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Sustainable Urban Transportation: Examining Cargo Bike Use in Seattle

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Abstract

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Cargo bikes have become a more viable and attractive alternative mode for transporting children and cargo, such as equipment or packages, as Seattle's motor vehicle traffic congestion has increased. Using cargo bikes has several environmental, economic, health and safety benefits for individuals, businesses, and the cities, however, cargo bikes are a recent urban transportation trend with limited research and a general lack of awareness in the United States. As the cargo bike trend continues to grow in Seattle along with urban population densities, it will become increasingly important for urban planners, transportation engineers, households, and businesses to recognize cargo bikes as an effective tool for establishing more sustainable urban transportation practices. In my thesis, I argue that cargo bikes should be acknowledged as viable car replacements and incorporated and supported within urban transportation plans, policies, and designs. My argument is supported by a literature and practice review, interviews with Seattle cargo bike users, and some local plan and policy analysis, resulting in an outline for improving cargo bike support in Seattle.

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1. INTRODUCTION

As urban populations continue to grow and the negative externalities of conventional transportation increases, cargo bikes become a viable and attractive alternative for transporting parcels, kids, equipment and other cargo. If a portion of freight, household, vending or service related trips were replaced by cargo bikes, traffic congestion, air and noise pollution, and injuries and fatalities, could be reduced significantly. Cargo bikes, however, are a recent urban transportation trend with little research that supports their use and a general lack of public awareness. As the cargo bike trend continues to grow along with urban population densities, it is important for urban planners, transportation engineers, households, and businesses to recognize cargo bikes as an effective transportation tool for establishing more sustainable urban transportation practices. Throughout this thesis, I argue that cargo bikes should be acknowledged, incorporated, and supported when developing urban transportation and land use plans, policies, and designs.

Transportation infrastructure plays a crucial role in providing access to destinations, moving goods throughout the city, and the urban quality of life and it is local governments' responsibility to plan and invest in infrastructure for sustainable urban transportation. Current transportation infrastructure in Seattle does not prioritize public and non-motorized modes of transportation. Safe infrastructure for non-motorized travel, such as cycling, is lacking, private and commercial motor vehicles dominate the roadways, and traffic congestion has been increasing rapidly. The transportation sector is responsible for a significant portion of public health and livability issues such as air and noise pollution, greenhouse gas emissions, and traffic accidents that cause injury

and death. Managing transportation through plans and policies that deliver essential services, while reducing the negative impact on the environment and livability is central to creating a more sustainable Seattle. In the United States, and Seattle, there is a societal expectation that encourages owning a car and physical barriers in the City's transportation infrastructure that hinder people from living a car-free life. Walking and cycling are sustainable means of transportation that improve individual health and reduce noise and air pollution. To reach climate mitigation goals to radically reduce greenhouse gas emissions, the role of the car in everyday life needs to be challenged. This involves creative urban planning and the development of policies and infrastructure that supports sustainable transportation modes that provide the same services and mobility that cars do, such as cargo bikes.

Seattle's 2030 goal is to reduce greenhouse gas emission from passenger vehicles by 82 percent and vehicle miles traveled by 20 percent. The City plans to achieve this goal through expanding its transit, pedestrian, and bike infrastructure to provide alternatives to travel by car. While Seattle recognizes bikes, and has implemented more infrastructure through the Seattle Bike Master Plan to support their use, the City has not acknowledged cargo bikes as a similar, but separate mode with an entirely separate set of needs, capabilities, and benefits. Cargo bikes can transport freight and families; however, they are not acknowledged by the City as viable freight truck or family car replacements, or as a separate mode from regular bikes. While cargo bikes are not a solution for all urban transportation problems, they are one of many tools which should be utilized to achieve environmental and livability goals in Seattle. By not acknowledging cargo bikes, Seattle is turning its back on an opportunity to move towards a more sustainable city, and at this point, it is crucial that the City utilizes any means that presents itself. Cargo bikes are currently being used by

couriers and logistics companies, families and households, and vendors and service providers in Seattle with little support or acknowledgement from the public sector. If the public sector were to embrace cargo bikes in the form of supportive plans and policies, it may reduce some of the advantages car drivers currently have, but it would ultimately result in a more equitable distribution of public resources and a more sustainable Seattle.

My research objective is to identify how cargo bikes are used and the advantages and challenges experienced by cargo bike users in Seattle. Using this information, I suggest ways that local government can better support cargo bike use in Seattle. I chose to focus on Seattle because it is where I currently live and study urban planning. I have lived in Seattle for 13 years and I am familiar with local plans and policies, geography, history, and culture. I am an active member of the bike community and have commuted by bike year around for my entire adult life. I have also worked for four different cargo bike based businesses as a vendor, service provider, and courier in Seattle. Through my own involvement as a professional, recreational, and utilitarian cyclist, I have recognized a growing trend in cargo bike use, as well as specific advantages and barriers to both regular and cargo bike use in Seattle. My experience has lead me to identify as an advocate for all pedal-powered transportation. While my position may be biased, I have been objective throughout my research to the best of my abilities.

1.1 RESEARCH OBJECTIVE AND OUTLINE

My research purpose is to identify how cargo bikes are used and the advantages and barriers faced by cargo bike users in Seattle. The first section covers an introduction, the definition and history of cargo bikes, and description of users. The second section covers a description of my methods

and research process. The third section includes the literature review, which covers the current cargo bike research and practices. The fourth section includes my findings, which identifies how cargo bikes are used and the advantages and barriers to using cargo bikes in Seattle. The fifth section discusses improving cargo bike use support in Seattle through local government intervention and the sixth and final section includes a brief conclusion.

1.2 DEFINITION

A cargo bike is a human powered bicycle designed to carry cargo. Cargo bikes also go by box bike, bakfiets, freight bike, carrier cycle, cycle truck, cargo trike, DHL's four-wheeled "Cubicycle", electric cargo bike (E-CB) or pedal assist electric "pedelec" cargo bikes. Cargo bikes have a frame and drivetrain designed to handle carrying weight as well as designated places to put cargo. There are several types and styles of cargo bikes that differ by where the load is carried, dimensions, number of wheels and their configuration. Some cargo bikes are purely pedal powered and others have an electric motor which can be engaged by riders for extra assistance. I have also included bike trailers in my definition of cargo bikes, although trailers can be detached and are not technically a cargo bike, they serve the same purpose of transporting cargo by bike, which is the focus of my research. The most popular types of cargo bikes used in Seattle are the long john style, such as a Bullitt (Figure 1.1), which holds the cargo down low up front, and the long tail style, such as an Xtracycle (Figure 1.1), which holds the cargo up higher in the rear.



Figure 1.1 A Bullitt brand cargo bike, which is a “long john” style, and an Xtracycle brand cargo bike, which is a “long tail” style. (Larry vs. Harry 2017, Xtracycle 2017)

1.3 BRIEF HISTORY OF CARGO BIKES

Cargo bikes are currently experiencing a renaissance, but they have been used since the late 19th century throughout Europe. Tradesmen such as butchers and milkmen used cargo bikes to transport and vend goods (Kirkels 2016). Postal companies had the largest fleets of cargo bikes and experimented with cycle logistics in European cities. Cargo bike technology evolved to carry heavier loads and were used by farmers, craftsmen, postmen, newspaper deliverers, garbage collectors, and street sweepers. Cargo tricycles were often owned by companies used to move goods and provide services while the conventional two wheeled cargo bikes were more often household bikes used to carry groceries and people.

Cargo bikes remained a popular way to move goods and people around through the 1920s in European cities, even as cars became more common. It was not until the 1930s that cargo bikes reached the United States when Schwinn produced the first ever cycle truck (Kirkels 2016). Around the mid-century, businesses began to abandon cargo bikes in most developed cities when automobiles took over and people’s needs and the urban environment changed. Cargo bikes

remained a household item in European cities, especially in societies that turned away from car centric culture in the 1970s, such as the Netherlands and Denmark where cargo bikes are still commonly used today. Cargo bikes are also still used in Asia, Africa, South and Central America where they still play an important role in urban goods transport particularly in developing countries. It was not until the 2000s that cargo bike technology was reborn and new designs emerged in Europe and North America to meet the diverse needs of modern urban society. Today, cargo bikes are experiencing a renaissance for all types of users, and cargo bike technology continues to evolve.

1.4 USERS

Cargo bikes are used for a variety of purposes throughout the world and the trend is growing, particularly in dense urban areas in Western countries. Rather than attempt a comprehensive list of worldwide cargo bike uses, for the sake of organizing my research, I have divided cargo bike users into three main categories based on their use: couriers and logistics companies, families or households, and vendors and service providers.

Couriers and Logistics Companies also known as messengers or cycle couriers, use cargo bikes commercially to transport goods to and from businesses or residential locations. Couriers may be further categorized by what they deliver such as legal documents, food, personal packages, or other miscellaneous items. Couriers operate as are either employees of a logistics, food delivery, or other cargo specific delivery service companies, or independent contractors that work for several companies or individuals. Logistics companies are also known as cycle, parcel, or freight logistics companies and are a part of the courier, express, and parcel sector (CEP). The logistics or CEP sector focuses on shorter trips, delivering small, light-weight parcels, quickly and accurately.

Couriers and logistics companies complete scheduled “last-mile”, end of supply chain deliveries, as well as on-demand, point-to-point deliveries. Oftentimes, logistics companies are multi-modal, utilizing motor vehicles for long distance transport and cargo transport within the urban core. Cargo bikes have recently begun replacing cars for urban center cargo delivery, acting as a mode with capabilities between cars and regular bikes, capable of carrying cargo loads short distances, more quickly and efficiently than cars, freeing up cars to do longer distance routes outside of the urban center.

Families or Households use cargo bikes to transport children and do household shopping. Families or households can consist of individuals, multiple people who cohabitate, and/or their dependents that choose to use cargo bikes to complete day to day activities. Cargo bikes offer families or households the ability to run errands, do shopping, transport children, gear or other cargo without using a car.

Vendors and service providers use cargo bikes to sell goods, provide services and haul equipment. Vendors are usually private companies that operate under a city permit to sell their goods in public spaces or designated areas depending on the city’s laws from their cargo bike using it also as a means of transporting their goods. Service providers can be either private companies or publicly contracted individuals that offer a mobile service in which they use a cargo bike as a means of transportation. Some examples of service providers include mobile landscaping or housecleaning, municipal maintenance or waste collection, or mobile advertising.

2. METHODS

The methods I used throughout my research process were: literature review, practices review, observation, interviews, and some policy analysis. I used literature and practice review to develop an understanding of the current research and strategies used to support cargo bikes. I used interviews and observation to identify barriers to cargo bike use in Seattle. I used interview findings to identify plans and policies that impact cargo bike use, or have the potential to. I developed recommendations for improving cargo bike use support in Seattle based on interview findings and observation combined with literature and practice review. I then evaluated my suggestions based on criteria that I developed and situated my recommendations within the Seattle planning framework.

The literature review process involved searching the University of Washington's peer-reviewed research database for the terms: cargo bike, freight bike, cycle freight, bike freight, family bike, family cycling, cycle courier, bike courier, bike messenger, cycle messenger, and cycle logistics. I reviewed the literature to develop a comprehensive overview of the current research on cargo bikes and varying focus. I also included sources that address regular bike use to support my arguments that are not necessarily specific to cargo bikes, but rather bike use in general. For these sources, I searched the University of Washington's peer-reviewed research database for the terms: safety bike, environment bike, livability bike, health bike, economic bike, sustainability bike, and bike use. I did not rely on the term much, because I was already knowledgeable and aware of the sources available that support regular bike use.

Throughout the literature review, I identified practices that support cargo bike use and further researched them through the internet. I performed an internet search using the Google search engine for the phrases: cargo bike share, cargo bike policy, cargo bike transit, cargo bike subsidies, cargo bike rebate, traffic restrictions and cargo bikes, consolidation center and cargo bikes, cargo bike parking, cargo bike incentives, cargo bike infrastructure, density and cargo bikes, cargo bike delivery, cargo bike family transport, cargo bike shopping, municipal cargo bike, cargo bike vending, and cargo bike based business. One of my main sources for identifying practices that successfully support cargo bike use was the European Cycle Logistics Federation, which publishes presentations, reports, and literature on cargo bike use. I elaborated on practices that were most frequently mentioned throughout the literature and internet searches that demonstrated successful adoption, feasibility, and support of cargo bike use.

