Mainstreaming Bicycling in Winter Cities: The case of Oulu, Finland.

by

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Abstract

Bicycles offer an efficient, emission-free mode of transportation, particularly ideal for shorter distances in urban areas. Consequently, bicycling is increasingly being perceived as a viable and important part of the urban transportation mix. Despite increased progress and attention, few cities have successfully incorporated cycling as a key feature of their urban policy, or substantially increased cycling's modal share. Meanwhile, research suggests that climate and weather influence cycling and transportation in urban areas, with cold climates in particular reducing the likelihood of cycling.

This research examines how bicycling can be mainstreamed in winter cities, thereby improving cycling conditions and increasing modal share. Oulu, Finland serves as a case study. Located at 65 degrees latitude, Oulu has a twenty percent modal share for cycling. A close examination how cycling was mainstreamed is presented and synthesized. The goal is to present Oulu's experience in bicycle planning as a model for other winter cities, particularly in Canada.

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1. Introduction

This thesis explores how cycling can be mainstreamed in urban transportation, with a focus on the distinct challenges faced by winter cities. Oulu, Finland serves as a case study. Oulu is the largest city in Northern Finland, serving as a regional, educational and high-technology hub. Located at 65 degrees latitude, this city of 130,000 experiences long, dark winters yet boasts a modal share of 20 percent for cycling.

The case study utilizes in-depth document reviews, semi-structured interviews with key informants, photography and ethnographic analysis[1] in a process-tracing exercise. The goal of this research is to inform planning efforts in other winter cities, particularly in Canada and the northern United States. Findings are represented using the three domains of sustainable transportation as described by Schiller et al. (2010).

Cycling is increasingly accepted as an important component of transportation planning. In recent decades academic literature, public policy and action have shifted towards sustainable urbanism, planning, and transportation causing what can best be described as a *paradigm shift* (Balsas, 2002; Black, 2010; Boschmann and Kwan, 2008; Broydo-Vestel, 2010; Daniels 2009; Evans et al., 2001; McClintock, 2002; Newman and Jennings, 2008; Patton, 2007; Plaut, 2005). Planning literature and policy has thus seen a steady progression on sustainability from questions of 'should we?' and 'can we?' to 'how do we do it?' (Chifos, 2007, p. 436).

According to Litman (2003), a sustainable transportation network requires using each mode of transport according to its particular strengths. Bicycles offer an efficient, emission-free mode of transportation, and are especially ideal for shorter distances. This

[1] Chapter 4 presents a detailed overview of research methods.

thesis does not advocate for car-free cities, but stresses the need for multi-modal transport options. Bicycling can be part of the solution to urban environmental issues, including air quality, traffic congestion, and climate change, while increasing the livability of cities (Crawford, 2009; Leinberger, 2008; Newman and Jennings, 2008; Rees, 2003; Wilkinson, 1997). While the automobile represents the dominant mode of transport in most cities, there is a widespread recognition that this must change in order to achieve a sustainable future (Black, 2010).

There has been a large volume of research on the various benefits of cycling and the provision and design of bicycling infrastructure (see for example, Anderson-Pinsoff and Musser, 1995; Balsas, 2002; Crawford, 2009; Heinen et al., 2010; Krizec and Roland, 2005; McClintock, 2002a; Wray 2008). Many cities have crafted bicycle master plans in an attempt to facilitate an increase in cycling, and guide the development of route networks. While there has been widespread progress and attention paid to cycling issues and policies, few Western cities have successfully mainstreamed cycling as a key feature of their urban policy, nor have many seen substantial increases in cycling's modal share (Heinen et al., 2010; Parkin et al., 2008; Pucher and Dijkstra, 2003).

Climate and weather influence cycling and transportation in urban areas (ECMT, 2004; Parkin et al., 2008). Climate is a crucial component of planning for bicycling because:

> Either excessively high or low temperatures can deter cycling, while precipitation of any amount, whether rain or snow, generally discourages cycling (Pucher and Beuhler, 2006, p.270).

Research indicates that cold climates, in particular, reduce the likelihood of cycling (Bergstrom and Magnussen, 2003; Pucher and Beuhler, 2006). Cities that

experience harsh winter conditions (referred to henceforth as 'winter cities'[2]), face further challenges in encouraging cycling and developing infrastructure and policy to facilitate year-round use. Despite this obstacle, some winter cities have found success encouraging cycling, and others are attempting to do the same.

Chapter 1 sets the groundwork for the case study of Oulu. The focus of this thesis is mainstreaming cycling. Therefore it is crucial to explore the concept of "the mainstream" in detail to establish what it means to mainstream cycling, and how this may occur. It is established that there are three components of mainstreaming cycling:

- Policy
- Infrastructure
- Bike culture

When these three components are present, one can measure their success through modal share, or the number of people cycling compared to other modes of transportation. Thus modal share is a quantitative reflection of cycling being in the mainstream.

Chapter II is a two-part literature review. Part I covers the theoretical framework of this thesis, defines sustainable transportation, discusses how to achieve sustainable transport, and presents a brief discussion of automobile dependence, and how cycling can be part of the solution. Part II delves deeper into issues that pertain directly to the case study. This research emphasizes cities with winter climates, therefore the literature on winter cities, vernacular design, and transport vernacular are discussed. Next, a review of the available academic literature on bicycling is presented, with a focus on cycling and climate, infrastructure, and policies.

[2] Although the concept of a winter city is open to interpretation, Pressman (1995) defines a winter city as one in which "the average maximum daytime temperature is equal or less than 32 f (0 Celsius) for a period of at least two months or longer" (p.17).

Chapter 3 introduces Oulu, Finland, providing local context, and establishing why the city serves as an appropriate case study. Sections 3.1, 3.2 and 3.3 attempt to identify cultural factors that could indicate Finnish people may be predisposed to cycling, especially in winter. While such factors may exist, there are also similarities that ensure international winter cities, particularly in Canada, have much to learn from Oulu. Other topics covered include Finland's planning environment, an introduction to Oulu and its relevant local history, and cycling in Oulu.

Chapter 4 introduces the research methods used for this study, and provides the process of analysis. The main component of this thesis is a case study of Oulu, Finland. In order to gather the necessary information, this thesis utilizes semi-structured interviews, a literature review, photography and ethnography. The data is analyzed through a process of open, axial and selective coding.

