this problem is changing from car utilization to bicycle travel. There is thus a clear need for the proposed Dutch biking system as it will improve ease of everyday travel and make it safer to travel by bike for the everyday citizen.

4. Money Saving
Switching from cars to bike’s can also have an immediate effect on penny pinching Portsmouth townspeople. Similarly to cars, bike’s have an upfront cost that varies from model to model. The real effect that bike’s can have on annual savings for consumers comes from the annualized average cost of bike maintenance with a value of roughly $100 to $300 a year. With $10,000 annually being spent on transportation costs for an average family of 4, there is a lot of money to be saved and spent elsewhere. As previously stated, almost 70% of car trips are for a distance of under 2 miles, which could easily be accessed by riding a bike. Therefore a switch would be both monetarily beneficial and feasible for the everyday consumer. Beyond the savings felt on an everyday consumer level, there are massive savings to be had by giving biking infrastructure priority over freeways. Nearby in Boston their freeway cost almost $1 billion per mile with all of the associated costs. This was of course somewhat an exception to typical costs as they were essentially building below the city. Even so, when looking at an average calculation of cost per mile of freeway, it comes out to about $60 million per mile. (Blue, 2013). For comparison in Portland, where there lies one of the most extensive biking systems in the United States, their 300 miles of biking infrastructure would also cost $60 million to replace. This breaks down to a mere $5 million dollars spent per mile as compared to the average of $60 million per freeway mile. (Weigand, 2013). In this case a simple comparison reveals that the U.S. is presented with a choice between an infrastructure that allows for a full bike system with 100’s of miles to offer to
the general public, or paying to continue on building out its pre-established system of freeways. The question lies in how willing is the United States to stick to the age old tradition of prioritizing cars over other forms of transportation? At the end of the day it comes down to whether or not funders are willing to foot the bill for a new bike system so that users of the system can save money, which can then be allocated to more local stores due to their inability to travel long distances.

**Plausibility In Portsmouth:**

1. **The pre-established biking system in Portsmouth**
   
   According to the City of Portsmouth’s annual comprehensive financial report of 2023, the most recent year published, the city boasts 39 bike racks. As well, they have a parking division that has one of their means of offsetting property taxes as being bike and pedestrian plan implementation. (Belanger, 2023).

2. **The City of Portsmouth's Master Plan**
   
   Dating back to 2005 the city of Portsmouth has been working on implementing a master plan detailing how to incorporate bike lanes into the city. They describe multiple scenarios as to how best to incorporate bike lanes as identified by the type of street. The outline for this plan is illustrated below with the streets being classified into seven classifications. A majority of the plans call for a sharing of the street for bikes and cars with a painted lane separating where bikes are allowed to ride and where cars are allowed to drive. Other street types detail a safer option. The “Neighborhood Connector” lanes for instance call for either a separate bike lane with an optional buffer in between car lanes and bike lanes. The other option for this street type is to create a “sidewalk” of 10 feet that is open to pedestrians, bikers, skateboarders, etc. The recommended design is the first with 5 feet of space allotted to bike lanes against the curb and 6 feet allotted against parking. “Industry/Business Park”, “Gateway Corridor”, and “Primary Connector” also follow a very similar set-up with a buffer between bike lanes and a furnishing zone of grass separating bike lanes from the pedestrian zone. From 2005 onward the plans and guidelines that followed
essentially broadened the vision of the connections further and formalized the understanding of the need for bike lanes further within Portsmouth.

The design that incorporates bike lanes, a buffer section between cars, a furnishing zone, and a pedestrian zone can be seen above. The overarching goal of this plan is as follows:

“Streets and roadways in the City of Portsmouth will be convenient, safe and accessible for all transportation users, including pedestrians, bicyclists, transit vehicles and riders, children, the elderly, and people with disabilities.”
- City of Portsmouth Complete Streets Policy (2017)

This goal allows for a safer biking network than Portsmouth’s previous system (City of Portsmouth, 2017). This approach greatly resembles that of the dutch as illustrated by the system in Utrecht:

As illustrated in the graph above the general outline is very similar with the primary difference being that the bike lane takes up 6.5 feet instead of 6 feet. (U.S. Department of Transportation Federal Highway Administration).
3. Portsmouth Bike Lanes Vs. Dutch Bike Lanes

