

Master SHS
Mention Sciences Sociales
Villes et Territoires



UMR 6173 CITERES

Cités, Territoires, Environnement et Sociétés

CNRS-Université de Tours

MSH de Tours

**A Study of Economic Value Achieved by
Investments in Bicycle Infrastructure and the
Impact on Economies**

Master dissertation

Année 2011

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Description of the Problem:

In today's society, there appears to be the notion that there is little to no value in investing in bicycle infrastructure in cities. "Vancouver is spending \$3.2 million on yet ANOTHER bike lane downtown (on Hornby) are you KIDDING ME?! Is our city being run by monkeys?" "Yes but we already don't have enough room on the roads for the amount of cars- to take lanes AWAY for bikes is just stupid." (Schwartz, 2010) This paper aims to prove that bicycle infrastructure and safety of design actually pays dividends, many times more than the little investment initially required. Furthermore, the increase in the revenue into the economy may come from increased mobility in an urban setting, increased tourism in a regional environment or improved public health benefiting society.

What is required to create a truly bike friendly city? The concept of which comes first, the chicken or the egg, may come to mind. Does a city create a need for infrastructure by encouraging cycling or do you build the infrastructure to encourage cycling? The current problem for bike transportation is that most city infrastructure has been either designed for the car or adapted for car-dominated transportation. In the future, is continuing this current method of car-dominated transportation design realistic, cost effective and possible?

To promote a livable city, one needs to encourage cycling by building safe infrastructure for cyclists. Increasing safe infrastructure will promote safety in numbers. A motorist is less likely to collide with a person walking and bicycling if more people walk or bicycle. Policies that increase the number of people walking and bicycling appears to be an effective route to improving the safety of people walking and bicycling. (Jacobsen 2009)

The goal to increase bicycle use can only be reached by a concerted focus on infrastructure, so that, for instance,

1. Cycling feels safe by individuals; parents especially need to feel that their children are safe while cycling to and from school
2. By cycling a person follows the shortest route and comes closer to his destination than by car
3. Cycle traffic is given priority over or is on an equal footing with cars on public roads and streets and in crossings. Accessibility and parking for bicycles is given priority at shopping centers and public transit nodes. (Norwegian Pubic Roads Administration May 2003)

In order to establish the economic impact of bicycle infrastructure on cities, regions and societies, this paper is broken down into two main parts. The first part will describe the six factors that influence bicycle infrastruture, including safety, parking and congestion, cost, public health, why people drive and economics. To then evaluate how these six factors have had an effect on the economic impact of bicycle infrastructure, part two of this paper will examine nine case studies. These studies include reseach on street calming, bicycle tourism and health and environment in North America, Europe and Austrialia to provide a limited global view.

Part 1- Six factors for bicycle infrastructure:

Safety

What is safe bicycle infrastructure? Safe is hard to define because every person has a different level of risk they are willing to take. However, safe bicycle infrastructure for everyone is a place where people of all ages can ride together, protected from motorists. This environment puts a priority on the bicyclist's needs for fluid motion when riding. For the purpose of this paper, three areas of safety will be examined: rider comfort level, infrastructure that allows for safe riding, and the influence cars have on safety.

The perception of safety is very diverse, especially between men and women. A small-scale stated preference study in Melbourne, Australia has shown that men are more willing to ride in traffic than women. The researchers reported that female commuter cyclists considered the presence of a bike lane on their route versus no bike lane to be more important in route choice than males. (Garrard 2008) Some men prefer the danger and excitement of riding with cars, their ability to speed when not confined to a bike lane, and the thrill that come with the risk of being near cars. This type of cyclist does not want to see special bicycle infrastructure because of their fear of having to use it and the elimination of the excitement, thrill and risk they have been enjoying. On the other hand, most women are risk adverse and will not ride in traffic, creating the need for separated bicycle lanes. According to Dill, most regular bicycle commuters are young men. "This means that if the city wants to substantially increase the number of people riding bikes on a regular basis, it needs to reach out to young women and older people." And, Dill said, that is what the public spending on bike infrastructure can accomplish. "When I was in my 20s, I used to ride bicycles all the time and didn't really think much about whether it was safe. But as I got older, I got more cautious and cut back my riding. Now I'm riding more, but I take side streets and look for bike infrastructure like bike lanes," said Dill. (Redden 2008)



(WB, 2008) women cycling when safe environment is provided.

In order to increase biker comfort, bike routes should be designed with the cyclist's safety and protection from larger and faster moving vehicles in mind. Bicyclists are most vulnerable in intersections and are discouraged by the dangers of having to stop and start and crossing automobile traffic in these intersections. Consideration should also be given to how much more effort is required by a cyclist to start again once stopped compared to a driver who just needs to press a little harder on the accelerator. Although most laws state bikes and pedestrians have right of way, when confronted with cars, the bike loses. The human nature of 'he who is bigger wins' is very apparent when observing bicycle and car conflicts. It is plausible that accident risks do play a prominent role in the decision to use non-motorized transport because cyclists and walkers are relatively vulnerable per kilometer traveled compared with car drivers. The issue of perception of risks versus actual risk is of course a matter of concern: for the explanation of behavior, the latter is more important than the former. Nevertheless, research indicates that the actual low accident rates experienced by cyclists in a small town do matter in explaining their modal choice. (Rietveld and Daniel 2004)

In America and some other countries, the encouragement to use helmets creates an image of danger and makes people think it is unsafe to ride a bike, which in turn also discourages cycling. "If we want more people riding bikes, we need a wider range of people," Dill said. "If you make the environment safer for riders and give them more options, more people will ride bikes." (Redden 2008) The results indicate that cyclists are likely to detour longer in order to travel on routes with more green cover and routes where more bicycle-activated crossing signals are available.

The quality of bicycle infrastructure is the second factor to consider and it plays an important role in safety in general. In most cities, bicycle infrastructure is composed of the space that is left over after planning for cars and does not consider what is best for the biker. Bicycle lanes around the world have sign poles and street lights in the middle of the lane or path, causing potential hazards. When there are 0.25 fewer hindrances, such as posts, encountered on a trip per kilometer, the share of the bicycle use is increased by 1.3%. (Rietveld and Daniel 2004) Bike roads need to be designed just like car lanes with the removal of any prospective dangers from the road. The creation of safe infrastructure for cyclists further aides in reducing city traffic, parking problems, and improves public health, as will be discussed in more detail in the case studies section of this paper.



Rue Néricault Destouche Tours, France: Bike lane puts cyclist into a dangerous place. (Chapman)
 Puente de la Barqueta Seville, Spain: Light post in bike lane creating a safety hazard. (Chapman)

Lack of safe routes for cyclists is the top deterrent for people, particularly for women, to choose the bike for transport. “I’m a woman over 40 who would ride more if I felt the routes were safe,” said Dill. (Redden 2008) The design of infrastructure for cyclists requires specific focus on safety and function, but unfortunately they are often neglected because the perception is that they do not contribute any inherent beneficial consequences. In reality, the lack of safety and function largely contribute to why people are not bicycling now. When there is a percentage point of increase of people dissatisfied with the bicycle context, the share of bicycle use is reduced by 0.05%. When there is, on average, one less victim of a serious accident per one million bicycle-kilometers in four years, the share of the bicycle use is 1.1% higher. (Rietveld and Daniel 2004) Motorist behavior evidently largely controls the likelihood of collisions with people walking and that the risk of injury from car-bike crashes was a deterrent to cycling is more likely to detour bicycling. Efforts to enhance pedestrian and cyclist safety, including traffic engineering and legal policies, need to be examined for their ability to modify motorist behavior. (Jacobsen 2009) Whenever the use of bike paths needs to be combined with cycling along other main avenues where bike paths are not present, and bikers share road space with motorized traffic, this represents a serious deterrent of bicycle usage for both men and women. (Gomez 09/28/2000) In modern cities, a bike can be out of place. The speed difference between the car and bike can be too great for the cyclist to feel safe. Sidewalks are off limits for the cyclist because they are too fast for the pedestrians. Cyclists are often stuck in nowhere land and bikers do not feel safe in that type of limbo. The quality and design of bike paths is a determining factor to how well the facility will be received and used. A participatory approach is necessary in order to generate goodwill toward the project and to contribute to the creation or strengthening of a bicycle culture. Promotional and educational efforts are a critical component for the success of a non-motorized transport project. The project needs to address the specific issues that concern men and women with respect to bicycle riding and handling, and to the use of bicycles and bike paths. (Gomez 09/28/2000)

The current general infrastructure of most cities encourages car use, even when riding a bike could be faster. If the duration of a certain trip is 10% faster by bicycle than by car, then the use of the bicycle is increased by 3.4%. If there are 0.3 less stops per kilometer on a given trip, then the share of the use of the bicycle is increased by 4.9%. (Rietveld and Daniel 2004) By making the bicycle more of a priority, cycling can become the fastest method of transport in a city. The people in Amsterdam, The Netherlands, believe the bike to be the best way to move around anywhere in the city. One person shared that she rode her bike 35 minutes each way to school and it was still 10 minutes faster than the tram. Amsterdam has made a successful choice by discouraging cars in the city. Over 55% of transportation trips in Amsterdam are made by bike. Looking around at all the bikes on the road and all the bikes parked, it would be gridlock if every one of the bikes were a car. The Amsterdam City planners were warned that if they kicked the car out of the city it would be the end of the city. The bicycle infrastructure in Amsterdam is built around bikes and bikes have the priority. While it would be hard for most cities to achieve the 55% mode share of Amsterdam, a 20-30% mode share would have a great effect on how people get around the city. Cities need to take charge and build safe bicycle infrastructure to encourage biking. The long-term benefits clearly outweigh all upfront costs to implement the necessary facilities.

The third safety factor to be considered is reducing traffic speed. Reducing the speed of vehicles is a very effective means of improving the safety of cyclists and other road users, and can remove the need for specific facilities for cyclists along a route. Research has demonstrated a substantial reduction in accidents to all road users within 20 mph zones, with accidents to cyclists reduced by 29%. (Cycling England 2005) While it is not possible to generalize the study findings to other large, car-oriented cities, these findings are consistent with international comparative data indicating that high bicycle transport mode share for both males and females occurs mainly in countries and cities with extensive networks of separate bicycle paths and lanes. (Garrard 2008) Traffic safety concerns have been identified as a major constraint on cycling in countries with low rates of cycling, high rates of car use, and large gender differences in cycling. (Garrard 2008) Findings from this study suggest that the provision of on-road lanes on busy arterial roads may not offer the level of separation from motor vehicle traffic needed to attract increased numbers of female commuter cyclists. (Garrard 2008)

Walking and cycling are transport modes where relatively unprotected road users interact with traffic of high speed and mass. This makes pedestrians and cyclists vulnerable. They suffer the most severe consequences in collisions with other road users because they cannot protect themselves sufficiently against the speed and mass of the other party. Preventing collisions between fast and slow traffic is, therefore, one of the most important requirements for safe road use by pedestrians and cyclists. (European Commission SafetyNet (2009)

In summary, safe bicycle infrastructure is one that is built for people age six to eighty. This means that a parent can comfortably allow their six-year-old child to bicycle by his/her self and an eighty-year-old grandparent is comfortable cycling too. Several factors contribute to bicycle safety in general, as examined above, including perceived comfort levels (such as women's aversion to risks, protection from potential accidents, and the encouragement to use helmets), appropriate infrastructure (which should include hazard-free, safe and functional routes), and reduced vehicular speed. All people, but especially women, need to have a comfort level of safety created by a protection of cars and other dangers. Jennifer Dill's study showed that the majority of cyclists are young men and the best way to increase the number of riders in a city is to appeal to women and their desire for safety. Without the feeling of safety, people will not choose to ride their bike. Appropriate bicycle infrastructure can only be achieved by having clear passage ways, bike lanes that are separate from car lanes, and diminishing the perception of risk by increasing the perception of safety. The speed of cars is a very important factor when considering bicycle safety. A car can be similar to a gun: by itself it is not dangerous, but a person can quickly make it a deadly weapon.