Chapter 5 presents the analysis and findings. This chapter begins with a brief reflection on the research experience, and a discussion of the strengths and weaknesses of this project. Findings are separated into themes including history, policy and planning, hard and soft policies, physical infrastructure, bike culture, winter cycling, technology, issues and implications for other cities.

Chapter 6 utilizes a model called the *three domains of sustainable transport*, originally introduced in chapter 2, to frame the findings related to the case study of Oulu. A detailed analysis of the issues and opportunities faced in Oulu is presented along with a discussion of factors the city may wish to explore looking forward into the future.

Chapter 7 outlines applications and best practices for winter cities, presents a series of issues and opportunities that Oulu must address in order to ensure future success, discusses areas for further research and reflects on the research findings.

There are several applications and best practices that can be gleaned from this research on Oulu, and used to inform planning efforts in other winter cities. These are structured according to:

- Infrastructure
- Policy
- Cooperation
- Patience and realistic expectations

While Oulu has seen much success and boasts a trail network and bicycling modal share that are enviable, the city is facing a series of issues. The first issue is that Oulu has largely ignored “soft” (non-infrastructural) policy initiatives, including promotional and educational tactics (see Chapter 2.12). The second issue relates to Oulu’s size. The city has continually grown in population and land area over the last two decades to the point where many trips are long enough that cycling is no longer the best option. Thus, adapting the pathway network to accommodate longer trips and/or improving transit service are relevant topics for the future.

Areas for further research include:

- Detailed user-analysis of Oulu’s pathway network.
- Further research into Intelligent Transportation Systems’ applications for active transportation.
- Winter cycling.
- Cycling in hot environments.
- Vernacular transport.
- Urban extent and active transportation.

1.1 What does it mean to "mainstream" cycling?

According to the *Canadian Oxford Dictionary* (2004), to be part of the "mainstream," is to belong to, or be characteristic of, "an established field of activity" (p.932). In the realm of urban transportation, the automobile has been mainstreamed over the last century, meaning policies, funding, urban development and the public's psyche have largely revolved around this mode (Black, 2010; Cradock et al., 2009; Crouse, 2000; Daniels, 2009; Leinberger, 2008; Schiller et al., 2010; Wilkinson, 1997). This has created a transportation crisis and reinforced a phenomenon referred to as "automobile dependence" (see Chapter 2.4).

According to Batterbury (2003), environmental citizenship must be grounded in social realities and be conducted within mainstream political systems. Essentially, in order to be successful, environmental movements must "generate sufficient groundswell opinion to overcome the significant financial, bureaucratic and behavioural barriers that constrain the adoption of a real new transport agenda" (ibid p.166). Although many important forces, including cycling, begin at the fringe (see Batterbury, 2003; Carlsson, 2007; Culley, 2001; Furness, 2005; Kliewer, 2010; Mapes, 2009; Vanderslice, 2003; Wray, 2008), they must move into the mainstream to create real and lasting change.

While a great deal of progress has been made in recognizing the importance of non-motorized transportation in cities, there is still much to be done. According to the European Conference of Ministers of Transport (ECMT, 2004) there are five persistent difficulties confronting efforts to plan and implement cycling initiatives.

1) Cycling has largely maintained a marginal status, often reflected in transport budgets.

2) There is a lack of coordination between the diverse players in promoting cycling, for example, fields of activism, health, transport, and the environment.
3) Safety and fear of injury.
4) Lack of technical understanding of the unique needs and requirements for cycling-specific infrastructure.
5) Lack of road-space to accommodate different modes of transport.
6) Cycling is still seen as a recreation or sport activity, not utilitarian transport.

In addition to these endemic issues, other factors influence people's choice of whether or not to bicycle. For example, Sidebottom et al. (2009) discuss rampant bicycle theft as a deterrent to cycling, while Danyluk and Ley (2007) and Plaut (2005) discuss the relationship between socioeconomic factors and bicycle use. For example, higher incomes and home values are associated with lower propensity to walk or bicycle, but those with college educations have been shown to have increased likelihood of using active transport modes.

Addressing and overcoming the aforementioned hurdles will require consistent, multi-pronged approaches. For the purpose of this thesis, the mainstreaming of bicycling as a utilitarian form of urban transportation, is explored in relation to: policy, infrastructure and bike culture. These three strategic components fit within the three domains of sustainable transportation, as presented by Schiller et al. (2010- see chapter 2.3), and should be manifest in order for cycling to be considered part of the mainstream.

1.1.1 Policy

Policy is a crucial component of mainstreaming cycling. In order for cycling policy to be brought into the mainstream, bicycles must be "legitimized" as a form of urban transport (McClintock, 2002a). Policy helps create the conditions in which cycling can flourish. It shapes the laws that protect cyclists, educational programs, promotional

campaigns and other factors that can make cycling a more attractive mode. Policy also guides the funding and provision of infrastructure, two other critical components. McClintock (2002b) explains that policies can be "hard," relating to infrastructure and facilities, or "soft" referring to non-infrastructural developments that encourage cycling through emphasizing that mode's positive aspects (for example, promotional campaigns). The concept of "hard" and "soft" policies will be revisited throughout this research.

Schiller et al. (2010) highlight the multi-faceted relationship between policy and planning. On the one hand, planning must be "informed and directed by good policy products and processes" (p.228). Yet planning must also inform policy-making, "especially through its research and implementation-evaluative/feedback dimensions" (p. 229).

Crafting quality policy can be a challenge. However, even with policy documents, achieving action and results can prove elusive (Bulkely and Rayner, 2003; Gaffron, 2003; Jones 2001; McClintock 2001; Ryley 2001; White, 2007). Sirkis (2000) relates the difficulties within the government structure, and public opposition to enacting bicycling policies, while Courtney (2009) stresses how sound policy requires stringent implementation measures.

Policy is central to this research. The goal, however, is to look beyond policy per se, and examine its interaction with other factors. The confluence of policy initiatives originating at national, provincial/state and local levels will be accounted for. A goal of this research was to explore upper-level policies in sustainable transportation planning, while underscoring the role of local initiatives.