As Portsmouth already has this pre-established plan in the works, the plan itself can be compared to the typical Dutch biking system to see what other parts of the system would need to be added in order to make it resemble the Dutch biking system. Within the Netherlands the size of the bike lanes varies depending upon how frequently the lanes are used. The rules regarding bike lane width are dependent upon which municipality the lanes are in. The differences make it so that in between two municipalities the lanes actually double. Typically Dutch bike lanes adhere to a design manual called “Tekenen voor de fiets” or “Designing for the bicycle.” This manual stipulates that a bike lane should be no narrower than six and a half feet. This width expectation expands to 8.2 feet if the path typically has 150 bikes on it per hour. (Wagenbuur, 2011).

Experts On Subject Matter

Background Information Presented To Experts Prior To Interview:

This plan is looking at the plausibility of implementing the Dutch biking system in the United States given its cost, the amount of time for its creation, and the desire for such an infrastructure. With this breakdown of an implementation plan the economic and social implications can then be analyzed. Given the infrastructure of Portsmouth, its environmental mindset, and its healthy population, it has been chosen as the given subject for analysis as these variables increase the plausibility of implementation. The only things that are necessary in regard to your understanding of the Dutch biking system prior to answering the interview questions are: the dutch biking system operates similar to the U.S. roadways in which bike traffic is directed with lights, the bikers in the Netherlands have right of way over pedestrians and cars, and the biking system in the Netherlands is fully ingrained into their culture. Any additional understanding of the Netherlands will be explained directly before the question it relates to for these interviews.

Subject Matter Experts:

1. Mayor Deaglan McEachern - Elected in 2021
   a. He was selected as a subject matter expert because he has an understanding of current governmental policies and the wants/needs of Portsmouth citizens

2. Chief of Police Mark Newport
   a. He was selected as a subject matter expert because he has an understanding of regulations within Portsmouth and any necessary laws that would need to be updated for project implementation

3. Director of Education Abroad USA Leonie Meijer - UNH Global
   a. She was selected as a subject matter expert because she is from the Netherlands but has lived in the United States for years. She can thus
provide an interesting perspective as to the differences between the Dutch biking system and the United States biking system.

Qualitative Analysis of Portsmouth - Interviews:

The Current State of Portsmouth’s Bike Lanes and Plans:
Mayor McEachern sounded hopeful when discussing the bike plans Portsmouth has been working on to better downtown. In discussing the seacoast rail trail plans that would allow a bike path from Portsmouth to Hampton he said, “We’ve put a bunch of trailheads on the trail in Portsmouth, but we’re also connecting to the downtown more easily and making it easier to get people onto the rail trail is something that has been a been a big part of the master plan for the last three years. So encouraging that type of biking when it’s biking from one location to another, I feel has been more successful than trying to do a pilot program or one section of the road is protected and maybe other parts of that where it goes or not protected because it doesn’t necessary, reach kind of minimum viable product get you from point A to point B safely.” Funnily enough Leo used the same analogy to point out the differences of the Dutch system vs. Portsmouth’s current system saying, “In the Netherlands is seen as a mode of transportation to get you from point a to point b, whereas here it’s more for recreational purposes or, you know, physical or whatever. But in the Netherlands, I feel like for the most part, it's really seen as an alternative to a car.” When comparing this type of system to that of the Dutch biking system Chief Newport also noted, “Especially where, looking at the designs of those, they’re built to go to metropolitan areas. They’re not just like bike paths that run along a railroad track or you know a river or something to that matter. They’re trying to build it into the infrastructure of a city or town where they’re going the same place that cars go, so. I think the U.S. is pretty far behind that theory so I would see more of the probability of like multipurpose lanes that accommodate bicycles, pedestrians, runners, whatever rather than go onto a bicycle only lane.”