Safety for people is very important and spending on safe infrastructure is cost effective and has economic benefits that will be shown in the case study reviews in part two of this paper. The case studies on street calming effects will provide data and information illustrating that safe streets in communities not only protect cyclists but also increase business, helping the economy. Bike paths and trails built for the tourism case studies will show that investments made to provide safe bike routes encourage tourism, which in turn also benefits the economy. Finally, the case studies on public health provide information on how safety is an important factor in the economic impact of the economy.

Parking and Congestion

Increasing cycling in cities can help resolve problems with traffic and parking. A majority of city trips made by cars are shorter than 4km, indicating that riding a bike would be more efficient. Removing the barriers for cyclists can have more cost benefits than adding car capacity. The number of people owning cars is increasing every day and cities are getting to a point where they do not have enough parking. Lack of parking and congestion will eventually encourage more and more people to move out of the city, creating urban sprawl.

At this point, the world is seeing a major shift of people moving into the city regions. More people today are living in cities and trends show that in the future we can only expect the cities to become more densely populated. With this expected increase in city population, the methods of transportation within the city are going to have to change. Cities have, or are in the midst of, running out of space for the current automobile infrastructure. Many cities are therefore also running out of space for bicycle lanes. These cities need to question the value of on-street parking and ask whether it is more beneficial to have parked cars in their city or bicycle lanes.



Tours France: Parking in Bike Lane, Mover box in Bike Lane, Post in Bike Lane, Motor Cycle Parked on Sidewalk. (Chapman)

When observing an older city built before cars existed, it will be noted that there are narrow streets with little space between buildings. These cities were designed for people to walk as their main form of transportation. In the city of Tours, France, the size of the sidewalks have been drastically reduced to accommodate cars; these sidewalks are so small that they discourage walking, the whole purpose of sidewalks. Many drivers also choose to park on the sidewalk to not block vehicular traffic but do not consider the risk they are inflicting on the pedestrians. Today, an average car parking space is 15 square meters of prime real estate in most cities. In an average city, if every resident were to own one car, there would be no place left to drive these said cars because all the lanes would be full of parked cars. It begs the question, is the car really the best means of transportation for city residents? A densely populated city is actually more ideal for bicycle use. For example, the city of Amsterdam, The Netherlands, is very densely populated and the people prefer to move by bike. In fact, there are very few places that accommodate cars in Amsterdam. Other cities, however, provide free or inexpensive on-street parking, which actually encourages the inhabitants to own cars. In cities, land can be very valuable; giving that indispensable space to park a car is not necessarily the best use of that land. When the parking cost for a car is increased by 14 eurocents per hour, the use of the bicycle goes up by 5.2%. (Rietveld and Daniel 2004) To make better use of the land, cities should repurpose

some of the on-street car parking into bicycle lanes and start charging for the on-street parking to pay for bike lanes.

The cost of building parking structures or underground parking facilities for cars is expensive, and it is a cost shared by all the citizens and visitors, not just the car owners. Even if a citizen does not own a car they must pay for someone else to have a “free” parking space. The cost of parking a car should be directly linked to car ownership; however, the old adage is true, “nothing in life is free”.

Shoup, the author of “The High Cost of Free Parking,” made the basic argument that parking in cities is too cheap, in large part because many municipalities require businesses to provide a certain amount of spaces. The lure of cheap on-street parking continues to draw people into their cars rather than onto public transit, bicycles, or their own feet. As a result, the demand for parking spaces greatly exceeds supply, and drivers crawl around in search of a spot, increasing urban congestion. (Shoup 2005) Cheaper parking increases the demand for automobiles and gasoline, thus increasing oil imports, traffic congestion, and air pollution. The cost of parking will be hidden in higher housing costs and lower urban density. Cheaper parking also discourages travel by foot, bicycle, and mass transit. (Shoup 1997) The most beneficial parking method lets the market determine the supply and price of parking. Market-priced parking like this will restrain the demand for automobiles and gasoline, thus reducing oil imports, traffic congestion, and air pollution. The cost of parking will be conspicuous rather than hidden. Market-priced parking will encourage travel by foot, bicycle, and mass transit. The revenue from curb parking will finance neighborhood public improvements such as sewers and sidewalks. (Shoup 1997)

Concerning policy variables, significant parameters mainly concern variables associated with the improvement of the competitiveness of the bicycle vis-à-vis the car. As an illustration, municipalities have the possibility to pursue an active price-setting policy of car-parking costs and to adapt the spatial organization of the city. This latter can have the effect of reducing the number of stops or hindrances per bicycle trip, and of achieving a gain of time in comparison with the same trip done by a car. (Rietveld and Daniel 2004) Similarly, the costs for a bike rack that parks two bikes, about \$200, is dwarfed next to the costs of car parking at \$3,500 to \$12,000 for each space of surface parking and \$10,000 to \$31,000 for each space of garage parking. (Gotschi and Mills 2008)

The reduction of car lanes and car parking can then lead to creating more bike lanes. This method is often called a “road diet” or “traffic calming”. This reduction of car lanes can still maintain sufficient transport capacity. The increasing of car lanes for capacity can be seen as an expensive and an ineffective fix. By increasing capacity the motorist is encouraged to drive more frequently. More users increase business and developers to build along the expanded motorway, further increasing demand and overloading the capacity. The increased demand will create future congestions. The addition of more auto lanes is not going to be a viable solution for the future. Once the cars have arrived at their destination where can they be parked? Cities are already running out of places to park the cars and streets are congested with traffic. The modern city is going to be forced to make changes away from the car society and move toward other transportation methods.

In general, many car drivers struggle with cyclists because the cyclists slow down the cars by taking up space that car drivers feel entitled to. Some motorists also complain that cyclists do not obey traffic rules by running stop signs and red lights. While most cyclists do obey the laws, they also break some laws to protect themselves from cars, such as moving into an intersection early to avoid cars from behind. Since the invention of the automobile, transportation infrastructure has been focused primarily on how to make places better accessible for cars with no regard to the bicycle.

In summary, cities' parking problems have been created in part by accommodating cars so much in the recent past. Most cities were not initially built for cars, so there is an inherent lack of space for them. Bicycle lanes move people and are a better use of space than on-street parking. City streets are congested and land is valuable; parked cars are not a good economic choice for land use in congested areas. Increasing parking capacity encourages car driving which adds to street congestion. Parking costs are subsidized by the city tax payer, which costs all transportation users. Retail shops and restaurants with parking have to charge everyone a little more to provide free parking, regardless of who drove and who did not.

The street calming case studies examined later in this paper further explain how parking and congestion have been reduced by using street calming methods. Providing bicycle lanes and reducing cars lanes and speed limits create a street where people will be more likely to bike to their destination and not require as much space for parking. More bicycles will equate to less cars and less congestion overall. The studies have proven that the more space given to bikes has increased the number of users and visits to businesses, which in turn has increased spending that benefits the local economy.

Cost:

The bicycle could be a very cost effective way for cities to meet future transportation demands. When creating infrastructure, one of the largest hurdles is cost. Bicycle infrastructure funding is always difficult to come up with due to perceived needs and equities. In the United States, citizens believe that roadway-funding dollars come from automobile tax revenues. The general public believes the taxes paid by fuel tax, registration and licensing taxes are how the roads are built and maintained. Because of this misperception, drivers have the idea that they own the road and have priority when using it. These drivers will drive too closely to and speed by cyclists, making them feel threatened and unsafe. The advantage to bicycle infrastructure is that it is relatively inexpensive compared to the infrastructure of other transportation modes.

Research has shown that the cost to build bicycle infrastructures is an excellent investment and much cheaper than the standard investment made for the automobile. Creating better bicycle infrastructure is more beneficial than spending on other methods of transport. Bicycle infrastructure will make for a more livable city with less traffic congestion. An example of cost defenses of bicycle structure compared to auto infrastructure comes from Portland, Oregon in the US. They were able to paint bike boxes in all the city intersections for the cost of adding one traffic light. (Dill 2003) Specifically, Portland's Transportation Director Catherine Ciarlo notes that the \$243,000 cost of all the city's bike boxes was less than the \$250,000 price tag for installing one traffic signal. (Mirk 2010) In Eugene, Oregon, the cost of building, maintaining, and managing traffic on local roads adds up to about 6 cents per mile for each motor vehicle. The

cost contributed to these roads by the drivers of motor vehicles through direct user fees is only 0.7 cents per mile. The rest comes out of the general tax fund. (Seager 2010) (Blue, 2010)



(Dean, 2010) *Portland bike box installation*

Most of the bicycle infrastructure in North America and Europe are paid for by the general taxpayer. This is the same for the pedestrian and automobile infrastructure in the city. While bicyclists are often accused of being freeloaders, what is touted as the conventional wisdom on transport economics may not be a true statement. A short readable report, 'The Going Rate: What It Really Costs To Drive' by the World Resources Institute, concluded that motorized travel in the U.S. is heavily subsidized and that bicyclists do pay their way. In fact a large portion of the costs of driving cars are borne by the entire population, not directly paid by people who drive and not paid in proportion to how much they drive. The report finds that it is entirely possible that a committed bicyclist actually subsidizes motorized travel.

“Consider the following facts:

- Gas taxes and other user fees covered only 60 percent of the US \$33.3 billion governments spent on building, improving and repairing roads in 1989. The rest of the money came from taxpayers (property taxes -- also indirectly paid by renters through their rent) and other non-user sources.
- An estimated US \$68 billion not covered by user fees is spent each year on such services as highway patrol, traffic management, parking enforcement, traffic accident response teams, police work on auto accidents and thefts, and routine street maintenance.
- The costs of vehicular air pollution are hard to pin down because they include such elusive damages as illness, premature death, and reduced crop yield; but even at the low estimate of US \$10 billion a year, they are substantial and all of them are borne by society at large.
- Since motorists use about half of the US's imported oil, up to half the cost of maintaining a U.S. military presence in the Middle East, or US \$50 billion a year, could be considered part of the cost of driving not paid for by user fees.” (MacKenzie, Dower, & Chen, June 1992)

For the price of a single mile of a four-lane urban highway, approximately \$50 million, hundreds of miles of bicycle and pedestrian infrastructure could be built, an investment that could complete an entire network of active transportation facilities for a mid-sized city. (Gotschi PhD n.d.) According to the Federal Highway Administration, the basic cost of a single mile of urban, four-lane highway is between \$20 million and \$80 million. In urban bottlenecks where congestion is the worst, common restrictions such as the high costs of right of ways and the need to control high traffic volumes can boost that figure to \$290 million or more. By contrast, the costs of bicycle and pedestrian facilities range anywhere from a few thousand dollars per mile to rarely more than \$1 million, with great variability between types of infrastructure due to local circumstances. (Gotschi and Mills 2008) When studying the economic benefits of transport infrastructure, the efficiency of the number of people that can be moved by mode and space required needs to be validated. One of the reasons bicycle infrastructure may cost less than other modes is because the amount of space required is less than that of other modes. In cities where space is in large demand, the cost for that space can be expensive. To build bicycle and pedestrian infrastructure it costs much less on a per traveler basis than other transport modes. Over the width of one traffic lane, bicycling and walking can move five to ten times more people than driving. (Gotschi and Mills 2008)



*Amount of space required for transporting the same number of people by car, buss or bicycle
(Muenster Planning Office Poster)*

A study in Baltimore Maryland provided details that the bicycle infrastructure can be better for the economy by creating more jobs. The money spent on bicycle infrastructure was spent on labor to plan and design the project. The size of the infrastructure required is also reduced, making the cost of materials less too. Due to the facility size the machinery required was much smaller and more cost effective. Of the five types of infrastructure projects analyzed in the City of Baltimore, for a given level of spending, on-street bike lanes created the greatest number of jobs. Each \$1 million spent creating on-street bike lanes directly created 7.9 jobs and created a total of 14.4 jobs when the indirect and induced effects were included. By comparison, pedestrian projects and bike boulevards created slightly fewer jobs: about six direct jobs and eleven total jobs for each \$1 million spent. The two categories of road repairs had the lowest employment effects, with three to four direct jobs and approximately seven total jobs created for each \$1

million. Thus bike lanes, for a given level of spending, create about twice as many jobs as road construction. (Garrett-Peltier Dec 2010)

Bike- and pedestrian-friendly streets also result in higher market prices. The research shows that in London, an achievable improvement in street design quality can add an average of 5.2% to residential prices on main streets and an average of 4.9% to retail rents. These findings have a central role to play in justifying investment and they make it possible to use an evidence-based approach to the design, appraisal and funding of street improvement works. It is clear from this work that the rewards from investing in design quality can be very significant. (CABE 2007)

To summarize, the cost for building bicycle infrastructure should be looked at as a cost saving measure for the community. Cities like Portland, Oregon have seen savings in the city budget by building more bicycle infrastructure over building more roads for cars. The perception of auto taxes paying for the road has deterred spending for bicycle infrastructure in other US states. And yet, bicycle infrastructure has proven to be more cost effective per mile than that of car infrastructure. Furthermore, money spent on building bicycle lanes creates more jobs per dollar than roadway spending.