I used interviews as the main method to identify advantages and barriers for cargo bike users in Seattle. I contacted cargo bike users that I knew personally through my involvement in the Seattle bike community, who also referred me to other cargo bike users they knew. I conducted fifteen semi-structured interviews consisting of several key questions that helped define the areas of cargo bike use that my research was focused on, but also allowed the interviewees to talk freely.

The key questions included:

1. What type of bike do you own or use? How often?
2. What do you use your cargo bike for? Can you describe an average trip?
3. Do you feel that you have any disadvantages or advantages to using a cargo bike?
4. What determines your route choice? Do you prefer any bike facilities?
5. Are there any barriers you can think of that inhibit your cargo bike use in Seattle?

I chose a semi-structured interview format because it provides interviewees with some guidance for what to talk about regarding cargo bikes, but is also flexible enough to allow interviewees to elaborate and explore thoughts that may surface during the conversation. I also had several informal conversations with cargo bike users in Seattle that contributed to my research as well. Observation also informed my research, although it was not formal, I took note of cargo bike users in Seattle and their behaviors when I came across them throughout my daily routine.

I translated the interview findings into a list of issues and then developed approaches to better support cargo bike use in Seattle that addressed the issues identified by the interviewees. I used the literature and practices review to inform my suggestions as well as provide supportive evidence of successful implementation. Using my own knowledge and expertise as a planner, I identified Seattle plans, policies, programs, and other government documents that currently impact cargo bike use, or have the potential to. I then situated my suggestions within Seattle government documents in the form of amendments to existing plans, policies and programs, where and when appropriate. I evaluated my recommendation based on the following criteria:

1. Does it effectively address the issue?
2. What government documents is it related to? Does it comply with document goals?
3. Is it economically feasible and efficient?
4. Is it good for the environment? How so?
5. Is it socially equitable? Who gets and who pays?
6. Does it improve accessibility and mobility in Seattle? How so?

To summarize my methods and process, I began my research with a thorough literature review and researched current practices that have successfully supported cargo bike use. I then used interviews to identify how people use cargo bikes in Seattle, what advantages they have, and the barriers they face. Combined with my knowledge of local plans and policies, the literature and practice review, and the issues identified by Seattle cargo bike users, I developed suggestions to improve cargo bike use support in Seattle. I evaluated my suggestions based on criteria focused on effectiveness, economic feasibility, social equity, environmental impacts, and mobility. The result is a thesis that argues for cargo bike acknowledgement in the public sector, that also provides direction for improving cargo bike use support in Seattle.

3. LITERATURE REVIEW

Current peer reviewed research and literature on cargo bike use is limited. Most of that which does exist is focused on the potential for cargo bikes to be utilized for urban freight delivery, especially in Western European cities. Other literature comes from community advocates through reports published by the European Cycle Logistics Federation (ECLF), a group that supports cargo bike use in Europe. Cycling as a mode of transportation is increasing in the United States, in Seattle, commuting by bike increased from one percent to four percent of the mode share between 2010 and 2015 (PSRC 2017), however, cycling levels in European cities are still three to five times higher than the United States (Pucher et al. 2011), which explains why cargo bike use is more common in European cities. According to a 2015 count performed by Copenhagenize Design Co., there are 40-thousand cargo bikes, which is six percent of all bikes in Copenhagen, Denmark (Copenhagenize Design Co., 2015). While transportation and bike use in the United States and Europe are very different now, many cities in the United States are trying to shift away from motor vehicle use and encourage the use of more sustainable transportation modes. Cities in the United States are also growing and densifying, progressively resembling European cities, which suggests that planners should review European strategies for sustainable transportation to inform their own. In this section I address the reoccurring themes in the literature regarding cargo bikes as well as the most frequently mentioned practices that successfully support cargo bike use, most of which are from Europe.

To understand the potential and impact of cargo bikes, some organizations, companies, and governments in Europe have estimated the number of car or truck trips that could be converted to cargo bike by using household and commercial trip data. According to the European Cycle

Logistics Federation (ECLF) report, “In an average European city half of all motorized trips related to goods transport could be shifted to bicycle or cargo bike” (European Cycle Logistics Federation 2014, 7). The ECLF also claims that more than two-thirds of trips in the average European city are for the purposes of shopping, commuting, and leisure, while about one-third are for commercial transport. Private trips contribute even more heavily to traffic than commercial trips, and have an even higher potential to shift to cargo bike, but are not often considered by planners or logistics experts. Regardless of what sector contributes the most trips, the ECLF estimation (Figure 3.1) highlights the potential for trip conversion and the need to consider ways to encourage more trips in both sectors to shift to cargo bikes.

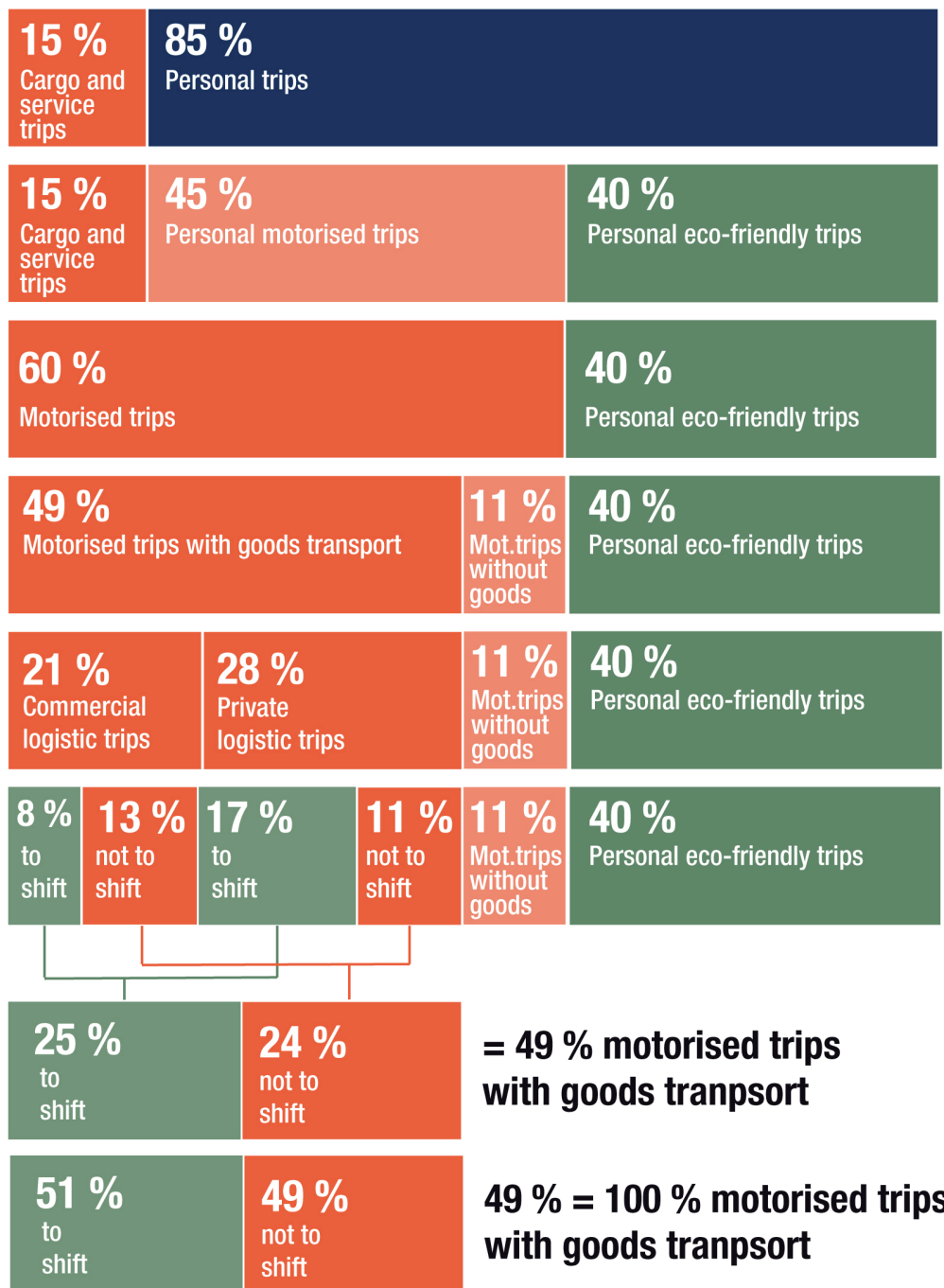


Figure 3.1 ECLF estimation of the percentage of trips that could shift to cargo bike in the average European city (European Cycle Logistics Federation 2014)

3.1 CYCLE FREIGHT

Cycle freight is the act of delivering goods by bike, such as parcels and food, which are usually delivered by truck or van and is carried out by couriers and logistics companies. Cycle freight has become more popular in areas where traffic congestion inhibits motor vehicles, such as trucks and vans, to deliver goods efficiently. E-commerce has contributed to the growing cycle freight industry, because more people are shopping online and receiving commercial deliveries to their doors, rather than making private trips to local shops and stores. Some of the literature on cycle freight has identified dense urban areas with motor vehicle traffic restrictions, designated consolidation centers, and well established bike infrastructure, as ideal conditions for successful cycle freight. The literature also suggests that government authorities acknowledge cargo bikes in plans and policies to further support their use in the cycle freight.

Barbara Lenz and Ernst Riehle give a comprehensive overview of current cycle freight logistics studies in Europe in their 2013 publication “Bikes for Urban Freight? Experience in Europe” (Lenz and Riehle 2013). The result of Lenz and Riehle’s research, which relied primarily on tests carried out by courier companies, showed a significant potential for cycle freight to complete deliveries with small volumes and comparably low weights. According to Lenz and Riehle, cargo bikes can carry 50 to 250-kilograms (roughly, 100 to 500-pounds) and are ideal for trips between 10 and 20-kilometers (roughly, 6 to 12-miles). Lenz and Riehle also found that the provision of space for consolidation centers on the edge of the city center (Figure 2.1) is an essential precondition to improve the potential for cargo bike delivery. Lenz and Riehle also identify pricing the use of city center streets and parking, by trucks and automobiles, is also a major factor in the success of cycle freight because it makes it more marketable. Based on their findings, Lenz and Riehle estimate

that cycle freight will continue to grow as traffic congestion increases and e-commerce becomes more popular. As a result, Lenz and Riehle strongly recommend that urban planners have greater consideration of the specific demands of cargo bikes and cycle freight delivery.

Schliwa et al. attempt to address the current gap in knowledge and awareness required for public authorities and private companies to jointly enable and support cycle freight. They identified language, perception, physical geography and infrastructure as the major barriers to widespread adoption of cargo bikes for urban freight (Schliwa 2015). Schliwa concluded cargo bike use needs to be facilitated both physically and non-physically. Physical interventions include bike infrastructure, driving and parking restrictions, and consolidation centers. Non-physical interventions include awareness campaigns and incentive programs for private logistics companies. Schliwa also concluded that cargo bikes need to be acknowledged by public authorities as viable car replacements with several benefits for them to contribute more to sustainable urban freight logistics.

Testing the feasibility of cycle freight in cities takes place through pilot projects or studies. Pilot projects can be tailored to test out strategies to meet several municipal or national climate, economic, or livability goals related to urban freight. One example of a pilot project funded and conducted by a private company includes the DHL Express pilot project in Germany and the Netherlands, which uses cargo bikes for inner-city parcel deliveries. The two DHL pilot projects are in progress in Frankfurt, Germany, and Utrecht, Netherland, both cities that have carbon neutral goals for the near future. DHL has executed several pilot projects which have resulted in the company replacing about 60 percent of inner-city vehicle routes in more than 80 European cities in 13 European countries with cargo bicycles (E-Commerce News Europe 2017).