1.1.2 Infrastructure

Infrastructure is an important component of mainstreaming cycling. Cycling infrastructure may include treatments as varied as marked lanes, off-road pathways, cycletracks, bicycle-specific traffic signals and secure parking facilities.

Cycling infrastructure enhances the experience of cyclists and is often viewed as a means to increase cyclist safety and comfort. There is much debate surrounding the role of infrastructure in mainstreaming cycling. Chapter 2.10 explores these matters in greater detail. Whether infrastructure is a tool to increase cycling, or a manifestation of a cycling public's demands, it is an important element of cycling's presence in the transportation mainstream.

Figure 1: Bicycle specific traffic signals in Copenhagen.
Photo credit: Jennifer Pauls (used with permission).

1.1.3 Bike culture

While policy and infrastructure provision are vital components of this research, cycling cannot be considered truly mainstreamed if it is not fully part of the psyche of urban residents. This third aspect of the mainstream is harder to quantify than the first

two, but is just as important. While hard to quantify, cycling's role in the local policies, opinions and actions, what we will call 'bicycle culture', is not completely intangible.

Goetzke and Rave (2010) define bike culture as "a social interaction or spillover phenomenon, where a higher bicycle mode share makes it more likely that some other person will also ride a bike" (p.2). They provide three reasons for the development of this bike culture. First, an increased utility arises from a proliferation of cyclists, possibly related to safety, comfort, or the social nature of cycling. The second reason is conformity to social norms, or what the authors refer to as "positively expressed fashion" (p. 2). Third, Goetzke and Rave describe how increased numbers of cyclists can send the signal to others that cycling is a safe, viable form of transport, basically "internalizing an information externality" (ibid).

Research by Bonham and Koth (2010), suggests that bike culture must "generate its own momentum" (p. 101). The study suggests bike culture is fostered through three interrelated means: social activities, cycling context and policy information. Social activities include events and activities that encourage cycling and celebrate the bicycle as a mode of transport. Cycling context is found through visible signals that a place is bike-friendly, such as wayfinding signage and safe, secure bike parking. Policy-information encompasses cycle-friendly policies that encourage cycling while discouraging driving, and providing easily available information for cyclists on routes, laws, safety tips, parking and other practical matters.

Figure 2: Copenhagen's bike counter re-enforces that city's bike friendly nature and develops positively-expressed fashion. Photo credit: Author.

Bike culture has often been steeped in subculture. Furness (2005) describes cycling's contemporary and historic role in subcultures. Meanwhile, Carlsson (2007) describes "Outlaw Bicycling," a phenomenon in which bicycling as a movement "challenges core values of our society" and the bicycle "has become a device that connotes self emancipation as well as artistic and cultural experimentation (p. 87).

In the contemporary context, cycling culture ranges from mainstream to fringe. The existence of a mainstream cycling culture, for example in Copenhagen, need not preclude the existence of a cycling subculture. Furness (2005) identifies five manifestations of "biketivism." These include direct action groups such as Critical Mass (see Carlsson, 2002); grassroots organizations that critique car culture through action, activism and literacy (see Kliewer, 2010); community bicycle collectives focused on

capacity-building, bike salvage and repair (see Borzo, 2009; Hamamoto et al., 2009); bicycle and transportation-related media, including zines, blogs and art (see *Momentum Magazine*, Poletti, 2005); and finally, the people who opt to cycle instead of drive automobiles.

This thesis focuses on mainstreaming cycling, and advocates moving beyond the "us versus them" confrontations that have permeated much of the active-transportation dialogue. However, to ignore biketivism would be to sell short the important role bicycling subculture has, and will continue to play, in mainstreaming cycling issues. Such an approach also overlooks the frustrating and dangerous situations that play out daily around the world on city streets where car culture is dominant over bike culture.

Figure 3: Cycling in the mainstream: Bike parking at the central train station in Aarhus, Denmark. Photo credit: Author

Figure 4: Guerilla bike signage found in Los Angeles is a reaction to that city's lack of bicycle infrastructure. Photo credit: Author

Ewing (2007) argues that bicycling shares a strong link with local and/or national cultures, and historical context. Bike culture is often grounded in the local, and reflects conditions specific to each location. For example, in the Netherlands one may find an unassuming, historic bicycle culture (Wray, 2008). Meanwhile, in Copenhagen the

culture is often seen as trendy, stylish aesthetically and environmentally minded.[3] Copenhagen and the Netherlands stand in contrast to the bicycle subculture steeped in rebellion and bicycle courier culture found in many North American cities (Culley, 2001; Mapes, 2009; Wray, 2008). Thus, a city's bike culture serves as a representation of the conditions faced by cyclists.

Bike culture and 'biketivism,' as described by Goetzke and Rave (2010), Bonham and Koth (2010), and Furness (2005), reflects the fruits of policy, infrastructure and activism initiatives. Interestingly, bike culture also feeds policy directly, creating a cycle in which it is difficult, if not impossible, to determine which must come first (see the *Policy Wheel*- Chapter 1.1.5).

This thesis argues that successful initiatives to mainstream cycling may originate from multiple sectors. Kliewer (2010) describes how grassroots initiatives in Canada have largely fuelled success, while Pucher (1997) suggests the German experience was largely policy-based originating with government initiatives. Maddox (2001) disagrees with Pucher (1997), and instead, argues that the origins of the German policy initiatives were grounded in citizen initiatives and preference.

According to Maddox (2001), increased political action and public advocacy are the foundation on which all other tactics and initiatives rest. Strong policies, quality infrastructure provision and all other measures require public support for success. Maddox argues:

> Any groundswell of support for cycling can and should be harnessed to help create a mutually reinforcing situation in which community activism intersects with policy and planning (p. 47).

[3] Copenhagen is widely regarded as being a "cycling city." The popular blog *Cycle Chic* portrays the aesthetically minded bicycle culture in the city: http://www.copenhagencyclechic.com.

1.1.4 Modal Share

Modal share, sometimes referred to as modal split, is simply the percentage of passengers or freight moved by a given mode of transport (Rodrigue et al., 2006). Measures of modal share indicate how many trips are taken by bicycles versus other modes of transport, and thus serve as the quantitative manifestation of cycling's position within, or without, the mainstream.