Further detailed examples are provided in the case studies portion of this paper and will show that the cost of bicycle infrastructure may have excellent returns on investment. The street calming studies will provide details on the safety and business improvements that justify the cost. Attracting tourists through bicycle infrastructure will be illustrated in the tourism case studies to be cost effective by increasing tourism spending. The savings made in public health and the environment will complete the case studies to show how the spending has greater positive outcomes than the cost. The cost of the facilities can be expensive up front, but the economic returns have shown they are very worthy investments.

Public Health:

Along with the cost savings, bicycling is a way to improve public health in general. The bicycle as transportation can be beneficial to a city's health. The automobile-dominated infrastructure creates an environment for people to arrive at places with little or no exercise, which is contributing to an unhealthy society. Bicycle infrastructure will allow people better access to work, school and retail while also creating a healthy way to make the trip. Obesity in America and throughout the world is growing, as people are becoming more and more over-weight. The automobile is one of the causes creating a sedentary life style. If the general public biked as little as fifteen minutes to work each day, it would be a big step in changing the life style of many people. Bike-friendly cities such as Copenhagen, Amsterdam and Portland have a much lower obesity rate than other comparable cities around the world. The health care costs saved by people changing to bicycling alone would cover the cost of bicycle infrastructure. Moreover, more than physical health is affected by bicycling. Studies show that increased exercise can help modify depression. People who participate in physical exercise before work are more alert and productive. By creating a safe bicycle infrastructure, workers arrive stress free and ready to work.

Well-designed buildings, spaces and places contribute to a wide diversity of values and benefits. These range from direct, tangible, financial benefits to indirect, intangible, long-term values, such as improved public health or reduced levels of crime. Benefits like these are very important to

society but it is not easy to put a value on something as difficult to define as ‘better public health’. (CABE 2007) Consequently, environmental and other interventions to facilitate increased population physical activity through cycling and walking are likely to be amongst the ‘best buys’ across many areas of public policy, such as public health benefits, cost savings for health services and for transport planning. (Davis 2010) A first of its kind cost-benefit analysis for investments in bicycling by a US city shows that relatively modest investments of \$137 million in bicycling will produce health care cost savings of \$470 million by the year 2040. Investments in bicycle infrastructure and promotion should therefore be widely considered as a highly cost-effective measure to increase physical activity among Americans. (Gotschi PhD n.d.) An increased level of cycling could have a major beneficial impact upon public health through the reduction in the use of motorized transport; one of the main sources of atmospheric and noise pollution. “Millions of Europeans live in air pollution severe enough to cause each year thousands of premature deaths and many more chronically ill and disabled.” (World Health Organisation 2003)

To conclude, bicycle infrastructure has beneficial economic impacts on public health through direct and indirect means. Bike facilities provide a method for people to reduce the growing obesity rates with increased opportunities to exercise more often in a safe environment. A reduction in obesity can be linked to a reduction in health care costs to society. People who engage in more physical exercise have lower mental health occurrences. Reduction in crime has also been linked to improved bicycle infrastructure. The more people who bike will lead to fewer cars creating noise and emitting fewer pollutants into the air, resulting in a better environment for everyone’s health.

The environmental economic impact of non-motorized transportation has a great effect on many aspects of our daily lives but it is hard to know what is the true extent of that value. People are a commodity that is impossible to value. In the case studies portion of this paper, three case studies on the effects of society and health are reviewed in more detail regarding the health and societal effects of bicycle promotion and infrastructure. These case studies show how bicycle infrastructure increases bicycle usage, which then increases the amount of exercise society engages in, benefiting everyone with reduced health care spending.

Why people drive:

It is to be expected that most people will select the path of least resistance. When it comes to transportation, the majority of people will choose the means that delivers them to their destination in the easiest way. Easy would mean without harassment, quick, convenient, safe and the least expensive. Most infrastructures make the car the easiest way to get to a destination. One can leave in a car when one wants and a car provides protection from the elements. The cost of having a car is not rationalized on a trip-by-trip basis or considered as a distance-per-trip cost. When riding public transportation, one will be deterred by having to wait and pay a fare. Wait times, travel time, transfer time and the risk of safety also discourage the use of public transportation. Because sprawling areas are so thinly populated, they are essentially unserviceable by mass transportation. As a result, the automobile has become the primary mode of transport for people living in sprawling areas. (Embarq n.d.) Transportation infrastructure design should focus on designing a system to utilize the best means of transport for the given location and constraints. Many bicycle advocates are seen as car haters or have a single focus on transportation planning only for bicycles. It is understandable to a point, though, because for a cyclist, the perception is that every millimeter of space has been allocated to the car and drivers

want more and are unwilling to share or give up what they already have. Bicycle planning has been neglected in the past so there is a need for extra help to bring bicycle infrastructure back to a level of importance. With good transportation design, people can choose the best method to travel though the city.

In the largest urban areas, it is important to focus on cycling, mass transit and walking as a strategy for achieving greener transport. In smaller cities and towns, a primary focus on cycling and walking would be key in achieving greener transport. A bicycle's range is long enough to make it a suitable alternative to the car for short trips. (Norwegian Pubic Roads Administration May 2003)

Motorized traffic prevents a "natural" volume of walking and cycling to occur in urban areas. A "natural" volume of walking and cycling refers to the volume of walking and cycling that would take place if people were able to choose their mode of transportation according to their preferences in a situation where motorized traffic did not cause insecurity and other inconveniences. (Saelensminde 2004)



Bad design: Getting from Point A to Point B is much more difficult in sprawling areas. (Embarq)

Building for Cars, Not for People: Most sprawling areas are not designed according to a grid layout, which is the most efficient way to organize a city. Instead, developers have used curving roads as a selling point because they are said to evoke the feel of a winding country road. But with winding roads it is more difficult and time consuming for people to move from place to place. As the two maps above show, a routine two minute walk to the store in Washington, DC becomes a several minute car ride in suburban Maryland. Because sprawling areas are designed for cars, even the most basic tasks require them. (Embarq n.d.)

Any avid cyclist who is interested in promoting bicycle use will have found this research very interesting. One may find through personal experiences of reading and conversation in general that the people who are 'for' bicycles are generally 'anti' car and vise-a-versa. The data presented above can help to explain why there is such a great division between these two strongly opinionated groups. Resources are scarce and people want to move about freely without conflict. Economics play a large role in the design and perceived inequalities of the existing transportation

infrastructure. The infrastructure is built to accommodate the most prominent users and whichever would have the best economic outcome. The large power of the auto industry has made the automobile one of the most prominent methods of transportation in America and parts of Europe. The car is and can be a great method of transportation; however, the problem lies in the design of public space with the car as the primary benefactor. City planners and government officials need to be more conscience of their citizens and how car infrastructures affect their space. Due to the nature of a car, occupants have a different perspective of their environment than with other methods of transportation. When driving, there is a perception of being protected from the elements and the surroundings. One's perspective changes while driving with this perceived cocoon of protection. The extra feeling of protection can lead to the idea that drivers are superior or more important than other means of transportation.

People love and want to have cars for the freedoms that are inherent when using one. Having a car can allow one to leave when one wants and can get one safely to one's destination in a quick amount of time. However, it has become a 'one size fits all' method of transportation. The priority has been put on creating infrastructure for cars, which has created a neglect for other methods of transportation. This neglect is now making our cities' open spaces over-crowded with cars. People are conditioned to think it is always easier to get somewhere by car and no longer look for the most efficient means of transportation.

The street calming studies in part two of this paper will provide a look into the existing environment and how providing wider streets and car parking encourage people to use a car. The health and environment case study will demonstrate how the benefits to society are not realized because motorized traffic prevents people from biking and walking to the extent that they would prefer.

Economics:

Bicycle infrastructure spending effects all sectors of the economy. As shown so far, safe bicycle infrastructure creation increases the number of bicycle riders. Increased riders will reduce parking and congestion issues. The cost to build bicycle infrastructure is much less expensive per kilometer than automobile infrastructure. Public health is improved with increased exercise and pollution reduction, minimizing health care costs. More street activity due to increased cycling reduces crime, which in turn has a positive benefit to the local economy. With improved bicycle infrastructure, people are encouraged not to drive or spend money on fuel and other auto expenses, which in turn increases their ability to spend more on local goods that add more to the economy.

If one were able to choose the best-suited travel mode for each trip, the transportation system would experience an unprecedented force for efficiency, saving citizens billions of dollars in fuel costs and millions of hours of wasted time in congestion. In addition, investments in bicycle and pedestrian infrastructure would translate into direct savings for the federal highway trust fund by reducing the need for road capacity expansion projects, providing resources needed to repair and maintain our existing roads. (Gotschi PhD n.d.)

Cars cost cities money by needing to build and maintain the streets for driving and parking. In Eugene, Oregon, the average driver travels 10,000 miles in town each year and contributes \$324 in taxes and direct fees. The cost to the public, including direct costs and externalities, is a whopping \$3,360. (Seager 2010) When looking at the economic impacts, the cost to provide for

cars is often underestimated due to the perceived returns. On the opposite pole, someone who exclusively bikes may go 3,000 miles in a year, contribute \$300 annually in taxes, and costs the public only \$36, making a profit of \$264. To balance the road budget in Eugene, twelve people would need to commute by bicycle for each person who commutes by car. (Seager 2010) With the current economic times, it would be good for the economy with respect to tax benefits for Eugene in particular but all cities in general, to invest in bicycle infrastructure to receive economic gain.