Another cycle freight study example is the 2013 German electric cargo bike (E-CB) study “Ich Ersetze ein Auto” (I substitute a car), published by Gruber et al. in “A new vehicle for urban freight? An ex-ante evaluation of electric cargo bikes in courier services”. The study provided the use of a fleet of 40 E-CBs (Figure 3.2) to courier companies in several German cities. Courier companies are slightly different than express parcel delivery companies, because they generally work within smaller delivery zones in the inner city. The Berlin, Germany case study revealed that 42 percent of the courier vehicle deliveries could be switched to cargo bike, which accounted for 19 percent of the mileage that was then generated by cars (Gruber 2015). The project also looked at courier perception and willingness to use E-CBs and found that 72 percent of the bike couriers interviewed were willing to use E-CBs, but most felt that they did not know much about them.



Figure 3.2 “Ich Ersetze ein Auto” electric cargo bike (Gruber 2015)

The 2016 economic feasibility study, “Economic Analysis of Cargo Cycles for Urban Mail Delivery” by Choubassi et al. performed in Austin, Texas, provides an example in the United States. In the study, three different styles of cargo bikes were tested in three different traffic settings within the city to test the economic benefit of switching Austin’s urban mail delivery to cargo bikes. Choubassi et al. found the electric cargo trikes to be the most successful, in economic terms, in dense urban areas of Austin (Choubassi 2016). There are several other examples of pilot projects that have evaluated different aspects of cycle freight feasibility, most of which have been conducted by private companies.

Another trend in urban cycle freight are depots or consolidation centers (Figure 3.3), which are areas on the edge of city centers where freight arriving by truck can be dropped off and “last mile” delivery is executed by cargo bike. This model helps reduce traffic congestion caused by freight and has become more popular for cities that have traffic restrictions. Consolidation centers also ensure cargo bike trips are short and efficient. According to Schliwa et al., “Existing studies also identify a number of essential preconditions for the growth of cargo bike logistics. They require space for central depots, referred to as Urban Consolidation Centre (UCC), Urban Distribution Centre (UDC) or Urban Micro-Consolidation Centre (UMC) preferably on the edge of the city centre” (Schliwa 2015, 52).

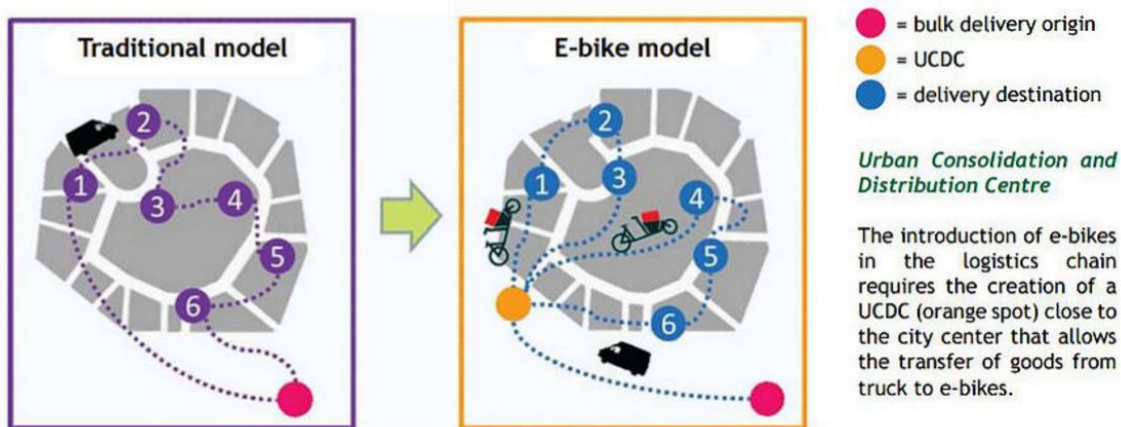


Figure 3.3 Diagram illustrating the traditional model of urban delivery using a truck and distribution center compared to the electric cargo bike model using an urban consolidation center (Poliedra 2015)

One example of a city and company that uses the consolidation center model is Outspoken in Cambridge, United Kingdom, a city that also physically restricts vehicular traffic from entering the city center during certain hours. Outspoken receives around 300 parcels per day at their consolidation center and delivers them throughout the city with their fleet of cargo bikes (European Cycle Logistics Federation 2014). The consolidation center model works for Outspoken because vehicles are restricted in the city center, but cargo bikes can enter and deliver goods. Some courier companies in Switzerland and the United Kingdom also utilize trains to bring cargo into the city center from the consolidation center, which is then met and unloaded at the station by couriers and distributed throughout the city center by cargo bike. Mobile, micro consolidation centers are also being tested by logistics companies such as TNT in Brussels, Belgium (Figure 3.4).



Figure 3.4 TNT logistics company's mobile micro-consolidation center in Brussels, Belgium (Netherland Ministry of Infrastructure 2017)

Driving and parking restrictions, also known as road space rationing, is a demand management tool used to reduce the negative externalities of driving such as congestion and air and noise pollution. Driving and parking restrictions play an influential role in cargo bike use, several studies have revealed that pricing the use of city center streets and parking is a major factor in the success of managing freight via cargo bike. Cities that have restricted access or pricing that limits use of their city center streets for freight or general vehicular traffic are looking to cargo bikes as the answer to transporting goods into and throughout the city center.

There are several types of motor vehicle traffic restrictions and most European cities have restrictive access for vehicles in the city center. One example of traffic restrictions is in Cambridge, United Kingdom where vehicular traffic is physically restricted in the city center from 9 am to 4 pm daily. As a result, cycle logistics practices are being used to move goods, collect waste, and

deliver the post into and throughout the Cambridge city center (European Cycle Logistics Federation 2014).. Another example of is in Paris, France where road space rationing is used in which access to city centers is restricted based on defined criteria such as even or odd numbered license plates.

Cities such as London, United Kingdom, Berlin, Germany, and Malmo, Sweden use low emission zones (LEZs) to restrict traffic from entering designated areas, such as city centers, where they do not want a concentration of greenhouse gas emitting vehicles (European Cycle Logistics Federation 2014). London, United Kingdom, Stockholm, Sweden, and Milan, Italy use congestion charges where drivers must pay to enter the city center (European Cycle Logistics Federation 2014). Congestion pricing and license plate restrictions are not seen as equitable because those who can afford to pay are able to drive. Regardless of equity, all traffic restrictions create a market for cargo bike use, particularly in cycle freight logistics sector.

While cycle freight has been found to be successfully adopted, especially under certain conditions, the literature has also identified perception and lack of acknowledgement as obstacles that prevent broader implementation (Lenz 2013, Schliwa 2015). Cargo bikes are not seen as a viable or suitable mode of transport and there is a lack of acceptance and acknowledgement of the feasibility and benefits of using cargo bikes from potential customers, logistics company managers, and urban planners. Despite the perception issue, cargo bikes continue to popularize in urban areas because they are more efficient in some cases and have been embraced by the couriers themselves.

The 2015 German study, “Ich ersetze ein Auto” (I Substitute a Car), lent out a fleet of electric cargo bikes and found that couriers are very willing to use them, even though they did not feel knowledgeable about the technology (Gruber 2015). The 2016 Cycle Messenger World Championships (CMWC), an international courier competition that takes place in a different global city each year, also displayed a growing popularity and wide spread acceptance of cargo bikes in the courier community. Couriers from all over the world gather at the CMWC to compete in work simulation competitions, where recently a cargo bike segment was incorporated to compete for the title of “cargo messenger world champion”. Despite the claims of negative perception, businesses have been using customized and branded cargo bikes for transport and marketing services. Some examples include Domino’s Pizza in the Netherlands, Whole Foods in the United States, Ikea in Denmark and Sweden, and UPS globally (Figure 3.4) (MyAmsterdamBike.com 2016).



Figure 3.4 Cargo bikes are being utilized by multinational corporations such as UPS Electric Cargo Trike (ElectricBike.com 2013), Ikea Cargo Bike (Momentum Magazine 2013), Domino’s Cargo Bike (MyAmsterdamBike.com 2016).

3.2 FAMILY BIKING AND INFRASTRUCTURE

Cargo bikes are used for transporting children and running household errands and is a common practice in Denmark and the Netherlands. Using cargo bikes to transport children is becoming more popular in the United States and it sometime referred to as “family biking”, or the act of

riding with or transporting children. There are few studies that focus on replacing family or personal vehicles with cargo bikes and they have shown that it is the most popular for those with young children. For example, a study that surveyed cargo bike purchasers using data from a distributor in California and found that 69 percent of those surveyed switched to using a cargo bike for one to two of their daily trips after purchase. The study indicates that cargo, such as children or gear, is one factor that determines mode choice, especially for families (Riggs 2016). Another study, in Stockholm, Sweden, provided a residential neighborhood with a cargo bike pool that residents could reserve and checkout. The study revealed that the residents who used the cargo bikes the most had young children and a desire to live a car-free life (Börjesson Rivera 2014). While there is little research on private cargo bike use, that which does exist reveals that families that own or use cargo bikes, utilize them as a car replacement for the purposes of transporting children and gear.

Bike infrastructure and facility design play an important role in encouraging and supporting cargo bike use for everyone, especially families. Researchers and practitioners have studied cycling in urban areas and identified what, in the built environment, facilitates or hinders regular bike use and according to John Pucher, it will take a comprehensive, integrated combination of policies, programs, and infrastructure to increase cycling in the United States (Pucher et al. 2011). This would include improved bike lanes and paths, better intersection crossings, traffic education, strict enforcement of traffic regulations, motor vehicle speed limit reductions, traffic calming interventions in residential areas, and land use policies that foster compact, mixed-use development (Pucher et al. 2011). While Pucher does not mention cargo bikes in his research, he does stress the importance of targeting women and children in policies because they are the most vulnerable cycling population and require special attention and protection from motor vehicle

traffic (Pucher et al. 2011). Pucher also emphasizes the importance of integrating bike infrastructure with public transit by coordinating bike lanes with transit stops and the provision of secure bike parking at major stations. While Pucher's research is not specific to cargo bikes, it provides the foundation for understanding cycling in the United States and where cyclists' needs are not being met.

According to Pucher et al., the health benefits of cycling far exceed the risks from traffic injuries, and as bike use increases, injury rates decrease, making cycling safer (Pucher and Buehler 2008). In the Netherlands between 1980 and 1996 the number of bicycle kilometers increased by 25 percent and the number of cycling fatalities dropped by almost half (Habitat Platform Foundation et al. 2000). Although cycling may be perceived as dangerous, it is both safe and healthy, particularly in the areas with sufficient infrastructure, such as the Netherlands, where cargo bikes are also used often. To quantify the health advantages of cycling in the Netherlands, according to a study done by Fishman in 2015, the total economic health benefits of cycling were estimated at 19 billion Euro per year, which translates to 3 percent of the Dutch domestic product between 2010 and 2013 (Fishman et al. 2015). Calculations suggest that people in the Netherlands would die about a half a year earlier without cycling and that 6,500 deaths are prevented annually in the Netherlands by bicycle use (Fishman et al. 2015). Bicycle infrastructure expansions in the Netherlands has made cycling safer and encourages more cycling. Fishman concludes that investment in bike use promoting policies and infrastructure in the Netherlands would likely yield a high cost benefit ratio in the long term (Fishman et al. 2015).

Cargo bike users have the similar needs as cyclists, but require more space in most cases. To accommodate for cargo bike users, particularly families, some train stations in Europe have

included cargo bike specific parking (Figure 3.5). The train station in Malmo, Sweden has several cargo bike parking stalls and racks that are designed specifically for cargo bikes. The stalls are covered, easily accessible, conveniently located in the train station, with sufficient room and security, allowing for easy multi-modal travel (Copenhagenize Design Co. 2014). Cargo bike specific bike lanes do not exist, but there are several European countries whose bike infrastructure accommodates for cargo bikes. Countries like Denmark, Germany, and the Netherlands have networks of bike lanes designed with sufficient passing room, bike sensors for traffic signals, and protection and separation from cars. These countries have historically and culturally favored bikes more than the United States, dating back to the 1970s, because they recognized the threat that motor vehicle dominance posed on urban health, safety, and livability (Pucher and Buehler 2008). It is no coincidence that family cycling is ubiquitous in these countries and that cycle freight has been tested and used most successfully there as well.