Census data is the major source of data for the transportation habits of the population at large (Parkin et al., 2008; Pucher and Buehler, 2005). However, some jurisdictions rely heavily on travel surveys. In Canada and the United States, censuses are the only comparable sources of information on cycling's modal share. Both of these only provide information on work trips (Pucher and Buehler, 2006). Meanwhile in Europe, many modal share data sets are representations of total trips, meaning they encompass trips for work, pleasure and practical matters, such as running errands. Due to this thesis' international context, and the differing measurement criteria between jurisdictions, modal share is used as a general indicator of bicycle use and not for scientific comparison between jurisdictions.

Cycling will be considered part of the mainstream when it is legitimized in policy, infrastructure provision and bike culture. However, modal share is the true quantitative indicator of cycling's widespread use as a mode of utilitarian transport.

1.1.5 Summary

According to Balsas (2002), walking and cycling can only reach their full potential as legitimate forms of transport through concerted efforts in the realms of advocacy, planning and public policies. Policy, infrastructure, and bike culture are three strategic components used in this thesis to discuss mainstreaming, but they must be seen

as closely related and inter-dependent on each other. Modal share is the ultimate manifestation of these three components' presence and success within a jurisdiction.

The *Policy Wheel* attempts to simplify and demonstrate the general interaction between policy, infrastructure, actions (meaning, people's choice of mode) and advocacy (see fig. 5). In general, advocacy can be seen to precipitate policy, which in turn, guides infrastructure development. The combination of advocacy, policy and infrastructure all influence people's decision to cycle (actions), represented through modal share. However, policy and action can influence each other directly, without infrastructure. This can occur through "soft" policies, which influence people to cycle, or conversely, through increases in cycling precipitating a perceived need for policies. There is also a direct link between advocacy and actions.

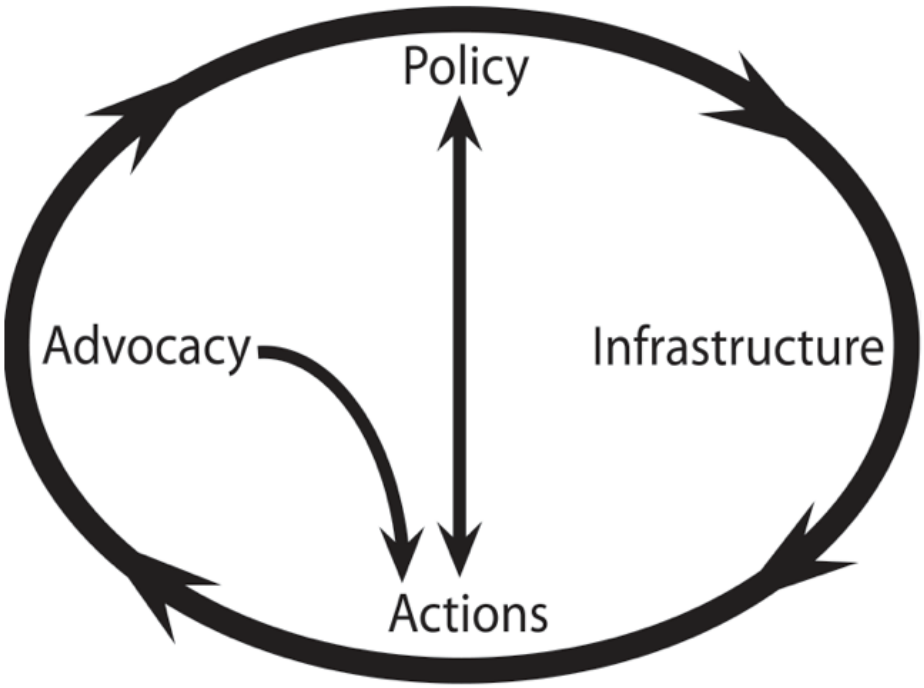

Figure 5: The "Policy Wheel" demonstrates the interconnected nature of policy, infrastructure, advocacy and actions. Concept and graphic developed by the author.

This thesis explores how Oulu has created an environment that fosters bicycle use as a mainstream form of transportation, with an emphasis on planning for year-round cycling in a winter climate. Attention will be directed to the role of local forces, such as politicians and advocacy groups to champion the mainstreaming of cycling issues.

In closing, a major component of cycling being in the mainstream is intangible. When cycling is reflected through policy, infrastructure and culture, local citizens and outsiders can sense cycling's status. For example, describing the Dutch experience, Black (2010) writes:

> One gets the impression that the bicycle in the Netherlands has the status of the bald eagle in America, namely as something that nation will go out of its way to protect (p. 174).

1.2 Research questions

This research sought to answer two key questions: How can winter cities successfully mainstream cycling?' And, what lessons can be learned in Oulu that may have application elsewhere? Three research questions guide this inquiry:

1) What were the most significant factors in mainstreaming bicycling in Oulu?

2) Through what process has cycling policy been translated into action?
    - Who were the key players-people, institutions etc.?
    - What relationships exist between key players?
    - Priorities, budgeting, enforcement?

3) What lessons (if any) can North American winter cities learn from Oulu's experience?

1.3 Assumptions

A project of this nature cannot be undertaken without acknowledging that I am a long-time avid cyclist. I firmly believe, through personal experience, that bicycles can provide a safe, healthy, efficient form of utilitarian transport. This assumption factors

heavily into why I chose this research topic, and how I approached it, although great care was taken to maintain academic integrity and avoid bias.

2. Literature Review

The following literature review explores concepts related to automobile dependency, winter cities, transport vernacular, and cycling issues and policies. In Chapter 3, a separate literature and document review relating specifically to the Oulu, Finland case study will be presented.

The literature review is divided into two parts. Part I discusses the planning framework, theoretical foundations, defines sustainable transportation and discusses how to achieve it. Part II explores automobile dependence and how bicycles can be part of the solution, the winter cities literature, climate-responsive design, and transport vernacular, with complete streets and context-sensitive solutions introduced as contemporary means of introducing concepts of the vernacular. Following these theoretical components is a detailed literature review on cycling issues covering climate, infrastructure and policies.