A Norwegian study of three cities evaluated the economic impact of cycling on each city. It was found to make good socio-economic sense to facilitate more cycling. The Institute of Transport Economics calculated that investments in a continuous cycle path network will yield a net benefit of over three times the cost for the three towns studied, Hokksund, Hamar and Trondheim; an obvious beneficial effect compared with other transport investments. (Norwegian Pubic Roads Administration May 2003) The lower absenteeism along with reduced costs, for instance, for parking and transport to school, constitutes a saving of up to NOK 30,000 a year for every sedentary person who becomes a cyclist. For these societies, this means a daily saving of NOK 150 for each new bicycle commuter. This calculation is based on expenditures on traffic accidents remaining constant compared with the current situation, and assumes that the main cycle path network is fully developed. (Norwegian Pubic Roads Administration May 2003) Best estimates of future pedestrian and bicycle traffic leave no doubt that building walking and cycling track networks in Hokksund, Hamar and Trondheim is beneficial to society. Net benefit/cost ratios in these cities are approximately 4, 14 and 3, respectively. (Saelensminde 2004)

In fewer than six years in Seville Spain, the proportion of bicycle journeys went from 0.2% to 6.6% or from 2,500 to 70,000. Nearly twice as many people now ride a bike than ride the metro. “The bicycle is not a miracle to solve all your problems, but it is a cost-effective way to address many issues,” said Manual Calvo, the founder of Estudio MC, a consultancy. “The network is already used by more than 66,000 cyclists daily, and it only cost 32 million euro. Compare this with Seville’s single-line metro system, which carries 40,000 people per and cost more than €600 million, or the €6 million price of one kilometer of motorway. The cost-effectiveness of the cycling scheme is pretty impressive.” (Cyclingmobility, 2011)

Bike lanes are cost-effective to build and they pay rich dividends. Since 2006, New York City has spent \$8 million (5.8 million euro) building 250 miles (402km) of bike lanes. 200,000 daily bike rides equates to \$2.00 (1.50 euro) a year per cyclist, less than the cost of one metro ticket. (Samponaro, 2011)

Québec Canada has also seen a measurable impact of bicycle tourism on its economy. In 2000, province-wide spending by bicyclists totaled \$166 million. The Québec bicycle industry generated sales over \$181 million, supporting 2,800 jobs and generating \$17.2 million in tax revenues for Québec and \$13.6 million in national taxes. To draw tourists and encourage cycling, Quebec developed a network of 2,702 miles of bicycle paths and roadway routes called “La Route Verte”, which is touted as the “best bicycle route in the world.” In 2000, when only part of the route was completed, La Route Verte cyclists spent a total of \$95.4 million, corresponding to approximately 2,000 jobs and \$15.1 million in tax revenue for Québec and \$11.9 million for the Government of Canada. In 2005, bicycle tourists spent \$83 a day, more than other tourists’ average of \$66. (Velo-Quebec Association June 2006)

Bicycle infrastructure has proven to be a better economic investment than that of other forms of transportation modes. Experience in the UK shows that the benefits of improved cycling infrastructure are far higher than for other transport schemes, in relation to their cost. (Pedal Power Canberra Region Cycling 2007)



(Piedmont-Palladino n.d.)

Using the information from the American Automobile Association study of cost to own and operate an automobile (see graphic above), the economic benefits of bicycle use can be calculated. The numbers from AAA indicate that the average American spends \$8,485 annually on an automobile. Of that amount, only \$1,390 stays in the local economy. The rest, \$7,095 per vehicle, leaves the local economy. (Piedmont-Palladino n.d.) Having the money stay in the local economy will add more jobs and added benefits to the local residence.

Other studies have shown that investments in bicycle and pedestrian facilities can reduce carbon emissions and improve quality of life. Additionally, these investments can bring an additional benefit to the community; they are an important source of job creation. (Garrett-Peltier Dec 2010)

The research above has provided details of how infrastructure for bicycles makes valuable economic sense. People who do not have car expenses will have more money to contribute back into the local economy. Very few auto expenses remain within the local economy. Any money that does stay in the local economy can be used to create more jobs. The reduction in congestion from the creation of bicycle infrastructure could increase savings of billions of dollars in fuel costs. The average driver contributes much less in taxes for facilities used and a bicyclist pays more than the amount used creating a surplus. When planning for the future, the best means of transportation for each city, region, or society needs to be considered and infrastructure decisions should help dictate how people will move around. It would be hoped that if given the choice of safe and efficient bicycle infrastructure, people would choose to bicycle more.

Part 1 Conclusion:

Bicycle infrastructure is very complex, which causes its impact to be diverse. Spending on bicycle infrastructure has proven to be economically beneficial to the people that use the facilities as well as for the people who do not choose to use it. By creating an environment where people feel safe and comfortable riding a bicycle instead of driving a car, people are more likely to ride to destinations within a five kilometer radius. As more people start to bicycle, safety will increase purely because of increased numbers because there will be an increase in visibility and awareness to drivers. Having more cyclists also reduces congestion problems by reducing the number of drivers and the amount of space required to move people. Space is also freed up from the reduced requirements for car parking. With the creation of safe bicycle infrastructure, a community can establish a bicycle culture that will benefit the entire region. When people are not spending money on fuel and operating expenses for cars, they will have more money to spend within their local economy, such as dining out, housing, dry goods and entertainment. This type of spending stays in the community rather than going to auto manufacturers and oil producers. Other benefits include better air quality, better health, safer streets, lower maintenance costs, less expensive infrastructure costs, and more diverse annual personal income spending. Overall, the cost for bicycle infrastructure pays for itself with the increased quality of life for the citizens who are paying for it. The cost of bicycle infrastructure relative to costs for other transport modes demonstrates how bicycle infrastructure is less expensive, even if only a small percentage of people use it.

In order to present a complete analysis, the following case study reviews evaluate the topic of bicycle infrastructure and economic effects. The case studies are divided into three categories to clearly define the different approaches used to evaluate economic impacts. The first category covers urban infrastructure changes to improve bicycle safety and numbers. The second category is based on infrastructure spending made by regions to improve tourism by attracting people to bicycle. The final category examines the economic impact increased bicycling opportunities has on public health and environment. These studies show that bicycle infrastructure has proven to be good for all levels of the economy.

Part 2 – Case Study Review

It is very difficult to show direct cost benefits for bicycle infrastructure. There is not a specific user tax or formula to calculate the return on investment for bicycle facilities. The infrastructure provides a wide range of benefits to society and with very little direct quantifiable outcomes. To prove that bicycle infrastructure investments make good economic sense, several case studies have been evaluated to find out how bicycle infrastructure impacts the economy. Study groups have been broken into three sections. The first section will examine the economic impact of urban investment in street calming. The second section will consider the economic impact of regional investments in bicycle infrastructure for attracting tourists. The third and final section will analyze how bicycle use has economic benefits to society's health and environment. The purpose of reviewing these studies is to demonstrate that bicycle infrastructure not only makes economic sense for the people that use the infrastructure but to society as a whole.

1st Study - Street Calming:

To evaluate the economic impact of bicycle infrastructure changes in the urban setting, three case studies on street calming were reviewed. Street calming is an approach of reducing car speeds by

replacing traffic lanes and on-street car parking with bicycle lanes and larger sidewalks. This approach of creating bicycle friendly streets comes with concerns from governments and business owners due to the perceived reduction in customers and spending due to the lack of cars. The perception is that without cars retail revenues will be reduced because of a reduction of clients and spending. A European Commission study from 1999 proves that traffic calming is indeed beneficial. When traffic is calmed or restricted from certain areas to encourage walking or cycling, levels of retail activity are generally improved. This is demonstrated by significant increases in pedestrian flow, retail turnover and profits. A German study also supports these results, showing an increase in size of turnover from between 5 to 20% for the majority of locations studied. (European Commission, 1999, *Cycling: the way ahead for towns and cities*) Indirect economic benefits of street calming can affect safety, as quoted from Cycling England, “The visual reduction in road width created by the scheme has a significant traffic calming and safety benefit.” (Cycling England 2005) The city of Hull in the UK, where extensive use of traffic calming zones have been implemented, resulted in major road safety benefits. The £4.5m spent on traffic-calming resulted in £40m of savings in accident costs (Cycling England 2005).

The Jennifer Dill study from Portland State University showed how cyclists use bicycle facilities and they will make a special effort to use the bicycle-specific facility. She wanted to research how people use their bike for transportation and the importance of bicycle infrastructure. Ms. Dill used Global Positioning System to study 164 bicycles to find out if people searched out bicycle infrastructure or not. Dill then used the GPS information to track their trips and determine whether they were taking the shortest routes or intentionally choosing longer ones. Remarkably, the results showed that although only eight percent of city streets are equipped with any kind of bike infrastructure, 51% of trips were taken on them. To Dill, this meant that most riders seek out such routes, even if they are not the shortest. “People are going out of their way to use bike infrastructure,” Dill said. (Redden 2008) In conclusion, her study showed that if safe bicycle infrastructure is built, bicyclists will not only use it, they will specifically seek it out. Portland is using street calming as a method of creating locations that cyclists will seek out and encourage business growth.

In order to examine how effective street calming has worked in a variety of regions, streets around the world were selected as evidence of positive impact. Lygon Street in Melbourne Australia, Bloor Street in Toronto Canada, and Valencia Street in San Francisco United States of America have each made changes to achieve a community friendly street without forgetting about the economic value of the surrounding businesses.

Lygon Street, Melbourne Australia

“Recognizing the Economic Role of Bikes: Sharing Street Parking” by Alison Lee and Alan March

In Melbourne Australia, Alison Lee and Alan March wrote the article “Recognizing the economic role of bikes: sharing parking in Lygon Street, Carlton” after evaluating Lygon Street. Their purpose was to determine the economic impact of bicycle and car parking in relationship to public space. Public space is dominated by cars, specifically by their roadways and parking needs. The paper argues that, in some retail environments, de-emphasizing car parking in the public realm can produce greater economic success for retail stores and restaurant/cafes. An analysis was made of the economic implications associated with removing car parking and installing bike parking.

The location of the study was Lygon Street in Melbourne's inner northern suburb of Carlton. They selected that site for the high demand of both on-street parking and bike parking, as well as competition for pedestrian space and bike parking.



(Bicycle Victoria, 2009) *Lygon Street Before and After Bike Parking*

The historic shopping strip is made up of a mixture of land uses:

- Specialty retailing (such as clothing, homewards, bookshops)
- General retailing (such as supermarkets, grocery stores, butchers, news agencies)
- Cafes and restaurants (including some prominent establishments with regional catchments)
- Cinema and some small theaters

Research method used included an intercept survey were completed by 1023 visitors to Lygon Street. The survey asked:

1. What is your residential postcode?
2. What was the main mode of transport used to get here today? (Bike, car, foot, public transport)
3. How long have you already spent here?
4. How much longer do you anticipate spending here?
5. How much money have you already spent here today?
6. What is the main reason for your trip here today? (Cafe/restaurant, entertainment, grocery, shopping, services, work, other)

With this data, the authors evaluated the two complexities between the 'trip origin data' (where did the visitors' trip start) and 'expenditure data' (how much did the visitors spend). A desktop analysis of public space uses in Lygon Street was done using aerial photography and GIS measurement tools. This was done to understand the current allocation of public space to various uses:

- Pedestrians: footpaths
- Public transport: bus/tram stops, tram tracks
- Cyclist: bike tracks
- Cyclist: bike parking
- Car: car driving

- Car: car parking

With the data the research findings looked at:

- Amount spent by transport mode
- Public space allocated to transport mode

The data showed that people who arrived by car spent more per hour than those who arrived by bike. As previously discussed, car infrastructure accounts for the majority of public space. So how much of the space was actually paid with the extra spending by the car drivers? To get a comparison they looked at how much space a parked car took up versus that to a parked bicycle. The chart below shows that per square meter, bikes generate more revenue per hour than cars.