Figure 3.5 Examples of bike infrastructure and facilities that accommodate cargo bikes. Cargo bike parking in Malmo, Sweden (Copenhagenize Design Co. 2014) and one-way protected bike lane in Amsterdam, Netherlands (Personal Photo)

3.3 GOVERNMENT ACKNOWLEDGMENT AND SUPPORT

Some European municipalities are acknowledging cargo bikes as one means to reduce greenhouse gas emissions from the transport sector and meet climate goals through programs, policies, and plans. The city of Bremen, Germany, for example, started a program for interested firms to rent cargo bikes from the City for up to four weeks at no charge. The program was developed to meet Germany's climate goals to reduce CO₂ emissions from the transport sector by 40 percent by 2030. The purpose of the program is to encourage companies to use cargo bikes by offering them a free opportunity to see their capabilities themselves in hopes of reducing transportation emissions. With 38 cargo bikes total, the city's campaign and total investment was around 100,000 Euros (Friends of the Earth Germany 2009). The German government also provides a guide for commercial companies to switch some trips to cargo bikes. According to the transport ministry spokeswoman for Germany, Brigitta Worringer, more than three-quarters of all journeys in Germany are less than 10 kilometers which shows that cargo bikes can be used for a majority of trips made (ABC News 2014).

Some European governments are subsidizing cargo bike purchases to encourage alternative transportation modes and meet climate goals. The city of Graz, Switzerland subsidizes cargo bike purchases for up to 50 percent of the investment costs up to 1,000 Euros (roughly 1,100 USD). The city defines eligible companies and institutions like schools, universities, building and property management companies as well as others and limits the number of grants to one bike per institution or company (Friends of the Earth Germany 2009). The city of Oslo, Norway provides its residents financial assistance toward buying an electric bike, cargo or other, for up to 25 percent of the purchase price capped at 10,000 Kroner (roughly \$1,500 USD) (Markham 2017).

There are no cargo bike purchase incentives in the United States yet, but there are programs which offer subsidies of green vehicle purchases. A program in Portland, Oregon offers subsidized purchase of electric freight vehicles weighing 10,000-pounds or more (Maus 2013), but does not offer freight bike subsidies. The state of California offers clean car reimbursements, but does not include bikes, either. The California Bicycle Coalition is petitioning the program and proposing a \$500 rebate for buying a utilitarian bike such as an electric cargo bike (California Bike Coalition 2016). While cargo bikes do not contribute to greenhouse gas emissions and offer the same services as cars or trucks, they are not subsidized under California and Oregon's programs.

Some municipalities utilize cargo bikes for municipal services such as transporting administrative cargo or documents, public waste collection, sidewalk cleaning, graffiti removal, and landscaping. Using cargo bikes for municipal services has a lower impact on the environment than cars, does not contribute to noise pollution, and promotes cargo bike use through example. The city of Copenhagen, Denmark was highlighted in the ECLF report for using cargo bikes for street cleaning, leaf and garbage removal, and park maintenance (European Cycle Logistics Federation 2014). The city has twenty bikes which the street cleaning department is responsible for the maintaining. The Downtown Seattle Association Metropolitan Improvements District also utilizes a cargo bike to maintain sidewalk cleanliness in the downtown area, but not to the scale of Copenhagen, Denmark.

Cargo bike shares are one way some municipalities and organizations are trying to encourage and test the public interest in cargo bike use. Providing affordable and conveniently accessed cargo bikes to rent or borrow allows people to test them out or use them for their occasional cargo related

errand. Cargo bike shares are helpful to those with lower income or people who are interested, but not ready to commit to purchasing a cargo bike. Current cargo bike shares exist in Austria, Belgium, France, Germany, Netherlands, Switzerland, and United Kingdom (McCartney 2016).

There are several ways to structure and fund cargo bike sharing programs which can be tailored to respond to the specific needs of a community. Some examples include the German towns of Konstanz and Norderstedt, which have 60 cargo bikes available through the Transportrad Initiative Nachhaltiger Kommunen (TINK) project. The TINK project started in the summer of 2016 and aims to provide the public with 24-hour access to environmentally friendly, healthy and equitable alternatives to cars for a low cost of nine euros a day. The TINK project is a pilot that will be tested for two years with hopes of spreading to other municipalities if successful. Some cargo bike sharing programs are based on voluntary contributions rather than defined fees such as Lastenradkollektiv in Vienna, Austria and Kasimir in Cologne, Germany, both of which have been operating successfully since 2010. Cargo bike sharing programs can also be part of a multi-modal program, such as Cambio, an existing car sharing program that partnered with the government in Ghent, Belgium in 2012 to create the first cargo bike sharing program in Europe and charges a fixed monthly fee and hourly rates.

Cargo bike shares can be supported by the private sector as well, such as Outspoken Deliveries, a courier company, and part of a United Kingdom initiative that makes cargo trikes and bikes available when not in use on deliveries in the cities of Cambridge and Norwich. Cargo bike shares are more common in cities where cargo bikes are commonly used and bikes are favored over cars in general. For example, the city of Groningen, Netherlands offers flatbed cargo bikes in the city

center where college students can be seen using them to move their belongings and the local Ikea also offers cargo bike rentals to transport furniture purchases for a low hourly cost.

3.4 COMMUNITY ADVOCACY

While cargo bikes are receiving more acknowledgement and support from governments, their use, particularly in the private sector, is still predominately supported by community advocacy organizations, such as the European Cycle Logistics Federation (ECLF). The ECLF develops and helps implement strategies for transferring the movement of urban freight/goods from motorized vehicles to cargo bikes. The organization consists of members involved in urban freight, cargo bike technology, and other related sectors, from several European countries. The ECLF will support any business or social enterprise which uses or intends to use a bicycle to deliver its operations or services. Their main objectives as an organization are to highlight best practices in cycle freight, share knowledge and experience, establish lobby groups to influence others, identify opportunities for shared promotion, marketing, and costs, as well as establish information resources for the cargo bike community. The ECLF provides workshops and holds an annual conference in a different European city each year. The 2017 conference in Vienna, Austria had 400 participants, 41 exhibitors, and 27 countries represented, making it the largest attended ECLF conference yet (European Cycle Logistics Federation 2014).

There are also several family oriented cargo bike advocacy groups throughout the United States, which have a strong internet and social media presence in the form of Facebook groups and blogs. A Seattle example is Familybike, a non-profit organization whose mission is to decrease barriers to cycling for families of all income levels. Familybike provides a small family bike rental fleet

and hosts workshops that address what kind of equipment is available and safety concerns and strategies, as well as family oriented events and rides such as Kidical Mass.

Other cargo bike events that demonstrate an effective way to encourage cargo bike use and create more cargo bike awareness include the Disaster Relief Trials (DRT), a competition in which cargo bikes compete to transport supplies in a disaster simulation that occurs annually in Washington DC, Seattle, Eugene, Portland, San Francisco, and other cities (Disaster Relief Trials 2017). The DRTs attracts a diverse group of cargo bike users, creates awareness of cargo bike abilities, and promotes community resiliency and disaster preparedness through cargo bike use. The courier community also holds events, such as the annual European Cycle Messenger Championships (ECMC) and the Cycle Messenger World Championships (CMWC), which provide a space for cargo bike couriers to compete, connect, and share cargo bike work related experiences and industry tips and technology with one another.

4. FINDINGS

Throughout this section I identify who Seattle cargo bike users are and the advantages and barriers they face in Seattle. I first discuss who Seattle cargo bike users and community members are and provide a brief description of how they use their cargo bikes or are involved in the cargo bike community. I then discuss the results of my interviews, and the advantages and barriers faced by Seattle cargo bike users organized by the themes that emerged.

4.1 WHO ARE SEATTLE CARGO BIKE USERS AND COMMUNITY MEMBERS?

According to SDOT, in 2013, 158-thousand of Seattle's population (around 24 percent) claimed to use bicycles (SDOT 2013). I was unable to find or collect the data necessary to calculate the number of cargo bike users in Seattle, but with SDOT's figure in mind, it is safe to assume that a miniscule percentage of Seattle's population uses cargo bikes. Although there are very few known cargo bike users in Seattle, the trend is growing amongst all user groups.

4.1.1 *Couriers and Logistics Companies*

There are thirty to forty actively working couriers in Seattle that work for logistics companies or as independent contractors, not including couriers that deliver food for companies such as Jimmy Johns or Caviar. Of the thirty to forty actively working couriers, six to ten (20 to 25 percent) of them use or own cargo bikes. I interviewed five couriers, three of whom own their own cargo bikes and two of whom work for a courier company that has a fleet of cargo bikes. Three of the five couriers are employees of a courier company and two are independent contractors. I also interviewed two logistics companies that both own a fleet of cargo bikes, which their employees

use. Indy Stealth Logistics (Figure 4.1) and Freewheel Carbon Free Cargo (Figure 4.2) are featured in courier and logistics company cargo bike user profiles.

Indy Stealth - Courier Logistics Company - Seattle, WA

Stealth is a courier company that operates out of the Sodo area in Seattle. Stealth was founded in 1997 by former couriers and has been keeping up with the ever changing industry over the last 20 years. The company employs car drivers and bicycle couriers, serving Seattle and surrounding areas. Stealth brought cargo bikes to the Seattle courier industry in 2015 when they decided to purchase a fleet of Bullitts. The purchase was prompted by Amazon's interest in contracting Stealth to deliver their orders. While Stealth no longer works with Amazon, the business has developed around their fleet of cargo bikes.



Bikes: Stealth has a fleet of 10 Larry vs Harry Bullitt cargo bikes, 6/10 have motor assist, 2 are convertible, 4 are solely pedal powered. Bikes are roughly 8 feet long and weigh about lbs. The Bullitts are capable of carrying 500 lbs including the riders. Cargo can be stacked as high as the rider feels comfortable depending on skill level and visibility. One rider says he successfully transported a stacked up a load almost 10 ft tall. Bikes are also capable of pulling a trailer for additional cargo carrying capacity. Built to handle weight and withstand constant use and stress of couriership for \$6,000 each without the electric assist, and \$9,000 each with an electric assist, when typically one could purchase a Bullitt with a standard build for around \$3,500.

Use/Trip Description: Stealth operates like typical courier service in which they can be hired to transport various things via car, van, cargo bike, or regular bike, at established rates. Cycle couriers are given jobs by a dispatcher that operates from the office headquarters coordinating multiple clients and deliveries. Couriers have the option of using regular bikes or cargo bikes, depending on their deliveries. Cargo bike users transport a variety of items such as legal documents, as well as food, which is a newer addition to the company as well as the courier industry in general. Trips are generally under 5 miles, with full-time riders averaging 40-55 mile days. On a flat surface, unloaded, the Bullitts can travel 20 mph easily and have reached over 40 mph on descents.

Figure 4.1 User profile – Indy Stealth Logistics, Seattle, WA

Freewheel - Bike-Based Delivery and Advertising - Seattle, WA

Freewheel is a cargo bike based freight transport company that has been operating in the Downtown Seattle and Capitol Hill areas since 2014. Freewheel fits into both the courier and service provider category because it provides similar services that courier companies have recently taken on such as regular food delivery, as well as non-courier related services, such as whole sale distribution and advertising. Some current clients include Middlefork Coffee, The Stranger Newspaper, and Peach lunch service.



Bikes: Freewheel has a total of 4 cargo bikes. Two electric cargo trikes with boxes made by Mainstreet based out of Colorado with dimensions of 10 ft long, 4 ft wide, weighs 200 lbs, 4ft. Tall, able to carry about 400 lbs. One electric cargo trike from China without a brand name with a box with dimensions of 9ft long, 4ft wide, weighs about 150lbs, 4ft tall, able to carry about 400 lbs. One Yuba pedal powered Xtracycle style cargo bike with a box, which is not used often. The bikes cost around \$2,000 base, plus \$1,000 modifications such as cargo box and electric assist with maintenance running around \$100/month.