Portsmouth’s Downtown:
When discussing whether or not the mayor believes that the people of Portsmouth would want updates to the current biking system he stated that, “We found that for whatever reason the bollard system generates more anger and resentment for reasons that are difficult to comprehend, but the multi use path is definitely much much more appreciated meaning where there’s a curb that separates the biker from the car. I know as a parent, most people would generally want their kids to have a protected bike lane system.” This bollard system that he discussed would involve a short term type of perimeter being set up to keep cars from driving through downtown past a certain hour. This plan that faces opposition would require reworking the streets of Portsmouth to allow for the flow of traffic to continue whilst downtown is closed. Chief Newport agreed that this system has some pushback explaining “You know, as you’re aware, when they first put em’ out there and implemented them, there was some heartache and where the bollards were placed and sections of the roads …” This opposition for the barrier could make it difficult to create a walkable downtown which would resemble many downtown portions of Dutch cities.
The Mayor expanded the intentions behind this “Market Square Plan” by saying the issue lies in, “Can we make that can we make state Street at two way street again and then more selectively closed down the market Square area? There is still a need to have deliveries and trucks get into there but from like a bollard thing where we could, instead of putting put out a bunch of jersey barriers, we could actually close it off weekends, nights, etc. [...] The biggest thing to overcome is people’s imagination as to how bad it’s going to be. So if you get something started you can see that it’s not as bad as people think. Every time the streets are closed downtown people are like ‘oh we should do this more often.’ So it’s trying to get the businesses to realize that you can actually still do business and get deliveries, do all the things you need to get done to continue to run a profitable business. We can also have this more vibrant city, and downtown, where there’s people walking and biking …”

**Changing The Mindset of Car Reliance:**

When discussing with Leo the cost differences for a car vs. a bike and the reasons why Americans may be willing to front the hefty car bills, she explained: “So it’s definitely that a car is way more expensive than a bike. It’s a matter of how you are going to get the people out of the cars. In order to do that you need the infrastructure, but to me it’s more a different mindset and a cultural change and making people see the opportunity to use a bike as a mode of transportation, rather than just for recreation.” The mayor of Portsmouth had an interesting take on how the community’s mindset would change due to bike infrastructure. In discussing how the public might be more open to a biking system he explained, “I think in order to solve housing we’re gonna have to limit the amount of parking that we allow and enforce that. By enforcing it, we will limit the amount of cars in an urban area, and that would have a general result of having potentially more bikes there because it will be an alternative mode of transport. That is not governed by the amount of cars.” A big issue that Portsmouth is facing is that it is becoming over congested with people and cars. The mayor expanded his solution to this issue by claiming that they would potentially “allow(ing) one [car] per development and we’re going to enforce that by only issuing a certain number of parking or permits. By doing that we will limit the amount of new cars that are able to come into Portsmouth, while not limiting the amount of new housing. Biking would generally be your next best thing when it comes to getting around and maybe your first best thing if enough people start doing it. It’s viewed as you know this is more of an infrastructure that we have. so I don’t think we’re gonna be able to solve it just by saying ‘hey guys you should all start getting on bikes’. I do think that it could be a secondary effect of solving for housing and limiting or more enforcing parking requirements that would make housing more affordable and allow neighbor opposition to go down.” He explained that this plan would only affect new buildings that are being built.

The chain reaction from this may McEachern claims is, “From there and see you have more people in that kind of cohort want more services for bikes, that’s a low-cost service, and then other people that are currently not bikers would see those services and say ‘hey it’s actually a lot easier for me to bike. I’m gonna start biking more because the city is investing.’ Because
it’s a way to solve for housing crisis and it’s also a way to keep cars out of our [roads].” His overall reasoning behind this is, “I don’t think anybody cares about people walking or riding a bike from their house to wherever is there going to care about cars and parking and all that other kind of related stuff so it would allow us to have more more housing more quickly if we were able to eliminate cars from housing and cars.” According to the mayor it is best to go about changing of people’s mindset in this way because, “It would create enough people that would form a habit around that, that those people would then want more of that. That’s the secret I think to government is getting enough, buy in so that then people are like this is a good thing for us to do. It’s really difficult, even to take a good idea, and force it on people. It’s always better to have it be their idea or a result of an action that we all agreed that we want to take.”