Mode	\$ spent per hour	Parking space measurement	*Hourly revenue generated per sq m
Bike	\$47	1.5 sq m	\$31
Car	\$65	13.0 sq m	\$6

*Based on car occupancy of 1.2 persons per car and bike occupancy of 1 person per bike. (Lee and March 29 June 2010)

Moving a car takes about 28 times the amount of public space that moving a pedestrian takes and 14 times the amount of space for moving a bike. Because space is so limited and hourly spending was calculated per square meters, the study illustrates that cars could be de-prioritized. Since some cars came from outside of the region, the authors suggested incremental replacement of car parking spaces for bike parking spaces. The goal would be to ensure that parking spaces become reprioritized at the same rate as cycling grows. The increase of pedestrians and cyclists on Lygon Street would create a greater density of people with the potential for greater revenues. Some venues, such as clothing stores, comparison goods shopping and food and drink business, received more customers by foot or bike than other venues, such as entertainment and grocery shopping, where it was more common for customers to arrive by car.

Increased bicycle parking, in addition to the removal of car parking spaces, was concluded to be a legitimate way to increase the economic impact of the public space available on Lygon Street.

Bloor Street, Toronto Canada

“Bike Lanes, On-Street Parking and Business” by Jennifer Forkes and Nancy Smith Lea

In the study “Bike Lanes, On-Street Parking and Business” from Toronto Canada, Jennifer Forkes and Nancy Smith Lea looked into how customers arrive to Bloor Street in Bloor West Village. This study was a follow up study to similar research conducted in the summer of 2008 in the Bloor Annex neighborhood. The study’s aim was to examine the allocation of space for an understanding of what would be best for the shopping corridor.

Currently, the allocation of street space along the Bloor-Danforth corridor is on-street parking. Merchants and residents are currently under the belief that on-street parking is vital to the economic success of business. Recent research studies suggested these beliefs have been overestimated. The removal of parking spaces for bike lanes and wider sidewalks could prove to be a better economic investment.

The surveys were designed to collect data about:

- The assumptions of Bloor West Village merchants about the modes of transportation used by their customers, and about the potential impact of changes in street use allocation to accommodate active transportation on their daily number of customers; and
- The modes of travel that visitors in Bloor West Village usually use to access the area, their consumer behavior in the neighborhood, and their preferences for different types of street use allocations on Bloor Street in the area.

Additional data about merchants' business types and visitors' postal codes were also collected. On-street parking capacity and private parking capacity in Bloor West Village were estimated during a site visit in February 2010, and municipal pay-parking lot capacity data were retrieved from the Toronto Parking Authority's website.

Conclusions about Bloor Street:

- Four out of five people surveyed do not usually drive to the area.
- Merchants overestimated the percentage of people who drive to Bloor West Village and yet more than half of merchants surveyed believed that reducing on-street parking by 50% and adding a bike lane or widening sidewalks would either increase or have no impact on their daily number of customers.
- People who arrived by public transit, foot, or bicycle visited Bloor Street more often in general and reported spending more money than those who drove.
- People who preferred to see street use reallocated for widened sidewalks or adding a bike lane were significantly more likely to spend more than \$100 per month than those who preferred no change.
- The majority of people surveyed (58%) preferred to see street use reallocated.

Valencia Street, San Francisco United States of America

"Economic Effects of Traffic Calming on Urban Small Businesses" by Emily Drennen

Researchers in San Francisco, CA, USA studied traffic-calming effects in the business neighborhood of Valencia Street, specifically how the addition of bike lanes increased the revenues of local business. The study investigated how traffic-calming changes made to the streets and sidewalks in an urban area made them safer, more attractive, and more livable and how this in turn affected the small businesses in the same area.



(Helquist, 2010) *Bike Lane Construction and Completion on Valencia Street*

The Valencia Street bicycle lanes project is a good example of how traffic calming has been implemented in the city of San Francisco. The neighborhood is primarily low-income and working-class with a combination of residential, mix-use and commercial zoning defined by the Mission Economic Development Association. The street is a very dynamic part of the Mission District and is used by pedestrians, buses, bikes and auto activity along its length. A merchant survey was used to determine the economic impact of the bike lanes to the local businesses.

Demographics:

- Population 60,583 people
- 30,355 people per square mile
- 36% of annual household incomes are less than \$25,000
- 83.9% of households are renters

Census data (MEDA, 1999)

Prior to the March 1999 bike lane installation there were two auto traffic lanes in each direction and on-street parking on either side of the street. The lanes were reallocated to be: on-street parking, bike lane, auto lane, auto turn lane, auto lane, bike lane and on-street parking.



Source: Sallaberry, 2000, p. 20

Prior to making these changes, the city of San Francisco's Department of Parking and Traffic (DPT) conducted an extensive community outreach program. They contacted every merchant on

the block and talked to all the neighborhood associations. The response was overwhelmingly positive for the bike lanes.

The following summarizes the economic perspective of the changes based on standard evaluators and survey results:

Property Values: Eight-five percent of merchants surveyed did not know or did not think the bike lanes had any positive effect on property values, but 44% credited the bike lines to economic revitalization. No one thought the bike lanes harmed the economic conditions.

Reducing Auto Speed: Traffic speed was reduced by 46% and traffic congestion was increased by 44%. Many merchants felt the increased congestion combined with the slowed speed was good for their retail business, because then more people could actually see their stores and would more likely decide to stop and shop.

More Walking and Biking Customers: There was a 63% increase in the number of cyclists and a 22% increase in pedestrians. The bike lanes now serve as a main north-south thoroughfare for bicyclists. Moreover, auto traffic declined by 10% while bike traffic increased by 144%.

Customer Parking: The construction on Valencia Street did not remove any car parking, making it understandable that 65% of merchants surveyed did not feel parking was impacted. However, 15% felt that parking became easier and 12% believed it had become worse.

Construction and Cost: Seventy-seven percent of merchants did not remember the construction and did not think it had any impact on their business. The project was almost completely funded by the city government.

Impact on Employees: The survey results indicated that 67% felt that the bike lanes provided an added convenience to their employees, and especially to those who rode their bike to work.

Summary of the General Impact on Business and Sales:

- 65% reported a positive impact on their business and/or sales
- 30% reported no impact on their business and/or sales
- One merchant had a slightly overall negative impact on his business
- 64% would be willing to support future traffic-calming projects

The Valencia Street bike lane project can be considered a success with the increased business and positive feedback from the business in the community. Of all the merchants surveyed, only one felt there had been a slightly negative impact due to the project.

Street Calming Conclusion:

The study methodologies used to research street calming are important for understanding how each study approached the problem of determining economic changes made due to the street calming changes. As with most bicycle infrastructure, the direct cost benefit of infrastructure spending is difficult to assess. It is important to note that the economic impacts were positive for all three studies. Businesses reported increased sales and more visitors linked to the changes

made to the environment. The value of these changes is proof that the investments these cities made in street calming have had positive economic effects on the streets in the studies.

Lygon Street Study: Revenue from people who arrived by bike generated \$31 per square meter of parking space vs. Revenue from people who arrived by car generated \$6 per square meter of parking space.

Bloor Street Study: Reallocated space to widen sidewalks or add bike lanes, which led to customers who were significantly more likely to spend more than \$100 per month.

Valencia Street Study: 65% of merchants surveyed reported a positive impact on their business and/or sales.

By calming traffic, car speeds were greatly reduced and added bicycle lanes made riders feel safe. The three studies reviewed above have proven that the changes made by having better bicycle infrastructure allowed businesses to witness an increase in business and sales. Once citizens were provided with appropriate facilities to ride and park their bicycles, they visited these locations more often, while also improving their health with more exercise. One would think that reducing cars could reduce the number of visitors because without cars they would not come. However, as these studies have proven, reducing the car volume actually resulted in businesses becoming more attractive because the environment was built for people, not cars. People were able to see the shops, cafes and restaurants as they biked or drove by slowly. When a facility is made more convenient and safe, people are more likely to employ it and choose to bicycle more often.

2nd Study - Infrastructure for Bicycle Tourism:



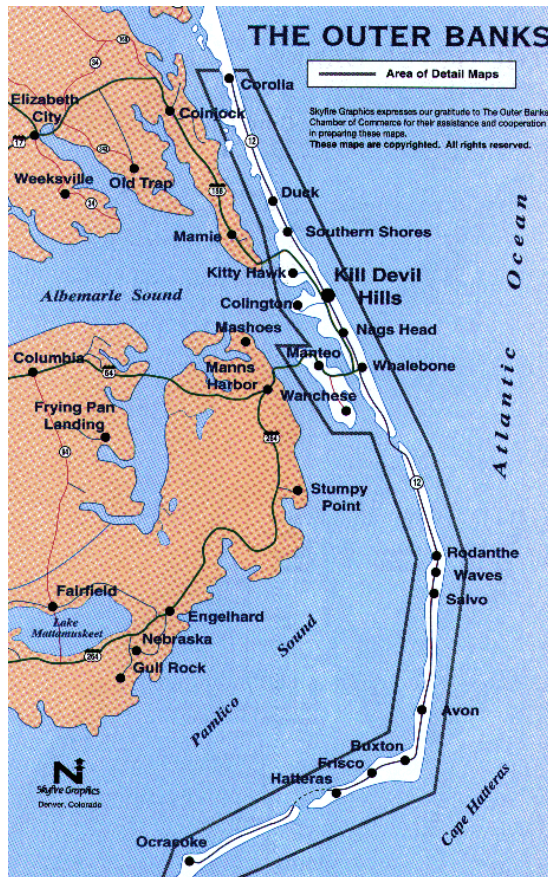
(Blue, 2010)

Many regions around the world have invested in bicycle infrastructure to promote tourism in their region. Once again, to obtain a more global look into the economic effects of bicycle infrastructure investments, three regions in three different countries were reviewed to verify whether the investments made were good economic choices for each region. Two of the regions selected are in mountain regions, Sea2Sky Canada and 7stanes Scotland, and the investments for both were made in mountain bike trails. The Outer Banks USA study was done in an ocean-side region, so the investments were made on paved bike paths. Tourism is a very large industry globally. There is great competition for cities and regions to attract tourists and their spending. To attract tourists to their regions, cities invest large amounts of money to assure that visitors will come and stay. The length of visitors' stay and how often they visit a region are good indicators of the success of investment. The longer the stay, the more money spent on lodging, food, gifts and entertainment. The three studies below researched how much revenue tourists bring into the economy. Just like other bicycle infrastructure investments, it is very difficult to see the direct correlation between investment and the return on investment. The studies needed to prove that

the visitors came and spent money in the region because of the bicycle infrastructure. The distance people traveled and how often they visited was also important to determine how much was spent during a visit. To provide background on bicycle tourism in the regions of study, the case studies have been summarized for each of the three regions. Following the summaries is a description of similarities and how the studies provide evidence of positive economic impact for bicycle infrastructure investments for tourism.

Outer Banks Study, North Carolina United States of America

“Pathways to Prosperity, The Economic Impact of Investments in Bicycle Facilities” by the N.C. Department of Transportation Division of Bicycle and Pedestrian Transportation, Technical Report July 2004



<http://allnews.com>

The North Carolina Department of Transportation Division of Bicycle and Pedestrian Transportation commissioned a study in the summer of 2003. The study was meant to provide information on the ten years of a \$5.9 million of federal/state investments and \$800,000 of construction costs for the towns of Nags Head and Duck that the Dare County Tourist Bureau made for bicycle infrastructure, making the total public funding for bicycling in the region \$6,685,000. Over the ten years, the region built an extensive system of facilities for bicycles. The Outer Banks of North Carolina are located on the coast of the Atlantic Ocean, from Corolla south to Nags Head and west to Manteg. This region attracts people to the ocean with many actives such as surfing and golfing. Because of all these various attractions, it was important for the study to determine the actual numbers of visitors who came for the bicycling.