Literature Review Part I: Framework, foundations and sustainable transport

2.1 Planning framework and theoretical foundations

Research projects are structured by theoretical frameworks, or paradigms, under which they operate. These frameworks, essentially “sweeping ways of looking at the social world” (Neuman, 2000, p. 59), include certain assumptions that provide focus and context for the research and findings. This project operates within the postmodern planning paradigm.

Simonsen (1990) explains that concepts of postmodernism are ambiguous. Postmodern is merely a relational term, indicating a difference and progression from modernism, and easily evades clear definition. In order to understand the postmodern planning paradigm, it is useful to recognize the characteristics of modernism. Modernism as a movement, with its emphasis on clean form and function, shaped a great deal of art and architecture through the 20th century (Berman, 1982; Frampton 1992; Holston, 1998).

City planning was influenced by, and grounded in, the concepts of modernity during this period. Modernist planning was based on rational decision-making and a belief there is "absolute truth and the rational planning of ideal social orders" (Allmendinger, 2002, p. 160).

In the 1920s the *Congrés Internationeax d'Architecture Moderne* (CIAM) released manifestos advocating that "the state to assert…the collective priority of collective interests over private interests by imposing on the chaos of existing cities the construction of a new type of city based on its master plans" (Holston, 1999, p.40). The manifestos were grounded in the belief that, "the state, usually in the form of a national government, can change society and manage the social by imposing an alternative future embodied in plans" (ibid). Any utopian ideal that attempts to "transform an unwanted present by means of an imagined future" often attempts to alter the urban fabric and remove the historic and the familiar (ibid, p. 41). These ideals manifested themselves through a top-down approach in which planning experts dictated new urban forms. The pursuit of 'the new' largely came at the expense of the old urban fabric. According to Berman (1982), this wholesale change killed the vitality of the urban street.

Modernist planning literature and planning history presents the act of planning as a "heroic" progression based on evolving the social order, according to science and modern ideals. According to these beliefs, the planner is a flawless, solution-driven hero. Any battles lost are not the fault of the planner, but the fault of "evil world in which he must operate" (Sandercock, 1998, p. 4). This set the stage for the large-scale slum clearance and urban renewal projects of the mid 20th century and urban freeway projects that cleared out entire neighbourhoods.

A major aspect of urban renewal saw vast tracts of inner cities demolished for redevelopment and highway construction (Berman, 1982; Fogelson, 2001; Frieden and Sagalyn, 1989). This phenomenon was not unique to North America and played out throughout the world (Diefendorf, 2000). In some cases this approach aimed to unabashedly embrace the automobile at the expense of all other modes. Caro (1975) recounts the work of Robert Moses in New York, who rejected proposals to incorporate public transit into highway projects, and even ensured some overpasses were designed to prevent buses from passing underneath. Other approaches, such as *The Compact City* concept proposed by Dantzig and Saaty (1973) is modernist in its organization, planning and design, yet accommodates and encourages transit, bicycling and walking, albeit through a strict separation of rights-of-way.

Modernist transportation planning, much like land-use planning, embraces instrumental rationality, which bases reason on logic and empirical science, and objectivity. Wilson (2001) explains instrumental rationality is a "process of optimizing means (plans and programs) according to identified ends (goals)" (p. 3). The modernist

approach to urban transportation, similar to land-use zoning, focused on a strict separation of uses.

With modernism's focus on the new, as a general rule, the automobile was embraced as a form of transport. Under this paradigm, traffic engineering focuses on traffic flow, which sees streets as mere conduits of high-speed traffic (Patton, 2007). It should be noted that traffic engineering is a crucial aspect of planning for all modes of transportation.

The problems caused by traffic engineering in the post-war period are essentially two-fold. The first is the focus on automobiles as a superior mode of travel. The second is the lack of coordination between engineering and other sectors, often resulting in purely technical solutions to traffic. These often came at the expense of the human realm. Duncan (1992) portrays the perils of the purely technical:

> Technical obsession is like an unlit, ever-narrowing mine shaft leading straight down through the human mind. The deeper down one plunges, the more confined and conditioned one's thoughts become, and the greater the danger of permanently losing one's way back to the surface of the planet (p. 273).

Within this realm of the technical, Patton (2007) explains that pedestrian safety served as a focal point for the "politicization" of traffic,[4] as safe streets became a rallying cry for movements as diverse as NIMBY-esque opposition to development, to groups working to increase safety conditions for cyclists and pedestrians. Safety fits "squarely within the purview of traffic engineering" in that collision data can be quantified (ibid p.937). While this created the conditions for pedestrian safety to be an issue, Patton explains it also created a "bifurcation of solutions" (p. 939) where, on the one hand,

[4] Patton discusses this matter in terms of pedestrians, but the concept can be extrapolated to cyclists and other road users.

bicyclists and pedestrians could be safely accommodated, but conversely could also be banished from roadways altogether.

In recent decades there has been a paradigm shift towards postmodern planning and urbanism. Postmodern planning stands in stark contrast to modernist planning. Summarizing the work of Ellin (1999), Hirt (2005) sums up in five key aspects of postmodern planning:

- Participatory planning methods.
- Search for urban identity, urbanity and cultural uniqueness.
- Appreciation for historic spaces.
- Return to traditional building forms; mixing land uses and flexible zoning.
- Pursuit of human-scale, pedestrian-friendly, and compact urban forms.

The postmodern planning paradigm, therefore, shifts emphasis from modernism's pursuit of efficiency (Berman, 1982; Le Corbusier, 1987; Hall, 1996; Holston, 1989) to creating livable places (Hester, 2006; Hough, 2005; Krier, 2009; Newman and Jennings, 2008). In simple terms, postmodern planning sees a shift in emphasis from efficiency to livability.

Postmodern planning values traditional urban form and city building. Ellin (1999) explains, "although transportation, communication and building technologies are increasingly sophisticated, postmodern urbanism tends to resist extensive use of them (Ellin, 1999, p. 291). Crawford (2009) echoes this view, arguing that modernist design and master panning was based on "the notion that a single moment of inspiration was superior to centuries of accumulated design wisdom and the deliberations of thousands of people over time" (p. 21). This is not to say postmodern planning eschews technology or advancement, after all, "the search for urbanity is misguided when it ignores the contemporary context" (Ellin, 1999, p.158).