Safety:
When discussing the safety of the current bike lanes within Portsmouth Mayor McEachern admitted, “We are much more distracted, drivers with cell phones. So the general perception of whether or not children are able to drive safely … They might be able to do it within our neighborhood but you know in between neighborhoods … generally there’s not a lot of confidence in that.” Part of the issue when it comes to safety is that the police have more pressing issues to deal with on a daily basis. When it comes to monitoring the bike lanes themselves Chief Newport explained, “So the the the uh bike lanes that we have here, they’re there but it’s not like we’re out like actively monitoring them, patrolling them. They’re more so there for the citizens or people who want to use them. If something were to happen, an accident or something that happened, obviously we’d respond to it and deal with the situation based of the rules of the road. But we’re not actively enforcing the bike lanes in Portsmouth.”

When it comes to bike safety in Portsmouth the police serve less as a regulatory force on that end and more ensure safety within the plans themselves. When discussing the police force’s input into the meetings regarding the Master Plan Chief Newport described “So I think it was just really just our input on the safety of the lanes: where the placements were, where the bollards were going to be placed, did we feel comfortable. This was new to the city, it was new to us. So there were occasions where we felt it wasn’t going to be safe. I know the fire department had a lot of issues with it, just because it really narrowed down certain sections of area roads. The maneuverability of, in fire trucks through, the way the design that we had with ballards. Once it was implemented and started working, for our purposes, it actually benefited us because it actually slowed cars down. The big issues were, you know, people were concerned that it was narrowing the roads down and people were gunna get hurt, but it made people slow down because the road weren’t nearly as wide as they use to be.”

The issue of safety also deals with ensuring that riders are following the rules of the road. In discussing how the cops would deal with a drunk bike rider Chief Newport explained, “So here right now a bicycle has to follow the same rules as a motor vehicle. So, therefore, we can enforce the same traffic rules as a motor vehicle, on a bicycle. Technically you can get arrested for a DWI while riding a motorcycle, I mean riding a bicycle on the road. [...] So if you’re riding
a bike on the street and you make an illegal turn or riding the wrong way you could get a ticket just as if you were riding a motor vehicle.” That being said an issue such as that is a very specific circumstance. Overall, when it comes to additional fees and regulations with a system such as this, Chief Newport said: “I think for the most part law-enforcement would not act … like we have enough going on right now and I’m not looking for more responsibility. I mean we do it if you know like I said if that’s what the community’s requesting and you know demand for the police department, but it’s not something we be looking to actively get involved or want to take enforcement action on. Unless, like I said, there was an accident that we would deal with. It’s tough to say because we don’t have a system built like that where that gets the amount of use they get there to dedicate personnel to specifically monitor.” So in the end the amount of safety regulations that go into place would likely fall into the hands of the people. It seems that the citizens of Portsmouth would need to directly demand for safety regulations of such an infrastructure in order to have them in place and enforced.

**Stolen Bikes:**
A pressing issue in the Netherlands, that is associated with the heavy amount of bike use, is bikes getting stolen. Chief Newport noted that if a bike was stolen “They would just call it in. We deal with stolen bikes all the time now […] there’s always going to be stolen bikes.” Leo didn’t share this view of lack of bike safety within New Hampshire. She explained, “I've noticed here that people often don't even lock their bikes and I'm like, wow, you can do that here. Which, as you know, in the Netherlands, there is no way that you can do that because you need to have a block that's more expensive than the actual bike.” This difference in opinion is likely because bike stealing is so prevalent within the Netherlands. She even disclosed that she herself was a victim saying, “I've been the victim of getting my bike stolen. It's not fun. Okay, and the first time you're really, really, really mad. And the second time you basically just give up and you just make sure that you get another bike, but you don't put a lot of money into it anymore because it's not really worth it. Yeah, but it's frustrating. Yeah, there's whole gangs and they all get exported. It's wild.”