A survey was created to evaluate visitors' activities and spending. The study was conducted by the Institute for Transportation Research and Education (ITRE) at North Carolina State University. Researchers surveyed bicyclists riding on the bicycle facilities, including on paths and wide paved shoulders, and also obtained data from self-administered surveys of tourists at three visitors' centers in the region. The survey was used to determine the nature of the bicycling activities in the area, specifically asking visitors for information about where and how often they cycled. This information, along with amount of money spent, provided the ability to determine an average amount that visitors spent per day. These figures were put into a computer model created at North Carolina State University to estimate the overall economic impact of bicycle infrastructures.

Because of the uncertainty of the exact number of cyclists and the true economic impact, the researchers created a high, mid-range and low estimates of impacts. The ranges were calculated by the methods described below:

High Estimate: Seventeen percent of visitors surveyed said they cycled at some point while on vacation. The Outer Banks attracts an estimated total of 4 million tourists annually. In order to estimate the total number of visitors who cycled in the Outer Banks regions, 17% of 4 million equals 680,000. However, in order to estimate how many visitors came to the region specifically to cycle, the number was reduced again by 15%, resulting in 102,000 bicycling-specific visitors annually.

Mid-range Estimate: The 102,000 bicycling-specific visitors were reduced by 25% to represent the respondents who also rated the bicycling in the area as 'high quality', which equals 40,800 bicycle visitors annually.

Low Estimate: The estimate of 40,800 was reduced by 25% to represent the number of respondents who would return to the region for its cycling.

The following data from the North Carolina State University economic model provides an idea of how much bicycle tourism added to the community:

Number of Cyclists	Annual Economic Impact	Estimated Number of Riders	Number of Jobs Created
High Estimate	\$149 Million	102,000	3517
Mid-range Estimate	\$60 Million	40,800	1407
Low Estimate	\$15 Million	10,200	352

To summarize the economic impact for the Outer Banks region, the amount spent relative to the amount returned illustrates the benefit. The estimated expenditure of \$6.7 million compared to the mid-range estimate of \$60 million annually provides an estimated return on investment of just under 9% annually. The results of the study further determined that investment in bicycle infrastructure would continue to create a high return on investment.

Sea to Sky Study, British Columbia Canada

“Sea to Sky Mountain Biking Economic Impact Study” by the Western Canada Mountain Bike Tourist Association



<http://rbcgranfondowhitler.com>

The Sea2Sky study was conducted as a pilot study by the Western Canada Mountain Bike Tourism Association to quantify the mountain bike tourism economic activity during June 4 to September 17, 2006. There was a need for quantifiable data to demonstrate the value of trails and infrastructure investments for mountain bicycling. The Sea2Sky Corridor is located north of Vancouver on the southwest coast of British Columbia. The study included the North Shore, Squamish and Whistler communities. These three areas attract different types of riders. The “Shore” is known for the most challenging free-ride terrain; Squamish for the large number and diverse cross-country trails and free-ride trails; and Whistler features both cross-country trails, along with Whistler Bike Park that includes 44 lift-accessed downhill trails for all levels. Along with the trails, the areas host several bike related events, including the Test of Metal cross-country race and Crankworx Freeride Mountain Bike Festive in Whistler.

The residents believe that mountain biking adds considerable benefits to the community. The trails provide a venue for an active healthy lifestyle. This is one of the reasons for the increased desire to live in the area. Tourism is the main economic provider for the community with mountain biking in the summer and skiing in the winter. Like most tourist areas, there is more than one activity in the region, creating a challenge to determine the exact amount of revenue

generated from a specific activity. Without fees to use the trails, there is no direct link to rider numbers or revenue provided.

In this region, the mountain bike season is considered from June 1st to September 15th. To determine the number of riders and the economic impact, the study calculated the per week estimate of riders on each trail and multiplied that by the number of weeks in the season. The surveyors worked in shifts to count the number of riders that passed them. They were unable to count the numbers of visitors at the Bike Park, so they relied on the data provided by directly from Whistler Bike Park.

Weekly Intercepts	North Shore	Weekly Intercepts	Squamish	Weekly Intercepts	Whistler
Location	Est. Riders	Locations	Est. Riders	Location	Est. Riders
Cypress	5,145	Alice Lake	2,130	Rainbow Prk	4,590
Mt. Highway	5,985	Garibaldi Rd.	2,055	Comfortably	3,630
Old Buck	7,200	Perth	2,115	Function Jct.	2,175
Riverside	7,500	Plunge	1,215	Lost Lake Tr.	15,315
Total	18,660	Sorca Shelter	1,410	Bike Park**	76,671
		Total	8,910	Total (Trails)	25,695

** Whistler Bike Park rider volume provided by the WBP.

A survey of riders and their parties was used to determine an estimate of the percentage of true tourists.

Origins of Non-Resident Riding Parties, Squamish and Whistler

	Squamish	Whistler Valley	Whistler Bike Park
Greater Vancouver	69%	28%	18%
Sea to Sky Corridor	10%	3%	0%
Other BC	8%	9%	13%
Other Canada	6%	10%	10%
U.S.	8%	34%	41%
Overseas	8%	18%	22%

*Note: To accommodate mixed-origin parties, the surveyors allowed multiple responses, so the totals sum greater than 100%

Origins of Resident & Non Resident Riders, North Shore

	North Shore
North Shore	33%
Vancouver	29%
Burnaby/New Westminster/Port Moody	10%
Coquitlam/Port Coquitlam/Pitt Meadows/Maple Ridge	4%
Surrey/Langley/Whit Rock	4%
Richmond/Delta/Tasawwassen/Ladner	3%
Outside GVRD (eg Abbotsford)	5%

Sea2Sky Corridor	2%
Other BC	2%
Other Canada	3%
U.S.	5%
Overseas	2%

Upon review of this data, the researchers concluded that just 12% of the North Shore bikers were true tourists.

The following table was used to determine the average amount of spending per user, by user type:

Location Type of trip (Num of resp.)	North Shore Same day/Overnight (325) (32)*		Squamish Same day/Overnight (83)* (22)*		Whistler Valley Same day/Overnight (10)* (92)		Whistler Bike Park Same day/Overnight (13)* (103)	
Accommodation	\$0.00	\$292.81	\$0.00	\$95.72	\$0.00	\$629.57	\$0.00	\$576.14
Restaurant/Pub/Night Club	\$26.02	\$206.47	\$42.40	\$93.58	\$38.00	\$333.73	\$170.00	\$566.45
Groceries/Other F&B	\$7.05	\$56.09	\$6.66	\$89.61	\$3.50	\$105.08	\$0.00	\$153.44
Bike Park	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$230.38	\$384.33
Rec & Ent	\$1.45	\$8.59	\$3.57	\$19.00	\$0.00	\$81.97	\$0.00	\$72.85
Bike Shop	\$39.77	\$242.38	\$184.21	\$109.35	\$167.50	\$58.81	\$26.54	\$180.16
Other Shopping	\$3.67	\$40.63	\$0.90	\$28.05	\$30.00	\$116.26	\$8.08	\$78.72
Own Vehicle expenses	\$17.06	\$23.13	\$23.73	\$74.36	\$18.60	\$32.76	\$6.92	\$32.93
Rental Vehicle	\$1.23	\$56.25	\$0.00	\$0.00	\$0.00	\$36.07	\$0.00	\$57.36
Local Transport	\$0.47	\$21.88	\$0.00	\$0.00	\$7.00	\$2.32	\$0.00	\$9.30
Other Spending	\$0.69	\$12.19	\$3.73	\$8.18	\$	\$16.37	\$0.00	\$47.02
Total Per Party	\$97.41	\$963.41	\$265.21	\$517.85	\$234.60	\$1,296.70	\$433.85	\$2,080.1
Avg Party Size	2.5	3.2	2.9	3.0	2.8	3.1	4.4	3.2
Avg Nights		6.3		3.2		4.5		5.0
Avg spend per person per day	\$39.12	\$48.32	\$92.09	\$53.94	\$83.79	\$93.48	\$98.95	\$133.13

*Caution: small sample

Two additional surveys were used to cover the large events in the region, the Test of Metal (June 17) in Squamish and the Crankworx Festival (July 22-30) in Whistler. The Test of Metal had five surveyors completing 250 spectator surveys during the event. Of the people surveyed, 152 or 61% were non-residents. With the help of Tourism Whistler during the Crankworx Mountain Bike Festival, a total of 669 people agreed to participate in the survey and 487 people completed the entire survey. The volumetric estimates by Tourism Whistler concluded that over 55,000 unique visitors attended one or more of the Crankworx events during the nine day period of the festival. To create an accurate estimate of the visitors at the events, the researchers used the response of 8 or better on a scale of 1-10 on the importance of the event on their visit. Based on this criterion, 42% of visitors went to Whistler specifically for Crankworx, resulting in a total of 23,491 attendees from 7,142 visitor parties.

	Total Sea2Sky	North Shore*	Squamish	Whistler	Whistler Bike Park	Crankworx
Initial	\$10,323,600	\$2,044,212	\$1,674,046	\$6,605,34	\$16,236,267	\$11,957,48

Expenditures				2		5
Total GDP	\$9,334,321	\$444,858	\$1,474,006	\$1,003,081	\$18,823,005	\$13,440,190
Total Wages and Salaries	\$6,345,036	\$301,530	\$1,003,081	\$5,040,425	\$12,784,971	\$9,150,157
Total Jobs	194.8	9.6	30.0	155.2	384.1	268.0
Total Industry Output	\$20,434,585	\$1,049,191	\$3,590,666	\$15,794,728	\$3,846,213	\$3,039,433
<i>Taxes</i>						
Federal	\$2,172,327	\$106,762	\$359,468	\$1,706,097	\$3,267,614	\$3,039,433
Provincial	\$1,763,772	\$100,301	\$212,897	\$1,450,574	\$3,264,615	\$2,610,233
Municipal	\$624,267	\$14,970	\$175,818	\$430,479	\$944,861	\$730,777
Total Taxes	\$4,560,365	\$225,033	\$748,183	\$3,587,149	\$8,055,689	\$6,380,433

To conclude, the data provided by the STEAM Pro computer model of economic effect showed that mountain biking added \$35 million into the community during the summer of 2006.