Allmendinger (2002) explains the many drawbacks and positive aspects of postmodern planning theories, as they relate to other schools of thought. While entire books could be written, and have been written, on these matters, postmodern planning as described by Hirt ‘s five aspects (2006), provides the framework for this research. Within this overall paradigm shift to postmodern planning, we can situate the paradigm shift towards sustainable transportation, which emphasizes accessibility, integrated planning, multi-modality, energy efficiency and reducing environmental impacts (see-Balsas, 2002; Black, 2010; Boschmann and Kwan, 2008; Chifos, 2007; Daniels, 2009; McClintock, 2002; Newman and Jennings, 2008; Plaut, 2005; Schiller et al., 2010 and others).

The paradigm shift towards sustainable transportation is ongoing, and by no means complete. While non-motorized transportation has been increasing in prominence, few cities have mainstreamed this agenda. Patton (2007) warns, “the established means of calculation,” including transportation engineering based in rationality, “are a significant barrier to transportation change” (p. 942).

The academic understanding of sustainable transportation and non-motorized transport is far ahead of the implementation and reality of urban transport. Crawford (2002) argues that we have the technical knowledge to improve urban transportation and that the barriers that remain are largely political. Waddell (2011) explains the friction that can occur when planning theories and models attempt the transition from academic settings, which emphasize theoretical concepts and methods, to practice and public agencies, where emphasis is placed on ease-of-use and the ability of stakeholders to understand how and why these concepts operate.

Thus, within the shift to postmodern planning and its emphasis on community engagement, there exists a tension between the concepts of the "public good" and the "public will." According to Andres Duany (Lind, 2011), a new balance must be struck between avoiding the ills of top-down planning and harnessing the expertise and knowledge of planners and designers. Referring to rampant NIMBYism, Duany states, "if you can't build a bike path or lay a power line that connects to the new solar energy farm, then you can't engage in the 21st century" (ibid). Despite these issues and challenges, research and public understanding of sustainable transportation is continually expanding.

2.2 What is sustainable transportation?

Concepts of sustainability have permeated planning literature for decades and have been increasingly mainstreamed in public dialogue. Roseland (1998) describes the contemporary understanding of sustainability, a concept with roots on the Bruntland Commission's decree that sustainable development meets "the needs of the present without compromising the ability of future generations to meet their own needs" (p. 3). While many angles and interpretations of the concept have evolved and developed, sustainability is generally regarded as involving three main elements, or "three pillars:" social, economic and environmental (Roseland, 1998).

Transportation is a universally vital human activity affecting development, social structures, politics, the environment and economy (Rodrigue et al., 2006). Meanwhile, the transport sector is a major source of greenhouse gas emissions, and other harmful environmental concerns (Black, 2010; Forman et al. 2002; Hough, 2004; Keeling, 2009; McClintock, 2002b, Schiller et al., 2010). In the urban realm, transportation creates not only environmental concerns, but also directly influences how cities function and the

quality of urban life (Gifford and Steg, 2007; Hough, 2004; Newman and Jennings, 2008). Researchers have also explored the use of transportation as a means of social exclusion and discrimination (Bullard et al., 2000; Pucher and Buehler, 2006b; Schweitzer and Valenzuela, 2004)

Schiller et al. (2010) explain that the concept of sustainable transportation emerged from three primary sources. First was a growing concern surrounding the "burdens" of transportation and the apparent counterproductive nature of automobile-based transport planning and infrastructure. Second, there was a realization that in many cities traffic-calming measures had noticeable positive effects on overall urban mobility, while addressing social and environmental concerns. Third, there has been growing interest on part of the general public and multiple levels of government, for the concept of sustainability as advocated by the Bruntland Commission (Schiller et al., 2010).

Within the academic literature there is widespread recognition that transportation must be made more sustainable. However, definitions of sustainable transport vary widely across the literature, and the term itself has proved increasingly hard to define (Gifford and Steg, 2007; Schiller et al., 2010). Despite varying concepts of the term, it is necessary to define "sustainable transportation" for this thesis, because according to Fischer (1999), clear definitions are essential for meaningful discussion due to the ambiguity inherent in a topic.

Further complicating attempts to define the term, concepts of sustainability can fall along a scale ranging from "strong" or "hard" concepts to "weak" or "soft"[5]. This

[5] Drawing off the available literature, for the context of this thesis, "strong" or "hard" approaches to sustainable transport place emphasis on reducing VMT's, energy consumption and emissions through behaviour change, reductions in trips and a shift towards non-motorized and public transport. Hard or strong concepts will also place greater emphasis on social dynamics of transportation.

scale can be demonstrated through various definitions of sustainable transport. A sustainable transport system, according to Black (2010), is:

> One that provides transport and mobility with renewable fuels while minimizing emissions detrimental to the local and global environment and preventing needless fatalities, injuries and congestion" (p. 264).

Black (2010) adopts a decidedly "soft" (Banister, 2005) or "weak" (Taraveinen, 2009) approach to transport sustainability in this definition, as he foresees technological advances and renewable fuels maintaining automobiles as the dominant form of urban transport. Reducing the automobile's harmful emissions is certainly a worthwhile endeavor, but would such a state truly provide for sustainable urban transportation? A substantial volume of academic literature argues to the contrary (Heinberg, 2004; Newman and Jennings, 2008; Rosen, 2001). Black's definition lacks emphasis on access, multi-modal transport and overlooks the social, health, and economic aspects of sustainability. The following sections discuss the facets of sustainable transport and develop a working definition for this thesis.

2.2.1 Integrated Planning

Integrated planning ties land use and transportation together, as these two factors are inherently interrelated and co-dependent (Wegener, 2004). Urban form not only influences the distance and frequency of journeys, but can also influence the mode used (Hensher, 2008; Newman and Jennings, 2008; Woodcock et al., 2009). Schiller et al. (2010) argue that the sustainable transportation paradigm is grounded in integrated planning. They explain that the current state, referred to as "businesses as usual" (BAU),

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The "soft" or "weak" approaches emphasize technological advances to increasing transport sustainability. Such approaches espouse alternative fuels and increases in vehicular efficiency, generally embracing the private automobile as a viable and sustainable form of transport.

is:

> …reductionist, and tends to treat modes and facilities in isolation rather than in an integrated manner, it is necessary for sustainable transportation to adopt a multifaceted and integrated approach (p. 228).