Use/Trip Description: Freewheel transports a variety of things, such as coffee beans, ready to eat lunches, newspapers, and office supplies. The base is located in Belltown and the delivery zone is limited to Capitol Hill and Downtown areas. Trips are usually 2-3 miles at the most and include trip chaining when possible. The trikes are slow moving vehicles because they weigh a lot especially when loaded. For the sake of safety and consideration of the equipment, riders do not travel faster than 15 mph. The trikes are very cumbersome, when traveling with a load, riders must stop and start carefully, and more time and room is required to turn and maneuver around obstacles. Topography is a major determining factor for route choices because the trikes are not able to go up super steep hills, so rider choose routes on more gradual slopes. Seattle's infrastructure is also not large enough to accommodate the trikes and allow others to pass. The bikes are so large, slow moving, and visible, that riders do not feel at risk riding with traffic, but prefers roads that have multiple lanes and plenty of room for cars to pass if needed.

Figure 4.2 User profile – Freewheel Carbon Free Cargo

4.1.2 Families and Households

I interviewed three family oriented cargo bike users who own their own cargo bikes and use them on a regular basis to transport their children, run errands, and do shopping. All the family and household cargo bike users I interviewed were actively involved in the family biking community and were cyclists before they started transporting their kids via bike. While I do not have sufficient data to calculate the number of family oriented cargo bike users exist in Seattle, the Seattle Family Biking Facebook group currently has 1,725 members. While that is only .2 percent of Seattle's population, it is 20 percent of those who claims to commute by bike in Seattle. G&O Family Cyclery did not provide a figure for the number of cargo bikes they have sold to families, but claim

that the interest in family biking is growing rapidly. Mothers and family bike advocates Madi Carlson (Figure 4.3) and Shirley Savel (Figure 4.4) are featured in the family and household cargo bike user profiles.

Madi Carlson - Mom and Family Bike Advocate - Seattle, WA

Phinney Ridge, mother of two boys who she has transported by bike since they were each 10-12 months old. Madi is an active family cycling advocate in Seattle, maintaining a blog called Family Ride and author of the book 'Urban Cycling: How to Get to Work, Save Money, and Use Your Bike for City Living.' Madi is also the board president of Family Bike Seattle and leader of the Seattle area Kidical Mass/Critical Mass rides.



Bike: Surly Big Dummy long tail cargo bike equipped with a Surly Family Kit and a Rolling Jackass center-stand by CycleFab LLC, can carry both kids, a dog, toys, snacks, and groceries, weighs 110 lbs loaded.

Use/Trip Description: Madi uses her cargo bike mostly to transport her kids. Now that her kids are now old enough to ride their own bikes, the cargo bike acts more as a grocery getter or an emergency bike and kid transporter for longer trips when the kids may get tired or in areas that she does not feel comfortable with them riding on their own. Madi can carry anything with her Big Dummy, she uses it to make runs to the dump and the Goodwill, she transports large items for community events or friends in need, and she is capable of towing two bikes and two kids. On the cargo bike, Madi travels at a slow pace, she is a very cautious rider, especially at intersections, and obeys all of the traffic laws and uses hand signals to communicate to other people on the road, she will pull over to let cars pass because she is not comfortable having cars traveling behind her. Madi is also very careful with her routing, she prefers quiet streets and will go way out of her way to find the least steep route on her cargo bike.

Figure 4.3 User profile – Madi Carlson

Shirley Savel - Mom and Family Bike Advocate - Seattle, WA

Shirley is a mother of a toddler and a tween as well as a family bike advocate. Shirley lives in the Brighton area of South Seattle and has been car-free since 2007 when she moved to Seattle. Shirley won the 2015 Seattle Neighborhood Greenways Parking Day design competition with her protected bike lane demonstration on Rainier Avenue South, one of Seattle's most dangerous streets.



Bike(s): Metrofiets, a front loading bakfiets bike made in Portland, equipped with Ezee hub electric assist. She previously had an Edgerunner, long tail bike, with BionX assisted motor, she wanted something more powerful to ride any route in Seattle fully loaded with any kind of cargo.

User/Trip Description: Shirley's current setup can go up any hill including Yesler. The cargo bike is all around kid transporter and for all of her errands and shopping. Currently she use the cargo bike 6 days a week. 5 of those days are biking with her older daughter to school. Her younger brother goes in the box of the bike and she rides on her own, but Shirley carries all her school stuff. The assist means Shirley can choose low car use streets that are high grade roads. If she is alone with just the toddler on the bike she can climb, but if she has the older kid with her they have to choose a flatter route.

Figure 4.4 User profile – Shirley Savel

4.1.3 Vendors and Service Providers

I interviewed two mobile vendors, both sell food, and two service providers, a landscape business and a bike rental company. All the businesses were developed around cargo bikes and have been operating for less than five years. Other cargo bike based service providers that I was unable to interview in Seattle include: Seattle Pedicabs, passenger transporters, the Metropolitan Improvements District cargo bike, used to maintain Downtown Seattle sidewalks, and other private companies who use cargo bikes to deliver or transport their own products, such as Biscuit Bitch, Conduit Coffee, and the Seattle Sperm Bank. Six Strawberries (Figure 4.5) and Convoy Coffee (Figure 4.6) are featured in the cargo bike vendor user profiles and EDT Landscaping (Figure 4.7) and Pedal Anywhere (Figure 4.8) are featured in the cargo bike service provider user profiles.

Six Strawberries - Mobile Ice Pop Vendors - Seattle, WA

Will Lempke and his wife Vanessa Resler started Six Strawberries in 2011, a mobile ice pop business that uses dairy free local seasonal ingredients. Will and Vanessa sell their ice pops from a custom made, insulated Icicle Tricycle at farmers markets, festivals, and privately catered events. They also vend from a mobile food van and a production kitchen at Equinox Studios in Georgetown.



Bike: Icicle Tricycle, a custom, hand built, insulated commercial vending tricycle made in Salem, OR. Cost around \$2,500 total. Tricycle has two wheels in the front where the load it carried. Ice pops are kept cold within a fully insulated box with dry ice or cold plates. The trike can be parked and ice pops are served from a hatch on the top of the cargo bin. The trike also has a mount for an umbrella to provide shade or weather protection and cargo box can act as a small counter top. The bike has gears, but no electric assist.

Use/Trip Description: The trike is used to vend ice pops at farmer's markets, festivals, and catering events. It is not pedaled further than 5 flat miles because it's heavy, weighing about 300 lbs fully loaded, and unable to traverse steep grades. Ninety percent of the time the bike is wheeled into a van and dropped off at the vending location.

Figure 4.5 User profile – Six Strawberries

Convoy Coffee - Mobile Coffee Vendors - Seattle, WA

David Rothstein and Alex Johnstone own and operate Convoy Coffee, a mobile bike based coffee vending company. Convoy serves specialty coffee pour overs using a variety of locally roasted, sustainably sourced, single origin coffee beans. Convoy is based off of Leary Way in Wallingford and vends mostly at the Ballard and U-District Farmer's Markets on weekends, but also can also be hired to cater events.



Bike(s): Convoy uses a regular bicycle which pulls a custom made trailer/coffee cart made by CycleFab LLC. The trailer is equipped with an electric assist with regenerative braking made by Bike Swift. The trailer has evolved over time, initially starting off as a modified Burley flatbed trailer.

Use/Trip Description: Convoy's trailer/coffee cart weighs about 300 lbs and includes about 15 gallons of water, water heating devices, coffee beans, grinders, filters, and cups. They typically do not travel more than 5 miles, strategically vending at farmers markets near their home base, but are willing to travel a bit farther for catering events. The trailer/cart folds out into a counter top with legs where they prepare and sell coffee.

Figure 4.6 User profile – Convoy Coffee

EDT Landscaping - Bike Based Horticulture - Seattle, WA

Adam Toothaker operates a cargo bike based horticulture design and landscape company out of Sodo in Seattle, WA called EDT. He works mostly with residential clients, his approach is very interactive, he helps his clients pick out plants, design gardens, and plan for future maintenance, but does not do regular landscape maintenance that involves a crew or heavy equipment. Adam is an experienced cyclist who worked as a courier before he obtained his horticulture degree and launched EDT Landscaping.



Bike: Harry vs. Larry Bullitt, bought at cost from a bike shop in Boise, ID, where Adam lives part-time, standard build.

Use/Trip Description: Adam uses his Bullitt to haul his tools for his landscaping business in Seattle. His trips are generally under 5 miles because he keeps his work zone pretty compact and restricted to the South end of Seattle where he is based. His load is usually under 100 lbs, he carries a shovel, wire rake, a broom, and some hand tools and personal items. On occasion he will carry a bag of fertilizer, but does not usually need to carry plants because he meets his clients at the nursery where they can purchase the plants directly and build a relationship with their local plant providers. He feels comfortable getting anywhere on his Bullitt, carefully managing his work and rest time and choosing routes that work with his day. Adam uses streets with the least amount of cars on them and will avoid traveling during peak hour traffic.

Figure 4.7 User profile – EDT Landscaping

Pedal Anywhere - Mobile Bike Rental Company - Seattle, WA

Pedal Anywhere is a bike rental company that delivers its rental bikes by bike based in Seattle, WA. The company was founded in 2014 by Lucas Nivon and Zach Shaner. Currently, Pedal Anywhere has a fleet of 80 bikes that consists of three different types of road bikes, which they deliver around the Seattle by bike, and beyond by car.



Bikes: Custom made CycleFab LLC trailer equipped with re-adapted King County Metro bus bike racks. The trailer holds three bikes which are secured just like how they would be on the bus. The bike that tows the trailer is equipped with an electric assist in the rear wheel and rim brakes which Zach hopes to update to disc. Pedal Anywhere currently has two trailers, only one with electric assist, but Zach hopes to get the other one equipped in the near future.

Use/Trip Description: Pedal Anywhere delivers bikes all over Seattle and beyond, but tends to use the trailer for trips during rush hour and for shorter distances. A car is used for longer distance trips or trips that require more than three bikes to be transported to the same area. Fully loaded, the trailer weighs about 100 lbs and is capable of climbing up Capitol Hill at 20 mph, although it may drain the battery faster. In the summer, Pedal Anywhere struggles with parking and loading and unloading because their bike is not equipped with a stand and the trailer occupies a large amount of space on the sidewalk where they are permitted to park.

Figure 4.8 User profile – Pedal Anywhere

4.2 WHAT ARE THE ADVANTAGES AND BARRIERS TO USING A CARGO BIKE IN SEATTLE?

The interviews revealed that Seattle cargo bike users use their cargo bikes for very different purposes and therefore face unique advantages and disadvantages to using cargo bikes. Despite the diversity, the interviewees expressed a lot of the same concerns and suggestions for improving cargo bike use support in Seattle. Throughout this section I summarize my findings centered around themes that emerged from my interviews.

4.2.1 *Topography*

When I first began my research, I thought that topography would be a major barrier to using a cargo bike in Seattle, however, I found that with electric assist technology readily available and accessible in Seattle, almost any hill is traversable. One exception to overcoming topography is operating a heavy-duty cargo trike, such as Freewheel's or Seattle Pedicab's. The heavy-duty cargo trikes weigh a lot on their own, and even with an electric assist they are unable to climb up some of Seattle's steeper grades, including those around ten percent or more. Besides the heavy-duty cargo trikes, while topography is something that affects cargo bike users, it is not a major deterrent to using a cargo bike in Seattle, especially when electric assist is an accessible option, adaptable to most any bike, and easy use and overcome the hill climbing barrier.

4.2.2 *Weather*

I also thought that weather would play a significant role in deterring cargo bike use, but that is not the case. Most interviewees did not mention Seattle's weather as a barrier to using their cargo bike,

except for the mobile vendors. Like most Seattleites, cargo bike users invest in wearable rain gear and protection for their cargo, overcoming the potential barrier, and none of the interviewees mentioned their cargo bikes handling any different in the rain. The mobile vendors that I interviewed, however, sell products that are very weather dependent and do not operate on rainy or cold days. More traditional mobile food vendors, like food trucks, have pop-out awnings that protect their customers, but bike-based mobile vendors are not equipped with extensive weather protection. Other than the constraints it places on mobile vendors, I found that Seattle's weather is not a deterrent to using a cargo bike.