Initial Expenditures	\$36,473,140
Total GDP	\$35,185,140
Total Wages and Salaries	\$19,139,157
Total Jobs	846.9
Total Industry Output	\$24,280,798
<i>Taxes</i>	
Federal	\$8,479,374
Provincial	\$7,638,620
Municipal	\$2,296,905
Total Taxes	\$18,996,487

7stanes, Scotland

“7stanes Phase 2 Evaluation” by the Report of Forestry Commission Scotland



<http://onthelimit.org>

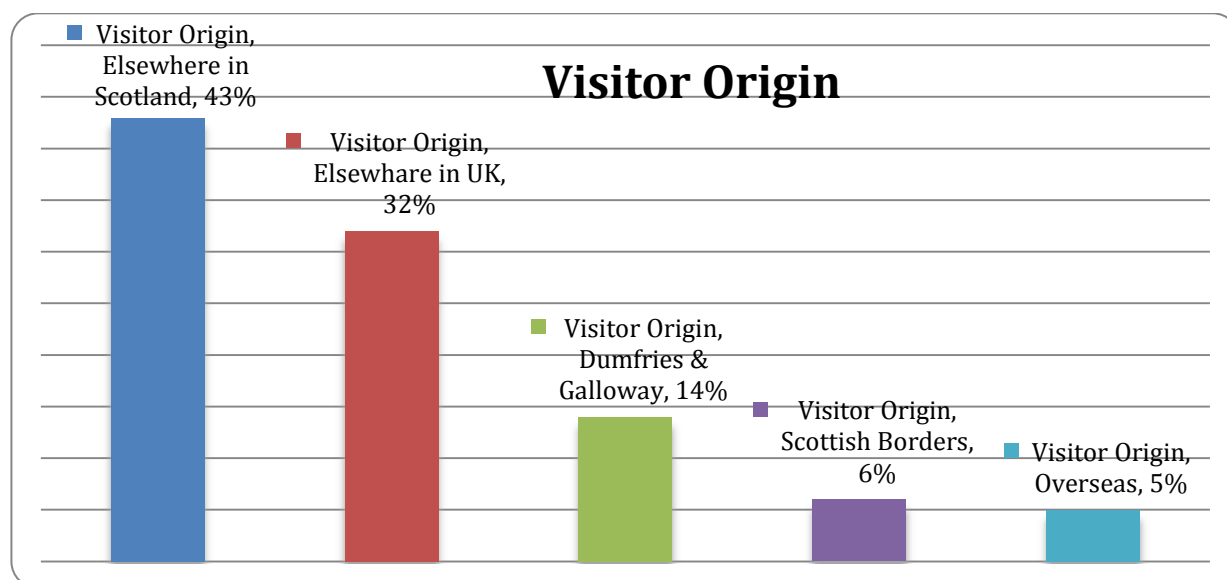
The 7stanes area consists of seven mountain bike centers in the south of Scotland. The centers are Glentroll, Kirroughtree, Dalbeattie, Mabie, Ae, Glentress & Innerleithen (Tweed Valley), and Newcastleton spanning from the heart of the Scottish Borders to Dumfries and Galloway. The Scottish Forestry Commission has invested in mountain bike facilities since 2001. The 2006 study was part of a second phase to determine the economic effectiveness of the investments made and to determine if further investments were needed. The goal of the complete project was to create a world class tourist destination that would attract visitors from around the world to benefit the economy. Like all bicycle infrastructure investments, it was quite challenging to isolate the economic impact of cyclists in a region. Phase 1 was evaluated by EKOS and the Tourism Resources Company in 2004 and Phase 2 during 2007.

The surveys undertaken consisted of 531 face to face surveys of mountain bikers from September to October 2007. The chart below contains the number, location and percentage of survey by area:

Location of Interviews		
Location	Number	%
Ae	39	7
Dalbeattie	101	19
Glentress	143	27
Glentroll	17	3
Kirroughtree	79	15
Mabie	112	21
Newcastleton	40	8

With the information from the riders, the surveyors were able to determine the visitors' origins. The results proved that 80% of the visitors were from outside of the South of Scotland borders.

Of these visitors excluding the residents of the South of Scotland, only 12% were visiting for the first time.



Importance of Mountain Bike Trails (excludes residents of South of Scotland)		
	Number	%
Only reason for visiting South of Scotland	330	78
One of the main reasons for visiting South of Scotland	62	15
One of several reasons for visiting South of Scotland	17	4
Not a factor in decision to visit South of Scotland	16	4

The survey asked visitors about the duration of their stay and the type of accommodations used. Sixty-nine percent of the riders planned to spend one day on the trails and 16% planned to spend two days on the trails. Fourteen percent were planning on spending three or more days, with 'more days' ranging from seven to nine days. The overall average for the days on the trails came to 1.5 days. To compliment this information, visitors were asked where they stayed. One third of the visitors were staying at least one night and 20% of them stayed at a hotel. Nineteen percent stayed with friends or relatives, 16% in a hostel, and the remaining 7% camped.

Concerning the quality of the trails, nearly 80% of the visitors responded they were likely to return in the next three years and 18% likely to visit again in general. The visitors' response of 2% who said they would be unlikely to return is a good indicator that the quality of the trails is very good. Since word of mouth is the regions primary way for people to learn about the region, these numbers look exceptionally good. In 2004, 68% of visitors rated the trails as very good and in 2007 that number increased to 75%. This further indicates that the investment in infrastructure is being noticed. The majority of visitors noted that the mountain bike trails were their sole reason for visiting the area. The 2007 study also showed that the number of visitors' overnight stays increased by 37% over the 2004 study.

Once the information about who was visiting, where and how long they stayed had been determined, the average amount spent per type of visitor in addition to how many visitors there were, resulted in the Gross Expenditure.

Average spent daily per person by visitor type	
Day visitor	In British Pounds
South of Scotland	5.91
Elsewhere in Scotland	10.61
Elsewhere in UK	13.94
Overnight Visitor	
Scotland	30.54
Elsewhere in UK	44.08
Overseas	42.46

Average Length of Stay		
	South of Scotland	Scotland
South of Scotland	2	2
Elsewhere in Scotland	2	2.1
Elsewhere in UK	2.9	3.6
Overseas	4.8	7.5

Gross expenditure was calculated as follows:

$$GE = dv.ndv + ov.l.nov$$

Where GE	=	gross expenditure
dv	=	average daily expenditure of day visitors
ndv	=	number of day visitors
ov	=	average daily expenditure of overnight visitors
l	=	average length of stay
nov	=	number of overnight visitors

Gross Expenditure: British Pound		
Visitor Type	South of Scotland	Scotland
Day Visitors	2,403,190	2,403,190
Overnight Visitors	6,775,990	8,681,905
Total	9,179,180	11,085,095

Adjustments were made to remove the amount of spending that would have been made if visitors had not visited the trails. The Scottish Tourism Multiplier Study (STMS) provided a standard supplier and income multiplier for the tourism sector. The table below indicates how the Net Additional Expenditures was calculated, along with the addition of Gross Value Added per employee within the tourism industry (18,200 pounds) multiplied by the number of full time employees.

Net Additional Expenditure: British Pound		
	South of Scotland	Scotland
Gross expenditures	9,179,180	11,085,095
Less non-additional expenditures	0	0
Less displacement	2,141,864	6,252,918
Net Direct expenditure	7,037,316	4,832,177
Plus multipliers	1.32	1.57
Net additional Expenditure	9,289,257	7,586,518
GVA per employee in tourism industry	3,723,887	4,140,169
Total Estimated Expenditures	13,013,144	11,726,687

To determine the economic benefit to the South of Scotland region, a formula was used to create a value for Gross Value Added (GVA). The formula consisted of: the GVA (18,200) per employee within the tourist industry multiplied by the full time equivalents (FTE) to determine the net additional gross value.

- 3,723,887 pounds at the South of Scotland level
- 4,140,169 pounds at the Scottish level
- 7,864,056 pounds Gross Value added
- 3,683,562 pounds Spent
- 4,180,494 pounds increase in 7stanes economy

Tourism Conclusion:

All three studies of regional bicycle infrastructure investments reviewed in this paper have demonstrated an increase of economic activities in a positive way. These studies on tourism define the importance of visitors' distance traveled to their destination. How far people travel to visit the destination is a good indicator of the amount of revenue brought into the region. People who travel from greater distances tend to stay longer and spend more money, in hotels, restaurants, transportation, and retail; whereas people using the facilities from within the region do not bring any new revenue into the community. Bicycle infrastructure designed for tourism has proven in these studies that it results in great returns on the investment.

Outer Banks – \$60 million in annual revenue on a \$6.7 million initial investment

Sea2Sky – \$35 million into the community during the summer of 2006

7stanes – 7.8 million pounds returned on a 3.6 million pound investment, resulting in an increase in the economy of 4.2 million pounds

Investment in bicycle infrastructure is a viable method of increasing bicycle tourism and generating more revenue for the community.

Biking allows tourists to experience all a community has to offer. On a bike, one is able to move through a city and countryside at a pace where one can truly enjoy the scenery, with the ability to stop to take pictures and smell the flowers. The speed of a bike allows more ground to be covered than walking, but environment can still be thoroughly experienced. For example, the bicycle infrastructure in London UK is very impressive. Such a large and busy city has made it very comfortable to ride a bike. The Cycle Hire bicycles make it easy for a visitor to use a bike and ride around the city. With so many bike lanes all over the city, road priority is provided to cyclists and their safety. Seville Spain is one of the largest tourist destinations in Spain and tourism is a crucial component of the economy. The bicycle share system provides access to many bikes and the car free streets made it a safe place to ride a bike. Both London and Seville have welcomed bicycles and have demonstrated an understanding of the benefits of bicycles for transport and tourism.

When one bikes, one travels at a speed that allows observation of all the actions in the surroundings. One becomes part of the city or country in which one is traveling. In April, Victor visited Paris for the first time and spent a couple days in the city traveling around only by metro or on foot. Then he used the bike share program, Velib, and rode around the city. His eyes lit up in amazement at how his perspective of the city changed. Locations seemed to make more sense when traveling by bike; using the metro system was almost like arriving at a new location after simply closing one's eyes, with no idea of how the arrival occurred.

By investing in bicycle infrastructure for tourism, the regions in these studies have proven economic benefits in the economy by increased visitor spending. Even with these great returns on investments, the results to the communities are far greater. The people in the communities are safer which means less risk of injury due to accidents. Public health also improves with reduction of car pollutants and people getting more exercise going by bike. When more people are on bicycle they are occupying less space that leads to less traffic congestion. As proven by these studies, the relatively low cost of bicycle infrastructure and the large return on investment indicates that bicycle tourism is ideal for regional economies.

3rd Study - Health & Environment:

To round out the case studies for this paper, health and environmental impacts from bicycle infrastructure was studied. These studies looked at the economic advantage of using the bicycle for transportation for commuting to work and other trips made by bike. A Vienna Austria study examined the "Cost of Bicycle Traffic for the Overall Economy," which focused on internal and external costs of bicycles versus car costs. A Portland Oregon study researched the health care benefits of having a healthier society due to increased bicycle use because of improved bicycle infrastructure. Finally, a Norwegian study investigated the effects of pollution health that can be prevented with reduced car use by promotion of bicycle infrastructure.

Vienna Austria Health Study

"Cost of Bicycle Traffic for the Overall Economy" by Michael Meschik and Gregor Trunk, Institute for Transport Studies, BOKU Vienna

Meschik and Trunk's research compared the economic effect of bicycle and car traffic in the city of Vienna Austria in 2009. Their report included the 'internal costs' (paid by the respected user of each specific mode) and 'external costs' (not paid by each user but by the general public) and identified and calculated both modes of transport.

Indicator (€-ct/km)	Internal		External		Total	
	Bicycle	Car	Bicycle	Car	Bicycle	Car
Health	-	-	89.89	-	89.89	-
Noise	-	-	-	<1.02>	-	<1.02>
Accidents	<6.26>	<1.44>	<8.42>	<1.85>	<14.71>	<3.29>
Running Cost	<10.20>	<38.30>	-	-	<10.20>	<38.30>
Travel Time	<66.53>	<54.29>	-	-	<66.53>	<54.29>
Pollutants	-	-	-	<0.63>	-	<0.63>
CO2	-	-	-	<0.85>	-	<0.85>
TOTAL	<83.02>	<94.03>	81.47	<4.35>	<1.55>	<98.38>
DIFFERENCE Bicycle-Car	<11.01>		85.82		<98.38>	

Using these numbers, Trunk was able to determine that the overall surplus to the economy was €0.90 per kilometer for bicycles. Extending this data to the amount of kilometers traveled per year in Vienna by automobile mode of transportation cost €35.4 million to the people.

Portland Oregon, United States of America Heath Study

“Cost and Benefits of Bicycling Investments in Portland, Oregon” by Thomas Gotschi 2011

Thomas Gotschi’s study “Cost and Benefits of Bicycling Investments in Portland, Oregon” evaluated the theory that bicycle infrastructure investments have great potential to increase overall physical activity and also researched the amount and effectiveness of investment needed for said infrastructure. The objective of the study was to assess how Portland’s past and future plans for investments in bicycling related to health and other benefits. Portland is thought to be one of the most bicycle friendly cities in America. The city has three investment plans that are compared with two types of monetized health benefits, health care cost savings and value of statistical life savings. Bicycling levels were estimated by using past trends, future mode share goals, and a traffic demand model. A benefit-cost ratio was used to determine the health care and fuel savings based on a statistical value of a human life. This cost-benefit analysis of investments made for bicycling in an American city showed that such efforts were cost-effective, even when only a limited number of benefits were considered. The information obtained from such cost-benefit relationships would help justify the construction of new initiatives.