**New Bike Racks:**
When discussing that Portsmouth only has 39 bike racks and the potential to increase this number in order to house more bikes, the mayor explained that the majority of bike racks were put downtown for ease of use and additional bike racks are not included within Portsmouth’s Master plan. Overall he said, “We’re not opposed to that, just haven’t seen as big of a need and people mostly just kind of lean them up against the buildings where they’re going.” Chief Newport agreed with additional bike racks not being included in the Master plan because“ … as far as bike racks and where they are, it’s more that we deal with the city, the counsel, and the ordinances of where to place things. It’s not so much a responsibility that we take on to say where they should be, where they shouldn’t be. If we’re asked for advice on that. I think you said there’s only 39 bike racks in Portsmouth, but I think that’s enough to accommodate the need
that’s here, so I guess it just depends on your community and how much of an impact bicycles are having on your community on what the needs are.” This view that people can simply lay their bikes anywhere along the road and that there is little need for additional space juxtaposed Leo’s experience in which, “… they have biking garages. And so around those biking garages, There may be laws where you are not supposed to park your bike. And there are signs saying that typically. So if people still do that, they could get their bikes taken away or be fined if they get caught putting the bike there right then and there. Although mostly I would say the police will give a warning first. But you know, if they come back and they see that you did so put your bike where it wasn't supposed to be, they will take action, I would say.” This presents the issue of whether or not new regulations would need to be put in place in order to ensure bike storage compliance, or whether Portsmouth would remain relaxed on the bike regulations.

Traffic System For Bike’s In Portsmouth:
In discussing with Mayor McEachern whether or not the Portsmouth Master Plan calls for separate traffic lights for bikes, similar to that of the Dutch system, he clarified, “They’re connected to the pedestrian system but in a multi use path, so there’ll be a dedicated walking path and then a demarcated bicycle path and then a curb and then the road. So they’ll still have to use, in that area, they will still have to use the pedestrian walk signal to cross the street at that location. [...] Again, I haven’t heard the request but it’s a good one in terms of the planning stage and if it’s going to be a dedicated … if the light will change for bikes or not, that would be an improvement that we would likely have to incorporate into the design phase right now.” Chief Newport agreed with the probability of the regular pedestrian lights being utilized rather than bike specific ones saying, “Yeah I think here, at least in New Hampshire, probably in the U.S., that even if we were to have the Dutch biking system, the rules all road and still apply the same as on a motor vehicle road. Pedestrians would have crosswalks, the system would be set up to work the same way. I would encourage that because you open people up to injuries and unnecessary risk, there’s a lot more pedestrians and there are bicyclists.” Leo shared this thought that there is a strong preference for cars making it difficult to be a bike rider in current day America. She proclaimed that, “I feel like bicycles here definitely take second, third, fourth, place in the whole traffic plan. It's very much car driven. Whereas in the Netherlands it is much more focused on bikes, and that infrastructure and they actually want to encourage people to ride their bikes.”

Potential For State Governmental Push For Bike’s:
In discussing the high costs associated with owning a car in the Netherlands, due to the small size of the country, and the feasibility of raising costs associated with cars here in the United States, the mayor explained, “I don’t think New Hampshire is going to say you can’t drive. I think that’s gonna be a lift that’s too hard, because we don’t have taxes or anything, so increasing those are I think unlikely. What I think is more likely is the market is gonna make it more
expensive to drive from an insurance standpoint. It’s just going to be more costly to carry insurance.”

**Electric Bike Regulations:**
One of the potential issues of implementing a system that allows bike’s is where to draw the line as to what amount of horsepower can travel in the bike lanes. In the Netherlands even mopeds are allowed to drive alongside bikes. Chief Newport touched upon this issue saying, “Most people can’t tell the difference between a scooter and what’s classified as a motorcycle. So initially people will say oh we’ll allow mopeds, but a moped is not supposed to go over 30 miles an hour and has a small engine, but a scooter cn have like 110 cc engine that does 75 miles an hour, but they both look exactly alike. For instance, in Portsmouth you can park a moped on the sidewalk, it’s considered like a bicycle. But if it’s classified as a motorcycle, cause it has 110 cc engine, it’s actually a motorcycle. It’s not allowed but they all look alike. So like we’re not actively trying to decipher between the two.” There would therefore need to be clearly stated regulations as to what horsepower is allowed on these lanes and training for those enforcing bike lane regulations. Even Mayor McEachern noted his own experience with an electric bike as, “I had one last summer that had 30 miles to the charge like I never needed that. That thing went way too fast for me and I couldn’t put my kid on there so I got a more family friendly one. The thing was going like 50 miles an hour.” This comes down to an issue of whether it is more important to allow a type of bicycle that would provide use an convenience to those who may not enjoy biking or not allowing them as it can pose a safety risk due to them increasing to a high speed.