Schiller et al. (ibid) use computer-based traffic engineering as an example of reductionism in planning. They argue that this system "prescribed more roads as a solution to congestion," while failing "to examine the feedback effects between transportation and land use, and the holistic implications for the whole city of building more and more roads" (p. 229). Kenworthy (2006) simplifies the relationship between land use and transport writing, "the shape and form of a city sets the basic framework within which everything else in the city has to operate" (p. 69).

2.2.2 Access and accessibility

According to Litman (2003) sustainable transport planning is proactive and seeks to prevent problems before they arise. Unlike the conventional emphasis on roadway capacity, sustainable transport planning promotes accessibility (ibid). Planning must separate access from accessibility as the latter means ensuring people are actually able to use transport efficiently as opposed to theoretically being able to access it (Bartle and Devan, 2006; Rodrigue et al., 2006). By emphasizing accessibility, sustainable modes such as walking, cycling, and public transit can reach the speeds and levels of convenience afforded by private automobiles (Bertolini et al., 2005).

Bertolini et al. (2005) perceives accessibility as being at the confluence of transport quality and land use. Erickson (2006) stresses that accessibility is tied to connectivity:

> An urban landscape with high connectivity is more accessible, more humane, and indeed more democratic. Connected urban areas allow exchanges between various

> social groups, democratizing the city in a spatial way. A connected urban landscape fosters mobility, visual interest, and efficiency. Humans need to easily access services and amenities at the neighbourhood and city scale, and this access should not be dependent on cars. The walkable, connected city is one that helps foster sound human-ecological health" (p.24).

Accessibility requires quality multi-modal transport options, compatible land uses, and high levels of connectivity.

2.2.3 Reducing vehicle miles traveled

There is increasing acceptance that the most crucial component of transport sustainability is reducing vehicle miles traveled (VMTs)[6] (Banister, 2006; Black, 2010; Krier, 2009; Schiller et al., 2010). VMT reductions address concerns of congestion, emissions and energy use. Banister (2005) explains two means to reduce VMTs: reducing the number of trips taking place, and facilitating a modal shift away from automobiles.

Banister (2005) argues that planning's role in reducing VMT's and tackling sustainability has generally been underestimated. While transport is only one of several major factors in sustainability, it is an area where we have a wealth of knowledge on how to make improvements and can potentially make great gains, especially in the urban context. Thus "transport must have an instrumental role in achieving sustainable development" (ibid, p. 246).

2.2.4 Participation

Public engagement and participation is a cornerstone of the postmodern planning paradigm, and according to many authors, it is also a cornerstone of sustainable transportation (Brody, 2003; Conroy and Berke, 2004; Litman, 2003; Rosen, 2001; Schiller et al., 2010). Schiller et al. (2010) discuss the increasing emphasis on "bottom

[6] VMT reductions are generally intended to apply to motorized vehicles.

up" planning and how increased participation can increase the legitimacy and quality of plans, while building community capacity. They conclude, "there is considerable potential for incorporating effective public participation within [sustainable transportation] efforts" (p. 205). Berke (2002) outlines similar findings, concluding that sustainability can be used as a means to move beyond factions and specific interest groups, to establish and pursue a vision. This collaborative approach allows barriers to be broken, and encourages the convergence of groups that previously pursued similar goals along parallel tracks.

2.2.5 Technology

The role of technology in sustainable transport is much debated, and could take many forms. Black (2010) describes four main facets of technology's role in making transport more sustainable. The first encompasses telecommuting, information and communications technologies (ICT), and e-commerce; the second, alternative fuels; the third, new vehicles, fuel cells, and catalytic converters; and finally, intelligent transportation systems (ITS). While many people hope technological advances will allow more sustainable transport without the need for individuals to alter their behaviour, this is largely seen as being unrealistic, only resulting in and a "soft" or "weak" approach to sustainability. Black (2010) writes that ITS and other technological advancements "appear to have only minor impacts on sustainable transport" and they provide limited potential for reducing VMTs because "every major transport improvement over the past 200 years ended up resulting in an increase in the total amount of travel taking place" (p. 259).

2.2.6 Context

Context and amenity are vital when discussing sustainable transportation. According to Black (2010), all modes of transport can be considered sustainable if they are used in manageable quantities. In this sense, bicycles too, could become unsustainable if they overwhelm the available infrastructure. A city need not eliminate automobiles in order to achieve sustainability in a transport system, and this research does not advocate for car-free cities. Solutions to unsustainable transport must be grounded in local context. To quote Litman (2003):

> Sustainable transportation requires using each mode for what it does best, which typically means greater reliance on non-motorized for local travel, increased use of public transit in urban areas, [and] a reduction (but not elimination) of personal automobile use (p.3).

Sustainable transport is not "anti-automobile;" it emphasizes the need to provide options. Yet it should be noted that continual increases in roadway capacity undermine efforts to facilitate modal shifts away from automobiles and reduce VMTs. Kenworthy (2006), Litman (2010), Rodrigue (2006) and others discuss the futility of increasing sustainable modes whilst increasing road volume and capacity.

2.2.7 Multi-modality

Cycling is not a "silver bullet" for sustainable transport in and of itself. However, cycling will likely be a major component of a sustainable transport network (Crawford, 2009; ECMT, 2004; McClintock 2002b; Rietveld and Daniel, 2004; Schiller et al., 2010; Wray, 2008). Kenworthy (2006) writes:

> Without a commitment to better public transport systems, especially rail, and better conditions for pedestrians and cyclists, it is difficult for any city to become more sustainable (p. 75).

After all, cycling and walking are the most sustainable forms of transportation (Kenworthy, 2006; Pucher and Buehler, 2005; Woodcock et al., 2007). Schiller et al. (2010) argue that walking, bicycling and transit should provide the building blocks for urban mobility, as these modes "have historically demonstrated synergies with humans and their settlements" (p. 78).