4.2.3 *Maintenance*

Cargo bikes in Seattle need to be more durable and maintained more frequently because of the wet climate, demanding topography, and poor street surface conditions. Descending a steep grade with a full load wears out brake pads faster on a cargo bike than on a regular bike. Riding along wet roads causes granular road debris to spray into the drivetrain and braking surfaces, which degrades the equipment faster. Ascending one of Seattle's many steep grades, while using an electric assist, drains the battery faster than riding on flat surfaces. Riding on bumpy streets with potholes and rail tracks stresses the bike frames, rattles components, and could damage or shake up cargo that is not secured properly. Given the conditions, it is necessary to spend more time and money on maintaining a cargo bike in Seattle.

Couriers stressed maintenance more than other user groups, most likely because they use their cargo bikes more frequently than others, traveling 30-50 miles per day with a load, causing the need for more frequent maintenance. Service providers and vendors also stressed the importance

of maintenance, describing their cargo bike as an integral part of their business, without it they are unable to operate at all. Annual maintenance costs vary from courier to courier and depend on the type of bike and daily work. On the low end, one courier said he spent around \$100 on maintenance in one year which covered disc brake pads and general tune ups while Freewheel estimates they spend an average of \$100 per month on maintaining their fleet of electric cargo trikes. Stace from Stealth Logistics invested up front in high end, durable equipment to avoid maintenance costs and stretch out the life of his cargo bike fleet, but he still has significant maintenance costs mostly related to the electric assist system. Families and households are the least concerned with maintenance and Davey from G&O Family Cyclery made note of this. He says that families do not bring in their bikes as often as they should because they do not recognize the need to do so. G&O is Seattle's cargo bike expert, but most bike shops are capable for working on cargo bikes because they use the same technology at regular bikes, but take up more room.

To summarize my findings on maintenance, the issue is both cost and technology. Maintaining a cargo bike in Seattle can be expensive, especially if it is used frequently for heavy loads. Regular maintenance is necessary to keep cargo bikes, and the households or businesses that depend on them, running smoothly. While cargo bike and electric assist technology has become more available and accessible over the last few years, the rate at which it is developing is not keeping up with the growing trend and specific needs of cargo bike users in Seattle. Many of Seattle cargo bike users rely on local company CycleFab LLC for customized fabrications, modifications, and repairs to meet their specific cargo bike technology needs that typical cargo bike designers/builders are not meeting.

4.2.4 *Infrastructure*

Of those I interviewed, less than half own or use a car and all were cyclists before they started using a cargo bike. The interviewees maintain a strong aversion towards cars and driving and feel threatened by cars in Seattle. Most of the interviewees are capable of riding in traffic and have grown used to it because it is often the only option in Seattle, however, they do not prefer it. Even the hardest of riders expressed a strong preference not to ride in traffic, even more so when using a cargo bike, especially when there is precious cargo on board. Interviewees unanimously expressed a desire for better infrastructure and more protection from cars. The problem with Seattle's bike infrastructure, according to the interviewees, is that it is limited or does not exist in some places, and the network that does exist provides very little protection or separation from cars and does not connect to destinations (Figure 4.9). The interviewees feel that an unfair portion of the right-of-way is given to cars and feel entitled to more priority as cyclists. Several of the interviewees strongly disapprove of sharrows or road paint, and do not view them as effective bike infrastructure. Interviewees also mentioned how unsafe it is to have unprotected bike lanes between traffic and in the parked-car door-zone. There is also a severe lack of enforcement preventing cars from parking in the bike lane or cycle tracks or preventing pedestrians from walking onto cycle tracks without looking. The bike detours and surface treatment from construction in downtown Seattle has also been identified by the interviewees as inadequate and unsafe.

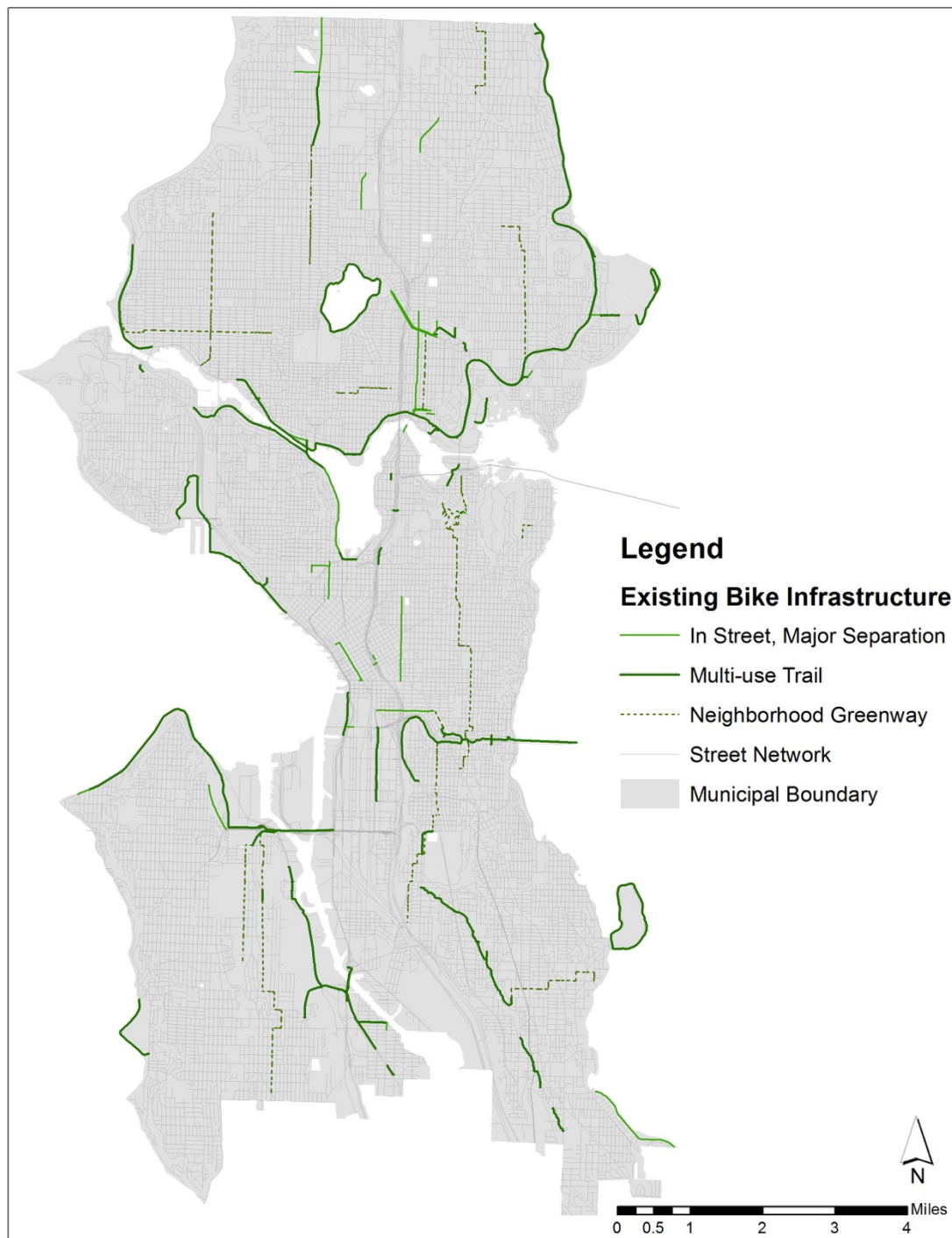


Figure 4.9 Seattle bicycle infrastructure map showing only protected or separated bike lanes, multi-use trails, and neighborhood greenways, highlighting the incomplete network of preferred types of bicycle infrastructure (Map produced using SDOT open source data)

Besides the bike infrastructure network deficiencies, the existing facilities do not accommodate for cargo bikes in terms of space and design. All the family users I interviewed, who use long tails or long johns, mentioned that they are unable to fit in the turn boxes which causes them to avoid left turns by making multiple right turns, in some cases. Shirley Savel, mother and bike advocate, says that she feels bike infrastructure in Seattle is designed for light, small, and easily maneuverable road bikes, not her 120-pound cargo bike. Shirley's bike is over nine-feet long, longer than a Car2Go, and she says that she often confronts turns that are too sharp and traffic islands and left turn boxes that are too small for her bike to fit in. The cargo trikes used by Freewheel, Six Strawberries, and pedicabs do not fit comfortably in cycle track lanes either, there is little room for other riders to pass and at times they cannot clear the flexible cycle track lane dividers.

All the interviewees also mentioned car restrictions or limitations in different capacities to make traveling by cargo bike safer and easier for them. Couriers and logistics companies were interested in restricting access to downtown, especially for freight trucks, because courier companies operate mostly within the city center and vehicular traffic, freight vehicles especially, pose a major safety threat to couriers. Families were more interested in restricting traffic on neighborhood streets and implementing more traffic calming devices in areas that they frequent. While neighborhood greenways are great, they can be indirect and confusing, says mother and bike advocate, Shirley Savel. Shirley and other cargo bike users want to see more aggressive measures taken such as less roadway space given to cars and more protected bike lanes on flat, direct routes such as Rainier Avenue South, a major freight route in Seattle. Families also mentioned that they are unable to use

public transit with their cargo bikes because they do not fit on the bike racks, or they are not allowed, limiting their traveling options to short trips only.

To summarize my findings on infrastructure, the issues are a lack of bike infrastructure that separates or protects riders from traffic, existing infrastructure is not designed for cargo bikes, and public transit does not accommodate for cargo bikes. There is not sufficient protected or separated bike infrastructure to remove bikes from traffic, which is a safety issue for cargo bike users and cyclists in general. Seattle's current bike infrastructure does not accommodate for cargo bike users by size or design. Public transit restrictions discriminate against cargo bikes, discouraging cargo bike users from traveling longer distances and limiting their use.

4.2.5 Distance, Speed, and Capabilities

All the interviewees use cargo bikes for short distance trips, under ten miles, and all agree that cargo bikes do not make sense for long distance trips, with the exception of purposes such as recreational camping or touring. Cargo bikes are limited to short distances in Seattle for several reasons: electric assists run out of battery power, it is not economical or efficient, it is physically exhausting, and there are other modes that are more efficient, economically viable and available for long distance trips. It is the time and economic value attached that makes long distance travel relatively inefficient rather than the bike's capabilities. As electric assist technology continues to develop along with Seattle's bicycle infrastructure network, distance will likely become less of a factor for cargo bike users.

According to the interviewees, cargo bikes can carry the same amount of cargo as a car or van. All the interviewees described their carrying capabilities as limitless, although it may take them multiple trips. Madi Carlson, mother and bike advocate, moves furniture to the Goodwill with her Big Dummy, John Michael Bayes, courier and recreational rider, once moved an entire office with his Bullitt instead of using a van. Not only do the interviewees feel capable of carrying almost anything, they also claim that cargo bikes are faster and more predictable than cars for short distances because they are able to bypass traffic and do not have to search for parking. This is beneficial for courier companies such as Stealth because they can guarantee timely deliveries and faster travel. According to Davey Oil, father and owner of G&O Family Cyclery, he and his partner have tested car versus cargo bike speed on the way to dropping their two children off at school, and he says the bike always prevails.

Cargo bikes also have capabilities that cars do not, besides going around traffic. The vendors said they are the quickest in and out of the farmer's markets and events because they do not have to find parking for their vehicles and everything is contained in their bikes. The Metropolitan Improvements District cargo bike sidewalk cleaners can stop frequently in places that a car would otherwise impede traffic. To summarize, cargo bikes are limited to short distances in Seattle, but are usually faster and more predictable than cars, and have some capabilities that cars do not. With improved electric assist technology and a better integrated transportation system, distance will most likely become less of an issue for cargo bike users.