**Rideshare Options:**
When discussing if Portsmouth had something similar to New York’s city bike’s the Mayor explained: “We had some options in that. The upkeep of the bikes wasn’t fantastic. [...] We had it like 6 or 7 years ago. It just in the infancy so it didn’t really take off. I think if it was back now it would be a different situation because a lot of the education has happened. Being one of the first places to do it wasn’t [easy given the infrastructure at the time].”

**Plausibility In Portsmouth:**
When discussing the specific sectioning off of bike lanes from pedestrian walkways he stated, “But I think looking at the system, looking at the infrastructure, it kinda looked like they have two separate systems: one for motor vehicles, one for bicycles, and one for pedestrians. So there’s really not a real reason for them not to enter or interact because they’re all next to each other. So that’s a huge infrastructure that most places in the U.S. are not designed to accommodate, and it would take a lot of investment and buy in for it to be developed here.”

**Finances**
According to the New Hampshire Employment Security Official Website, the city of Portsmouth “contains 15.7 square miles of land area and 1.1 square miles of inland water area” (Economic and Labor Market Information Bureau, 2022). With this city size in mind we can find a city or town of a similar amount of land, analyze how much it cost to implement their bike structure, and compare the resources utilized to current products and equipment in the United States. This is a simplification of the resources necessary as external factors may cause the project cost to deviate from the approximation. That being said it does provide a reasonable approximation of the anticipated cost of implementation. The city of Zutphen in the Netherlands is the closest in size to Portsmouth with the area encompassing 15.81 square miles of land and 0.76 square miles of water. (CBS, 2024).

Back in 2009-2010 Portsmouth was approved for a budget of $457,782.84 for their congestion mitigation plan to implement bike paths. This plan was 20% funded by the city of Portsmouth and 80% funded by the state. The 2005 Master Plan for bike implementation, as previously mentioned, is already an extensive biking system with said funding. (Finnigan, 2010). That being said, it does not adhere to the same design as the Netherlands. As such, the cost of resources can be approximated by comparing Portsmouth with the city of Zutphen to see what additional funding is necessary. The 2005 Master Plan allotts for 7 different types of roads, each of which will have a different bike plan depending on the road. In the Netherlands streets are designed with an approach of systematic safety: distinct bike lanes, lights specifically for only bike lanes, and set in place plans to keep bike paths clean. By diverting traffic from the main areas of towns and employing bike designs that suit the town, the Dutch are able to create a safe network for those to use as their primary form of transportation. (U.S. Department of Transportation Federal Highway Administration). As previously stated in the Plausibility of Portsmouth section, the Dutch biking system calls for a minimum width of 6.5 feet with the width going all the way up to 8.2 feet depending on the circumstances. For the sake of understanding the cost of implementation we will assume a width of 6.5ft is necessary to comply with Dutch standards.

With this background information in mind we can use the 2005 Master Plan to approximate how much it would cost for the Portsmouth system to update in order to comply with Dutch standards. The neighborhood slow street and city core slow street both call for a shared biking system rather than a separate roadway for bicycles. These roads are approximately half of the infrastructure outlined in the plan. As a majority of the work would be done on implementing roads with a set pedestrian zone and designated bike lane we can assume that the cost of implementation would need to more than double in order to implement a system of 6.5ft wide bike lanes into these additional roads. As well, the current system calls for bike lanes that are 6ft wide, in order to comply with Dutch regulations the bike paths would need to be extended an additional 0.5 feet. In looking at the $457,782.84 allotted, if that number is multiplied by (6.5 ft / 6 ft) we can approximate how much the extension would cost. This comes to a total of $495,931.41. Given that half of the system is missing bike lanes entirely this number can be
doubled to approximate how much the infrastructure would cost. This comes to a total cost of $991,862.82 to implement the overall system. This means that in order to comply with Dutch regulations the bike lane infrastructure would increase by approximately $534,079.98. It is important to note that this is an approximation and thus would need additional information in order to identify a set cost of additional implementation.