The study provided a cost-benefit analysis for an urban bicycling network in Portland. The analysis was possible thanks to nearly twenty years of investments and growth in bicycling, but also by the availability of long term data, which was unique for a US city to document the impact of investments. With no methodology available to predict future developments in bicycling, analysis were based on three different bicycle plans by the city of Portland. An economic analysis evaluated health related aspects of past and planned developments in bicycling and provided an evaluation of three purposes: 1) presentation of empirical findings, 2) economic evaluation of existing planning scenarios, and 3) discussion of methodological issues that came with the comparison of investment costs to health benefits of bicycling. The health benefits obtained from increased bicycling were compared by using the past and future costs of investments in bicycling in Portland Oregon. Portland currently has the highest bicycle mode

share in the US, with 6.4% of commuter trips on bike. In 2008, the city of Portland estimated it would cost \$57 million to rebuild its 274-mile bikeway network. Additionally, at an estimated cumulative cost of \$7.2 million through the year 2012, the city initiated the Smart Trips program in 2003, which encouraged bicycling, walking, and use of public transportation.

The city of Portland estimated future bicycle investments based on three different plans:

- Basic: A \$100 million plan proposed the renewal of the federal transportation bill, which was due in 2009
- 80%: A \$329 million plan would put 80% of residents within a quarter mile of a developed bikeway
- World Class: A \$773 million plan would provide the most complete investment

All three of the Portland investment plans would include trail sections, bicycle boulevards, traffic calmed streets, cycle tracks, bicycle and pedestrian bridges, improvements and maintenance of existing infrastructure, continuation of Smart Trips, and several additional projects.

Assuming an average cyclist rides at a speed of ten miles-per-hour, miles of bicycling can be converted into minutes of physical activity. Savings in health care costs were estimated at \$544 by achieving a sufficient level of physical activity based on thirty minutes of moderate physical activity, as recommended by the Centers for Disease Control and Prevention.

Gotschi reviewed three studies to help describe the benefits of bicycling. In order to estimate the health care cost per inactive person, Gotschi used the estimated cost of \$24 billion (as estimated by two different reviews conducted by Colditz and Wang), divided by the total US population of the year, divided by 0.75 to adjust for the proportion of adults, and divided by 0.48 to adjust for inactive people. Health care costs attributable to inactivity from these three studies were \$330 in 1987 (Pratt, Macera, & Wang, 2000), \$257 in 1996 (Colditz, 1999), and \$231 in 2001 (Wang, Pratt, Macera, Zheng, & Heath, 2004). (Estimates are inflated to 2008 prices and result in a final average estimate of \$544.) Estimates for health care cost savings in the three studies were \$305 (Colditz, 1999), \$421 (Wang, Pratt, Macera, Zheng, & Heath, 2004), and \$907 (Pratt, Macera, & Wang, 2000) for an active person, compared with that of an inactive person. Because monetizing health benefits from bicycling, or any specific physical activity in general, is difficult, the benefits from bicycling as described in these studies were based on health care savings from physical activity in general.

Health care costs have traditionally increased faster than other consumer goods. With the assumption that health care costs will increase at a rate of three percent higher than inflation, by the year 2040, health care savings will increase to \$300 million to \$400 million from bicycling.

Table 1 Key Figures and Results for 3 Investment Plans for Bicycling in Portland
(Dollar Figures are in Millions of 2008 Dollars)

	Basic	80%	World Class
Investment costs (after discounting; incl. past)	\$138	\$296	\$605
Projected mode share by 2030	15%	20%	25%
Max. annual bike miles (2030–2040)	86M	116M	145M
Max. daily bike trips (3km trip length)	60,000	80,000	100,000
Cumulative bike miles 1991–2040	2200M	2800M	3400M
Cumulative health care savings 1991–2040	\$388	\$491	\$594
Cumulative fuel savings 1991–2040	\$143	\$180	\$218
Cumulative net benefits 1991–2040	\$394	\$375	\$207
Year to break even	2015	2015	2032
Annual lives saved (1991–2040 average)	42	55	68
Annual value of statistical lives saved (1991–2040 average)	\$147	\$196	\$245
Cumulative value of statistical lives saved (1991–2040)	\$7,350	\$9,800	\$12,250
Benefit-cost ratio for health care + fuel savings	3.8	2.3	1.3
Benefit-cost ratio for value of statistical lives saved	53.3	33.1	20.2

The chart above quantified the estimated healthcare savings and benefits for proposed bicycle infrastructure in Portland. The results of the study provided a detailed breakdown of the estimated average amount of lives saved from 1991 to 2040: 42, 44, and 68 respectively for each of the three proposed plans.

Australia and Norway Studies

Studies from Australia and Norway on motor vehicle costs to the environment provided data to prove that pollutants are costing society greatly. The Australian study evaluated how poor air quality from motor vehicle emissions has had an effect on public health. The Norwegian study discussed the impact cars have on providing an unsafe environment that discourages cycling and which adds to the air and noise pollution. Both of these studies prove that pollutants from cars can be avoided by the increasing the bicycle mode share. The increase in bicycle use will provide societal economic saving by providing cleaner air, which in turns promotes better public health. Better public health will lead to reduced public health spending.

Motor vehicles are a major contributor of air pollutants, accounting for well over half the emissions of nitrogen oxide, carbon monoxide and almost half the emissions of hydrocarbons in Australia each year. Motor vehicles are also the main source in cities of sulphur oxides, volatile organic compounds and particulates. Air pollution has been reported as being responsible for more deaths among Australians than road accidents: each year on average 2,400 of 140,000 Australian deaths are linked to air quality and health issues, much more than the 1,700 people who are killed in crashes. (Air pollution 'bigger killer than road accidents', Sydney Morning Herald, March 2, 2004) The results of a complete cost–benefit analysis in Norway made it possible to calculate the benefits to society that are not realized because motorized traffic prevents people from bicycling or walking as much as they otherwise would prefer. These “barrier costs” attributable to motorized traffic are estimated to be of at least the same magnitude as air pollution costs and more than double the noise costs. Barrier costs should therefore be taken into account in the same way as other external costs, when the issue is to determine the

proper level of car taxes or to evaluate different kinds of restrictions on car use. (Sælensminde, Norwegian Institute of Transport Economics, 2004)

Health Care Conclusion:

The health impact of bicycle infrastructure can help reduce healthcare costs and the growing obesity rates in western society by promoting exercise and better health. Society experiences economic benefits and the environment improves with the reduction of pollutants from better bicycle infrastructure and increased bicycle use. Society saves on health care costs by improved health of, citizens, resulting in extended lives, reduced accidental injuries and better mental health overall.

Conclusion:

This paper has aimed to show how bicycle infrastructure affects the economy at many levels. The research has shown that improvements to bicycle safety through infrastructure investments have positive economic impacts. These impacts are seen in street calming methods that have improved businesses in several neighborhoods. Safety in general has shown to increase bicycle use which benefits everyone with improved public health and environment.

As demonstrated, appropriate and high quality infrastructure is key to creating a substantial increase in bicycle mode share. Bicycle infrastructure needs to be more than painted lines on the roadway. Separation from other modes is critical to the success of bicycle rider numbers. Bikeways need to be safe enough for parents to encourage their young children to use. When a city is designed to include people on bikes from ages six to eighty, the economic benefits are far greater than the investment.

The research on street calming provided data indicating that reducing car parking does not result in a reduction in visitors if bicycle facilities are made available. Parking and congestion can be reduced more effectively and with less cost with bicycle infrastructure. Every bike on the road is one fewer car at a stoplight and one fewer car taking up a parking space at the store or on the street. Fewer cars equal less congestion. Investments made in bike infrastructure are above all the best method of improving all forms of transportation.

Bicycle infrastructure has proved to be more effective and less expensive in cities around the world. The cost to build bicycle facilities can be pennies on the dollar compared to the cost for building other modes of transport. Spending on bicycle infrastructure for tourism, for example, cost much less than the immediate investment. Bicycle infrastructure could essentially be free thanks to the savings on health care it can afford.

Street calming and public health studies showed that increased bicycling has positive economic outcomes to the society. People have more money to spend when they do not have to put pay so much in health care. Businesses do better when people visit more often. Increased life expectancy along with accident reduction statistics have resulted in added savings to the economy.

People drive because it has been made to be so convenient, yet by altering the street infrastructure with street calming methods, people are more encourage to bike. When the built environment is designed for bicycles, people will get out of their cars and ride bikes. When there are less people driving, there is more money available for the local economy.

The economic impacts from the street calming study proved that wider sidewalks and bike lanes increased customer visits and spending by more than \$100 a month. Merchants witnessed a positive impact to their business and sales. People who arrived by bicycle tended to visit more often, which related to greater spending.

Tourism yielded impressive returns on investments from providing facilities for bicycle tourists, adding significantly to the regional economy. Bicycle tourism can be a gold mine for increasing revenue into the community. The North Carolina study showed nearly ten times the return on the initial investment.

Infrastructure investments to encourage cycling as transportation have proven to positively impact public health. Reduction of obesity and air pollutants expands life expectancy and reduces health care spending. The savings on health care spending are a large contributor to a society's economic prosperity.

All the studies reviewed in this paper have proven that investments in bicycle infrastructure from urban settings to society in general are cost effective and good for the economy.

As a result of the research for this paper, the concept of parking and how it affects all methods of transportation in cities would be an interesting future topic of research. When parking is abundant, the amount of car traffic increases and building density decreases. By making small but strategic changes to parking rates, demand is then affected: as rates increase, demand decreases. Too much parking has the same adverse effect as not enough parking. Determining the ideal number of spaces and prices to achieve the optimal outcome is very challenging.

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Additional Research:

Attended the following:

- Polis 2010, Dresden Germany, November 2010: European Transportation Planning Conference

- ASAP Symposium, Amsterdam The Netherlands, February 14 – 18 2011: University Amsterdam Student Planning Study
- VeloCity2011, Seville Spain, March 23 – 25 2011: Bicycle and urban planning, European Cycling Federation
- Niches, London United Kingdom, April 7 2011: European Transportation Planning Conference

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Année 2011

Summary:

This paper aims to prove that bicycle infrastructure and safety of design actually pays dividends, many times more than the little investment initially required. Furthermore, the increase in the revenue into the economy may come from increased mobility in an urban setting, increased tourism in a regional environment or improved public health benefiting society. Most city bicycle infrastructure has been either designed for the car or adapted for car-dominated transportation system. In the future, is continuing this current method of car-dominated transportation design is not realistic, cost effective or economically feasible.

The goal to increase bicycle use can only be reached by a concerted focus on infrastructure.

1. Cycling feels safe by individuals
2. By cycling a person follows the shortest route
3. Cycle traffic is given priority over or is on an equal footing with cars on public roads and streets

In order to establish the economic impact of bicycle infrastructure on cities, regions and societies, this paper is broken down into two main parts. The first part will describe the six factors that influence bicycle infrastructure, including safety, parking and congestion, cost, public health, why people drive and economics. To then evaluate how these six factors have had an effect on the economic impact of bicycle infrastructure, part two of this paper will examine nine case studies. These studies include research on street calming, bicycle tourism and health and environment in North America, Europe and Australia to provide a limited global view.

Keywords + geographic location:

Bicycle Infrastructure

Economic Impact

Bicycle Safety

Parking and Congestion

Tourism

Traffic Calming

Health and Environment

North America, Europe, and Australia