4.2.6 *Parking and Permits*

Most of the interviewees mentioned parking as both an advantage and a barrier. While cargo bikes do not have to search or pay for parking like cars do, oftentimes the sidewalk or bike parking area is not large enough to accommodate for cargo bikes, causing cargo bike users to park in areas that impede pedestrian traffic. Traditional bike parking facilities are not usually positioned or designed to allow sufficient room for cargo bikes to lock up. Madi Carlson, a family oriented cyclist, does not mind free-locking her Big Dummy cargo bike when there is not room on the bike rack. She is happy to utilize her bike as an anchor for other cyclists to lock to or a jungle gym for the kids, but not everyone is comfortable or capable of leaving their rigs free locked. Most couriers are concerned with security of their bikes or cargo on board, and opt for the most secure locations closest to the building they are delivering to. Pedal Anywhere does not have a kickstand and their trailer is too long to fit on the sidewalk without blocking pedestrians. Zach from Pedal Anywhere mentioned how using a commercial vehicle loading zone would be helpful for them so they can load/unload their rental bikes without being a nuisance.

Six Strawberries and Convoy Coffee, both mobile bike-based vendors, identified the SDOT Street Use Permit as the primary barrier to their operations and success as mobile food vendors. The SDOT Street Use Permit for mobile vendors does not allow them to sell in high foot traffic areas such as Downtown Seattle or Seattle Parks. While Six Strawberries and Convoy Coffee find other areas to vend such as farmer's markets, festivals, and private catering events, they are missing out on spontaneous business and the mobile aspect of their business models are restricted.

To summarize my findings on parking and permits, the issue is that traditional bike parking facilities do not accommodate for cargo bikes, which causes traffic impediment and discourages their use. The restrictions of SDOT Street Use Permit for mobile vendors also discourages cargo bike use for vending purposes.

4.2.7 Economic Costs, Benefits, and Perception

All the interviewees mentioned how they have benefitted economically from using or purchasing a cargo bike. Individual couriers say they make more money using a cargo bike particularly when paid by the job via commission or tips. Using a cargo bike allows couriers to take more jobs/orders and trip chain more efficiently. Logistics companies, like Stealth, say they have seen returns on their investment in their cargo bike fleet. Stealth's cars couriers are now free to take on more long distance jobs outside of the city, while the cargo bike couriers deliver within the city center, but at a lower cost because they are both faster and do not need to pay for parking. Cycle couriers also have lower wages than car drivers, which saves Stealth on labor costs as well.

The vendors and service providers also developed their businesses around a cargo bikes because of the low overhead costs, which are significantly less than investing in a van or truck or leasing a commercial space. Vendors and service providers claim that everyone benefits from their low overhead costs, because the savings they have incurred are transferred to their customers in the form of lower rates and prices. Simultaneously, some of the vendors and service providers feel that they should be financially rewarded for being low-carbon, especially when they compare themselves to their car-based counterparts.

All the families and households mentioned that they are saving money by not driving or investing in a car. Most families had a car prior to their switch to cargo bike and realized the high cost of owning and maintaining a car. Their choice to invest in a cargo bike was an easy decision that was very much driven by saving money, but not all families that are interested in using cargo bikes can see the economic benefit as easily or immediately. Davey at G&O Family Cyclery says he is constantly being asked why his cargo bikes are so expensive and he often confronts families that struggle to accept the initial cost of purchasing a cargo bike although they are obviously much cheaper than purchasing a family car. The variety of types of cargo bikes available and the research involved can also be intimidating. Davey offers free advice and test rides at G&O to help families decide what works for them and local organization, Familybike, offers bike rentals and workshops as well. Most families, however, said that if more services were available to rent or try out a cargo bike, they think more people would be willing to purchase one. Davey from G&O also mentioned how it is difficult to justify purchasing a bike that you know your family will grow out of in a couple of years and that having a consignment service would be beneficial for families.

To summarize my findings on economic costs, benefits, and perception, the issue is that cargo bikes are perceived as expensive because a lack of awareness of a somewhat new transportation mode and technology. Although cargo bikes cost less than a car, most interested purchasers hesitate to recognize the potential economic benefits they offer, because they are wary of cargo bike expertise. While cargo bikes have a proven economic advantage to cars, they are not perceived as a viable car replacement, due to a lack of awareness and support from the public sector. Advocacy for cargo bike use in any capacity in Seattle, comes entirely from businesses and organizations such as Stealth Logistics, G&O Family Cyclery and Familybike. Advocating and

providing free advice about cargo bikes puts stress on these organizations and businesses, but it is also confusing for interested cargo bike users or purchasers to take advice from an expert whose financial welfare depends on the acceptance of cargo bikes.

4.2.8 *Values*

All the interviewees expressed a great deal of joy and pride around their cargo bikes. There was not a single interviewee that expressed regret over their cargo bike use or purchase. Families described their cargo bike trips as engaging, interactive, quality time with their children. Vendors and service providers say that their cargo bikes attract a lot of positive attention their environmentally friendliness is highly marketable. Couriers and logistics companies are proud to be a part of an environmentally friendly movement in urban freight delivery. Cargo bike distributor G&O is seeing more interested cargo bike users than he ever expected. Most of the interviewees mentioned how riding a cargo bike keeps them healthy through physical exercise. All the interviewees expressed how they felt good about having a small carbon footprint as well as an enthusiasm about being part of the cycling and cargo bike community. Overall, interviewees have exhibited that their cargo bike use is an extension of their environmental, social, and health values and that cargo bikes have provided them with the ability to live car-free.

4.2.9 *Findings Conclusion*

The interviewees expressed several areas in which the public sector could intervene to better support cargo bike use that align with the literature and practices review. All user groups expressed a desire for more separated or protected bike infrastructure and more roadway priority given to

bikes. Couriers and logistics companies expressed a desire for driving and parking restrictions and consolidation centers in the city center to improve safety and efficiency. Families and households also expressed concern about safety and a desire for more protected or separated infrastructure, as well as an interest in having access to more opportunities to try or rent cargo bikes, and a desire for the option to combine cargo bike use with transit. Vendors expressed frustration towards the SDOT Street Use Permit and described its regulations as too restrictive and service providers feel they are lacking sufficient space for parking. Using the identified constraints and barriers faced by cargo bike users, I have developed some recommendations for ways cargo bike use could be better supported in Seattle.

5. DISCUSSION

The interviews and research revealed that cargo bikes work successfully in Seattle and that they have several advantages over cars in the Seattle context: they are more efficient, travel at safer speeds, are less expensive to own, operate, and maintain, and have a lower impact on the environment. Cargo bike use continues to grow, especially as Seattle's motor vehicle traffic congestion and the cost of transportation increases, but not without its challenges. Most of the issues that discourage cargo bike use can be attributed to local planning deficiencies, particularly, Seattle planning practices reflect a lack an understanding of new electric bike technology and fail to acknowledge cargo bikes as viable car replacements. As a result, planners have not responded to the needs of cargo bikes users and cargo bike use is not adequately encouraged or supported in the built environment or through government plans and policies in Seattle. I argue that this issue can be addressed through government awareness and education and have identified some Seattle planning documents through which cargo bike acknowledgment and some specific barriers to cargo bike use may be addressed.

5.1 TECHNOLOGY

Many of the advantages of cargo bikes can be attributed to electric assist technology, which has made the use of heavy cargo bikes, carrying larger cargo loads, climbing steeper grades, and traveling longer distances, possible. I argue that a combination of projected technology advancements and local government awareness of current and new technology will address some of the challenges faced by Seattle cargo bike users.

Our world is currently dominated by technology-driven companies, some of which are focused on improving transportation. According to a 2016 Navigant Research report, electric bikes are the highest selling electric vehicle in the world (Navigant Research 2016). If electric bikes are akin to a single-seater car or motorcycle, then electric cargo bikes could be considered the truck or minivan of bikes. The report attributes the growing popularity in electric bikes to increased urbanization and the desire to move away from cars for motorized transportation, and technology advancement, particularly in lithium-ion battery improvements, which has resulted in lighter and lower cost electric bikes (Navigant Research 2016). There are some limitations to electric bikes, namely battery life, however, as technology advances and more infrastructure supports electric bike use, battery life and travel range will most likely no longer be an issue.

Electric bike and cargo bike technology has presented itself as a viable, convenient, low cost means to replace cars (Navigant Research 2016) with a promising future, but the City of Seattle has not acknowledged it in most of its plans as a new technology trend capable of transforming transportation in Seattle. The City, however, is discussing ways in which it can support the long anticipated electric autonomous vehicles in the future (SDOT Blog 2016), but the problem with electric autonomous vehicles is that the technology is not ready yet (and may never be), they are not affordable, and they do not decrease traffic congestion or vehicle miles traveled. The electric and electric autonomous vehicles topic is an important part of the discussion on meeting local climate goals, but it draws attention away from the current attainable and equitable solution that electric bikes and cargo bikes offer.

A major barrier to the widespread adoption of electric bikes and cargo bikes in the United States is that they challenge the American transportation status quo of owning and driving a car, but other barriers include low consumer awareness, low gasoline prices, a lack of bike infrastructure, and comparatively high prices compared to regular bikes (Navigant Research 2016). I argue that most of these barriers can be overcome with government intervention, while also achieving climate, equity, and mobility goals in Seattle, but it would first require acknowledgement of electric bike and cargo bikes technology and benefits, followed by measures to drastically shift transportation habits.

5.2 ACKNOWLEDGEMENT

Along with a misunderstanding of electric bike and cargo bike technology, is a lack of local government acknowledgement of cargo bikes, particularly electric cargo bikes, as viable private or commercial motor vehicle replacements. When referring to acknowledgement, I mean the documented acceptance of cargo bikes as a distinct mode of transportation and recognition of their demonstrated capabilities and potential by local planning authorities within government documents. It is difficult to acknowledge a specific mode, such as cargo bikes, without having a clear definition that distinguishes it from other modes. According to SDOT, bikes are legally considered vehicles and allowed to operate on any public roadway except where they are specifically restricted, such as Interstate 5. Several of Seattle's transportation related documents address conventional bikes and vehicles separately, but fail to address electric bikes or cargo bikes, although they have their own set of needs and capabilities that fall somewhere in between motor vehicles and conventional bikes. Although cargo bikes are not addressed specifically in most of Seattle's planning documents, I assume that they are informally included in the bike mode category

of transportation. I argue, to acknowledge electric cargo bikes and their potential, it is necessary to provide them with an entirely separate mode definition that distinguishes them from both conventional bikes and vehicles. Through this definition, planners will have the tools necessary to acknowledge electric cargo bikes and their specific needs and capabilities, like they have somewhat successfully done through the Seattle Freight Master Plan.

The Seattle FMP, for example, positively acknowledges the advantages of using cargo bikes for urban freight transportation and plans to further evaluate their feasibility. The FMP recognizes the potential benefits of using cargo bikes to transport urban freight, “The support of alternative freight modes, such as bicycle delivery, may increase to deliver goods in dense, congested areas of the City. Bicycle deliveries produce zero emissions, are nimble, accommodate loads of up to 300-pounds per unit, and have few parking challenges during delivery. The maintenance and operational costs of bicycle delivery fleets are also lower than for trucks” (SDOT 2016, 41). The Seattle FMP has also integrated cargo bikes into its urban goods delivery strategy 2.1.7, “Evaluate and recommend on- and off-street tactics to enable bicycle, non-truck, and small truck deliveries in dense areas” and strategies to reduce greenhouse gas emissions produced by freight 6.2.4, “Support efforts to increase bicycle and electric vehicle freight deliveries” (SDOT 2016, 83).

While the Seattle FMP addresses the idea of using cargo bikes for urban freight delivery and acknowledges the potential benefits they offer, it does not explicitly describe how they are going to evaluate or support efforts to increase cycle freight. In late 2016, however, SDOT announced that it will work with the University of Washington Civil Engineering Department through a publicly and privately funded research program called the Urban Freight Lab. Through this

program, Seattle's urban freight system will be evaluated to identify ways it could be made more sustainable, possibly through the utilization of cargo bikes.