Beyond the bike lanes themselves there are other costs associated with Dutch bike lane policy. One of the largest additional safety measures are the traffic lights set aside for bike use only. If bridges are necessary for implementation they can be almost 100 times more expensive to create than simply implementing the infrastructure on level ground. Cost of a drainage system for the bike lanes can also be quite extensive depending on how well developed the system already is within Portsmouth. (Buczyński, 2021). As these costs can be extremely varying depending on various factors in Portsmouth that are not easily identifiable, we shall instead focus on traffic lights as being the main additional cost to ensure safety within the system.

Implementation Plan:

Assuming all of the funding requirements are met, the project scope is as follows. We are building this implementation plan based on the aforementioned cost level. The total duration of this project is anticipated to be several decades long based on the past precedent of the Portsmouth Master Plan. The initial project plan, based on William Malsam’s Project Implementation Plan breakdown (Malsam, 2023), is as follows:

- Project goals & objectives: The ultimate goal of this project is to create a safe network of biking infrastructure based on the Dutch biking system. Key milestones in order to achieve this include reworking of traffic to allow for such a system and in turn an eventual road by road implementation.

- Success criteria: A cost for implementation and project timeline will be set and met by the project manager and their team so as to ensure stakeholder satisfaction.

- Project deliverables: Road by road implementation. This can be done either piece by piece such as all of the traffic lights at once and then paving the roads for all of the paths after, or it can be a matter of implementing all of the aspects of the infrastructure on a road by road basis. Given the time necessary to section off these areas I recommend doing the latter, the road-by-road implementation.

- Scope statement: Assuming that all financing is met and the town of Portsmouth agrees to implement a biking system based on the Dutch biking system the project scope is as follows. The goal is to implement the Dutch biking system gradually over Portsmouth. Every month a new road will be reworked to have additional safety features such as: a 6.5
foot wide bike lane, buffers between the bike lane and the road, and additional traffic lights that are intended for bike use only.

☐ Resource plan: The resource breakdown details the additional resources needed to allow the biking system in Portsmouth to comply with Dutch biking regulations. This breakdown is based on the Portsmouth bike infrastructure plans that began in 2005.

☐ Risk analysis:
  ☐ Strengths: The Master Plan already accounts for improvements to the current bike infrastructure
  ☐ Weaknesses: It is difficult to implement a 6.5 ft wide bike path to every road due to the current set-up of the roads within Portsmouth
  ☐ Opportunities: The Mayor appears to be supportive of the system and could thus aid in bringing it up to the Portsmouth council to determine feasibility
  ☐ Threats: Cars are the primary threat as they are more ingrained in the U.S. culture

☐ Implementation timeline: The Master plan has taken decades to go through, as such the timeline will be set to several decades as an ongoing project goal.

☐ Implementation plan milestones:
  ☐ Identify a sponsor
  ☐ Generate funding
  ☐ Find a project manager
  ☐ Establish resource requirements
  ☐ Identify key stakeholders and establish partnerships for collaboration
  ☐ Identify potential barriers and opportunities for implementing a similar system in the American context
  ☐ Conduct surveys and public meetings to gauge interest and address concerns
  ☐ Develop a comprehensive biking infrastructure plan based on the Dutch model
  ☐ Review and revise local zoning codes, transportation policies, and regulations
  ☐ Process Implementation Monitoring
  ☐ Evaluation and adjustment
  ☐ Make adjustments to the infrastructure and policies as needed based on feedback and data analysis
  ☐ Educate the public on the new plans
  ☐ Expansion of previous plans - If need be
  ☐ Establishment of maintenance plans

☐ Team roles & responsibilities:
  ☐ Project Manager: Responsible for overseeing the entire implementation process, coordinating between different teams, and ensuring the project stays on track and within budget.
Transportation Planner: Develops the biking infrastructure plan, including bike lane designs, traffic flow analysis, and integration with existing transportation systems.

Community Outreach Coordinator: Engages with residents, businesses, and community organizations to gather input, address concerns, and build support for the project through public meetings, surveys, and outreach events.

Policy Analyst: Reviews local zoning codes, transportation policies, and regulations to identify barriers and opportunities for promoting cycling, and recommends policy changes to support the implementation of biking infrastructure.

Civil Engineer: Designs and oversees the construction of bike lanes, paths, intersections, and other infrastructure improvements, ensuring they meet safety standards and regulatory requirements.

Communications Specialist: Develops public awareness campaigns, educational materials, and media outreach strategies to promote cycling as a viable mode of transportation and keep the community informed about project progress and updates.

Data Analyst: Collects and analyzes data on cycling patterns, traffic flow, safety incidents, and other metrics to evaluate the effectiveness of the biking infrastructure and inform decision-making for future adjustments and expansions.

Implementation plan metrics:

- Number of cyclists using the lanes during peak hours
- Number of bike accidents per year
- Community satisfaction surveys - determine if the bike infrastructure is benefitting the citizens of Portsmouth
- Ratio of bikes to cars in Portsmouth a year after the project is finalized
- Reduction in greenhouse gas emissions and air pollution resulting from the decrease in car usage
- Evaluation of bike rack usage (establishes whether there is a need for additional storage)

*Note: As all projects have ups and downs this list is subject to change in the future given feedback from stakeholders or any issues faced when going through the plan itself.

**Final Remarks**

Additional Elements That Could Expand Upon The Research:

- A demographic analysis of bike users in Portsmouth could be conducted to best establish what stakeholders would be most invested in a new bike infrastructure.
• Bike sharing is intentionally left out of this analysis so as to have the primary focus be on infrastructure, that being said they would provide ease of use and thus benefit the structure utilization once implemented.
• Additional sources could be analyzed in regard to the background on Portsmouth
• Mayor McEachern mentioned that a good point of contact to delve into these matters further would be Matt from SABR, the President of the seacoast bike riders association, and Chav from Rad Moto. As transcribing and coding the interviews is extremely time intensive and takes up a large portion of the thesis, I thought it best to stick to the 3 subject matter experts. That being said, the additional insight from those who are invested in such a system would undoubtedly be beneficial.
• Utilization of R to predict when the best time is to implement such a system: Use R to look at environmental trends throughout the years, Use R to look at bike trends throughout the years, and look for patterns in increase in demand for both to suggest what year would be best
• Additional research could be conducted to find out the best course of action for funding the project
• An increase in bike use could lead to increased daily independence causing kids to go to school and extracurriculars by themselves. This could potentially lead to an increase in the job market, parents not needing to care as much for kids. An increase in labor would cause the supply curve of labor to shift to the right. (Lynham, 2018). As well, biking on a daily basis would potentially increase health and happiness as people would get more fresh air and spend less money on cars. These additional economic and social implications could be delved into deeper.

Conclusion:
The implementation of the Dutch Biking System in Portsmouth NH therefore presents a promising opportunity to revolutionize transportation infrastructure in the United States. By leveraging the rich history of bicycles, the success of the Dutch biking system, and the unique characteristics of American cities, this thesis has outlined a comprehensive plan for introducing a sustainable and efficient biking network. The identified weaknesses, opportunities, and threats underscore the challenges and potential rewards of such a transformative project. Through collaboration with key stakeholders, strategic planning, and ongoing evaluation, Portsmouth can pave the way for a more bike-friendly and environmentally conscious future. The dedication of the Mayor, support from the community, and alignment with existing urban plans position Portsmouth as a prime candidate for embracing a Dutch-inspired biking system. In order for the project to take effect, a change in the allotted amount of parking for each new building must be limited. This has yet to be passed by the Portsmouth city council and may thus take several decades. Once this is passed, and the aforementioned chain reaction of bike needs occurs, Portsmouth will have an environment that is receptive to the Dutch biking infrastructure. As well, by prioritizing biking infrastructure, Portsmouth has the opportunity to enhance public
health, reduce carbon emissions, and create a more vibrant and livable city for its residents. This thesis serves as a roadmap for cities across the United States seeking to emulate the Dutch model and embrace cycling as a core component of urban mobility. The implementation of the Dutch biking system is thus possible within Portsmouth, but with the caveat that some of the roads would need to be entirely restructured in order to fully implement the necessary width of bike lanes and safety measures.

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