5.3 PHYSICAL BIKE INFRASTRUCTURE

The major physical barrier to cargo bike and conventional bike use in Seattle is a lack of sufficient bike infrastructure. Existing bike infrastructure in Seattle does not necessarily protect or separate cyclists from motor vehicle traffic or connect to destinations throughout the city. Furthermore, facilities that do exist, including bike racks, left-turn boxes, and cycle tracks, do not accommodate for most cargo bikes by size and design. The lack of sufficient bike infrastructure throughout Seattle is an environmental and social equity issue, that is not being addressed by the City thoroughly or fast enough. The Seattle Bike Master Plan (SBMP) is working towards completing a bike network for all ages and abilities, however, it does not acknowledge cargo bikes within the document or through existing infrastructure.

Planning for cargo bike use, through bike infrastructure and supportive policies, is planning for equity in Seattle. Current transportation infrastructure in Seattle is inequitably distributed and neglects the needs of cyclists. The bike infrastructure that does exist does not always accommodate for cargo bikes and is even prohibitive at times. For example, infrastructure such as left turn boxes are too short for long tail cargo bikes to fit in properly, cycle tracks are too narrow for wider cargo trikes to utilize without impeding other traveling cyclists, and conventional bike parking racks are too small and not designed to accommodate most cargo bikes. Disregarding cargo bike users when designing infrastructure specifically effects families, who are the biggest cargo bike user group in Seattle. Families are the most vulnerable population, requiring the most protection from motor

vehicle traffic, particularly those who cannot afford a car. I suggest the SBMP consider acknowledging cargo bike users, particularly as a vulnerable cyclist group that requires special attention. One way to incorporate cargo bikes into the SBMP is to change the design specifications for bike infrastructure and facilities to meet the needs of cargo bike users. I also suggest that the SBMP consider ways it can coordinate with Seattle Transit Master Plan to support multi-modal travel for cargo bike users as well. Current bus rack and light rail policies do not accommodate for cargo bikes, but there are several ways in which design and investment in additional facilities could be more supportive of multi-modal cargo bike users, particularly families. Expanding the bike network and public transit policies to accommodate for cargo bike users may require some lane reductions or additional investment in public transit facilities, but it will actually decrease traffic congestion by enabling a significant number of people to bike and use transit for their everyday trips.

5.4 SUPPORTIVE PROGRAMS AND POLICIES

Supportive policies and programs are equally important as physical infrastructure is to encouraging cargo bike and conventional bike use. Seattle's cargo bike use barriers outside of infrastructure issues, include a lack of awareness, access, and incentive to use cargo bikes. I suggest that the City consider developing more supportive programs and policies to encourage cargo bike use, such as an awareness program, an improved bike share program, supportive public transit and permit policies, as well as motor vehicle driving and parking restrictions, which I will elaborate on further.

5.4.1 *Awareness Campaigns, Guides, and Programs*

One of the main barriers to cargo bike use in Seattle is a lack of awareness; families and businesses do not view cargo bikes as an option to replace some or all of their motor vehicle trips. Currently, Seattle has a guide that aims to inform and encourage more individuals to use bikes called “Come Ride With Us”. The guide consists of accessible and informative material on how to get around the city by bike and mentions cargo bikes and electric bikes as types of bikes available to transport cargo or children up Seattle’s steep hills. “Come Ride With Us” is a good example of how to inform residents of the alternative modes available, but it is weak compared to the effect that non-profit bike advocacy groups, such as Seattle Neighborhood Greenways and Cascade Bicycle Club, campaigns have had on encouraging and supporting bike use for all ages and abilities in Seattle. I argue that the local government should consider taking on more responsibility in promoting cargo bike use in the form of programs, guides, and awareness campaigns aimed at logistics companies, families, and local businesses. SDOT could provide logistics companies and local businesses with a guide to transitioning some of their operations to bike to create awareness and encourage less car dependency. The City could even develop a supplemental program that provides a fleet of cargo bikes to local businesses to try out, similar to the Bremen, Germany program I mentioned in the literature review. Familybike offers workshops for those interested in transporting their families by bike, but is underfunded and has a limited rental fleet. The City could expand on Familybike’s program or back it financially to create awareness and encourage more families to travel by bike. The City could also promote cargo bikes, and conventional or electric bike use, through example by adding City of Seattle branded cargo bikes and electric bikes to their fleet of municipal vehicles. Municipal cargo bikes could be used for ongoing services such as parks maintenance and employee transportation while also providing the City with alternative vehicles for disaster relief situations.

5.4.2 *Bike Shares and Subsidies*

Another barrier to cargo bike use in Seattle is a lack of convenient and affordable access to try or temporarily use a cargo bike. Local distributors and organizations, such as G & O Family Cyclery and Familybike provide several options to purchase or rent cargo bikes as well as expert advice on how to use them, however, they are limited and underfunded. To increase access to cargo bikes, I suggested that the City consider integrating them into Pronto, the current bike share system, however, public funding has since been pulled from Pronto and the bike share system is no longer in operation. Pronto's model failed for several reasons, but that does not mean that a bike sharing program will not work in Seattle. Whether it is publicly or privately funded, I argue that a bike sharing program, that includes electric and cargo bikes, is necessary to encourage more bike use and meet mobility needs in Seattle. Theoretically, a bike share program that offers conventional bikes, electric bikes, and electric cargo bikes would provide residents and visitors with a diverse set of affordable, and convenient options that have the potential to create awareness of alternative transportation modes and reduce car dependency. In all practicality, funding, designing, and managing a bike share system has proven to be problematic in Seattle and a better understanding of why Pronto failed as well as a feasibility study of any other proposed bike sharing program models is necessary to move forward.

Another option to make cargo bikes more accessible, or help individuals or businesses overcome the financial burden of the initial investment in a cargo bike, would be to offer subsidies for cargo bike purchases. Providing cargo bike purchase subsidies on the basis that they would replace a motor vehicle may outweigh the public costs of continued motor vehicle use. Although I do not have the sufficient data to support the feasibility of either of these programs, I argue that both the

bike share and cargo bike subsidy program have potential and should be considered and researched when developing transportation plans that aim to improve accessibility and livability in Seattle.

5.4.3 *Transportation Demand Management (TDM)*

Another barrier to cargo bike use in Seattle is a lack of incentive to convert some motor vehicle trips to bike or cargo bike. There is a need to reduce greenhouse gas emissions caused by road transportation, which, according to a 2008 community inventory report, comprise 40 percent of greenhouse gas emission in Seattle (City of Seattle 2013), which provides the grounds to implement more TDM strategies. Currently, 40 percent of trips in Seattle are under two miles, which shows great potential for conversion (City of Seattle 2013). Seattle has been somewhat successful in reducing motor vehicle travel, particularly single occupancy vehicles, through transportation incentive based TDM strategies such as increasing travel options such as biking, walking, and public transit. Seattle has also improved safety and reduced collisions through design and policies such as the complete streets approach and Vision Zero, which attempts to design streets for all modes and reduce vehicular traffic speeds. Although transportation options and safety has increased in areas of Seattle, alternative modes still do not provide the same convenience as driving does, nor have they been met with the same support and subsidies as cars. Driving in Seattle is convenient and inexpensive, gas prices are low, parking is cheap, and the streets are free to use and designed especially for driving. Transporting cargo, equipment, or children is also thought of as requiring a car and the City has not challenged this idea or offered many incentives to using alternative modes for commercial or family travel.

I argue that the Seattle can only encourage less motor vehicle travel and more biking, walking, and public transit use, if it both restricts motor vehicle use and provides the infrastructure necessary for alternative modes. The current programs that incentivize walking, biking, and public transit, such as the Commute Trip Reduction (CTR), have been successful, but are not effective enough without a regulatory element and supportive infrastructure. Regulatory TDM strategies, such as motor vehicle driving and parking restrictions, will help to achieve a more equitable distribution of investment and allocation of public right-of-way space, and have been proven as a precondition to successful adoption of cycle freight and increased bike use in European cities. While Seattle may not exhibit the need for driving and parking restrictions now, population growth and densification have increased traffic congestion to a degree that may warrant a more regulatory approach in the near future.

5.4.4 *Permits*

Vending in the public right of way requires a Street Use Permit from the Seattle Department of Transportation (SDOT). Ordinance 123659 regarding mobile street food vending was adopted in 2011 and streamlined the rules and regulations for street food vending to make it easier to be a mobile vendor. According to SDOT, “The City of Seattle encourages street-food vending to increase public use, enjoyment, and safety of our public right of way. With proper design and management, street-food vending can be a great way to encourage walking, add vitality to the street, and promote local economic development” (SDOT 2012) There are several types of Street Use vending permits, but the Mobile Food Vending Permit is the one relevant to cargo bike-based business. The permit is not location specific and the vendor can move around from place to place, but is restricted from within fifty feet of any public park, one thousand feet of any public or private

K-12 school, fifty feet from any food-service business, loading zones, all Downtown Seattle including the Stadium District, Pioneer Square, and the Waterfront, as well as the University District. The restrictions of the Mobile Food Vending Permit limit the abilities of mobile bike-based vendors to sell in areas of Seattle with the highest volumes of foot traffic and sidewalk activity. These restrictions have removed spontaneous vending from the mobile bike-based vendors' business model and driven them off the street towards more secure vending locations, such as private catering events and farmer's markets where they are invited and permitted. I suggest that SDOT reconsider its Mobile Food Vending Permit restrictions with bike-based vendors in mind, because the current restrictions are inadvertently discouraging bike-based vending and have even driven one vendor out of business.

Another permitting issue that could provide a parking solution for commercial cargo bikes is to allow them to apply for Commercial Vehicle Load Zones (CVLZ) permits. CVLZ were established in Seattle in 1989 (SDOT 2017) with the purpose to provide a parking space for commercial service delivery vehicles to load/unload on busy streets. Some examples of commercial vehicle activities are loading/unloading food supplies, beverages, or merchandise. The curb is yellow and marked by a 30 minute CVLZ sign and to use the CVLZ you must apply for a permit. Regular Seattle Truck-Only Load Zones do not adequately meet the needs of commercial vehicles because in most cases they are smaller cars, trucks or vans that need to load/unload only small amounts of cargo from the curb in a short amount of time. Currently the definition of commercial vehicle under the CVLZ Permit application does not include cargo bikes, although they often provide the same services and have the same needs as commercial vehicles. If SDOT altered their definition of commercial vehicle under the CVLZ Permit to include commercial cargo bikes, it would allow

them to find legal, short term parking with sufficient space to load and unload, that does not impede pedestrian or other traffic. Updating the CVLZ permit to include cargo bikes, however, would not be necessary if sufficient parking was provided to cargo bikes on the sidewalk. Allowing commercial cargo bikes to use the CVLZs may interfere with other commercial vehicles, however, recognizing cargo bikes as commercial vehicles and providing them with equal privileges may be necessary to accommodate for the growing cycle freight trend.

5.5 LIMITATIONS

If I had more time and resources to continue my research on supporting cargo bike use in Seattle, I would look further into developing feasibility studies and implementing one of my suggestions. For example, developing study around consolidation zone feasibility or testing the feasibility of a bike share system model for Seattle that includes electric bikes and cargo bikes. It would have been interesting to interview City of Seattle or SDOT planners on their knowledge and perception of cargo bikes and if they have thought about them in the planning context. Interviews with potential cargo bike users such as families and logistics companies would have also been interesting. I would have also liked to gather or access the data necessary to calculate the potential for trip conversion in Seattle, similar to the ECLF estimation, which would potentially provide even more leverage for supporting cargo bike use through public policy.

6. CONCLUSION

There is plenty of evidence that bike use has health, safety, equity, economic, and environmental benefits for individuals, businesses, and cities, however, the needs of cyclists, particularly cargo bike users, are overlooked and unacknowledged in transportation planning in Seattle. I argue, that an improved understanding of electric bike technology and acknowledgement of cargo bikes as viable car replacements within transportation planning documents is necessary to achieve an equitable and sustainable transportation system in Seattle. With the right combination of supportive programs, policies, and bike infrastructure, the City could create an environment that supports convenient, safe, and affordable travel with cargo or children via cargo bike and reduce car dependency for all Seattle residents and visitors.

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