Despite cycling's undeniable strengths, walking, transit, automobiles and technology have important roles to play in a sustainable transport future (Black, 2010; Halladay, 2002). Bicycle planning must move beyond an "us versus them" mentality. Complete streets and context-sensitive planning are of the utmost importance. Automobile traffic must be managed, and in some corridors or districts, restricted. Automobile traffic should also pose no serious risks to pedestrians or cyclists. Public education will be paramount in making clear the way in which how we travel affects our surroundings, and facilitating informed choices (Black, 2010; Lane 2000).

Figure 6: Sustainable transportation is multi-modal. German train carriage dedicated for bicycles. Photo credit: Author

2.2.8 Definition of sustainable transportation

While the available literature provides no consensus-based definition of sustainable transport, Gifford and Steg (2007) assert, "sustainable transport implies balancing current and future economic, social and environmental qualities" (p. 44). For the purpose of this research, we may draw off the aforementioned literature to define sustainable transportation as being:

> *Safe, economic, energy efficient, multi-modal and socially equitable. Sustainable transport is based on collaboration, choice, accessibility and sound environmental policy. Networks should be context-sensitive and should enhance the environments in which they operate.*

Within this definition bicycles can, and should, play an important role as they present an inexpensive, efficient, and socially equitable transport mode.

2.3 Achieving Sustainable transportation: The *three domains of sustainable transport*.

In chapter 2.2 a wealth of literature is used to determine a working definition of sustainable transportation. Moving beyond this definition, it is important to examine how we might increase the sustainability of transport systems. In order to frame the discussion and results from the case study on Oulu, this research utilizes a concept presented by Schiller et al. (2010), which explores the intersection of three major domains in sustainable transportation: planning and policy factors, background factors, and technical and infrastructure factors. These encompass "numerous factors representing issues or questions that policy-makers, citizens and planners should address" (p. 229). At the confluence of these *three domains,* one finds sustainable transportation (see figure 7).

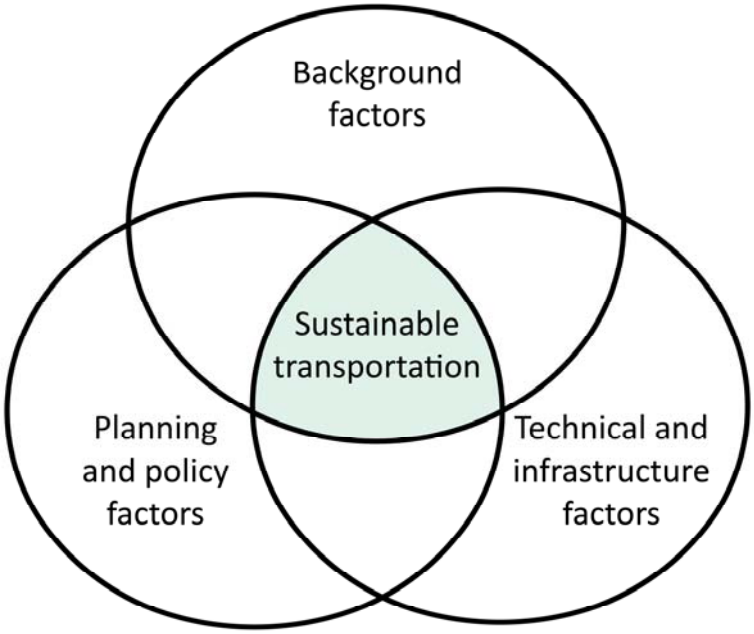

Figure 7: The Three Domains of Sustainable Transportation, as described by Schiller et al. (2010).

This thesis identifies policy, infrastructure and bike culture as three strategic components of cycling being in the mainstream, with modal share serving as the ultimate manifestation of cycling's prominence. Policy, infrastructure and culture fit within the

three domains of sustainable transportation, as discussed by Schiller et al. (2010), These domains also serve to frame the discussion of how conditions came to be in Oulu (this can be referred to as "process tracing"-see Chapter 4.1). The process tracing aspect of the *three domains* proves particularly useful in presenting an international case study, as concepts of "history, heritage, culture and values and geography-topology" (Schiller et al., 2010 p. 230) are useful in allowing outsiders to understand the local context. In Chapter 6 Schiller et al.'s *three domains* frame the findings from the semi-structured interviews and background research in Oulu.

2.3.1 Domain one: Planning and policy factors

The first domain of sustainable transport consists of planning and policy factors. These factors encompass the planning process, hard and soft policies, and capacity building. Planning and policy factors include (Sciller et al., pp.229-232):

- Critical event
- Policy makers, integrated policy-making, policy adequacy
- Citizens and community leaders
- Careful analysis, economic evaluation, impacts
- Scenario building, evaluation of all options
- Vision of a preferred future, backcasting to inform planning
- Appropriate planning structure, motivated staff
- Deliberative planning
- Good data/evaluation
- Soft path/mobility management orientation
- Effective communications

2.3.2 Domain two: Background factors

The second domain consists of background factors, which are the natural and cultural conditions that shape the development of sustainable transportation goals. These will be of particular interest, as they help frame the context for this case study. The factors are (Sciller et al., pp.232-233):

- History, heritage, culture and values
- Geography, topology
- Accountable governance systems
- Social organization
- Existing transportation and land-use system

2.3.3 Domain three: Technical and infrastructure factors

The third domain is technical and infrastructure factors. These can be seen as manifestations of the policies and planning in the first domain. Technical and infrastructure factors include (Sciller et al., pp.233-234):

- Appropriate infrastructure and energy sources
- Availability of appropriate hardware
- Appropriate standards and measurement
- Orientation and skillsets of technical personnel
- Existing built environment
- Technical aspects environmental impact assessments

Literature Review Part II: Automobile dependence, winter cities, the vernacular, cycling infrastructure and policies

2.4 The perils of automobile dependence and cycling as part of the solution

As early as the 1960s the negative side of automobile dependence was becoming evident. Mumford (1964) wrote: “The fatal mistake we have been making is to sacrifice every other form of transportation to the private motorcar” (p. 237). Kenworthy (2006), describes the use of Urban Transportation Planning (UTP), a computer-based modeling system that formed the backbone of automobile traffic engineering in the post-war period. UTP modeled and predicted travel growth, and provided calculations for the “necessary” infrastructure to accommodate these needs. This system became associated with self-fulfilling infrastructure provision and created unending demand for roadways.

Automobiles are inherently inefficient for short trips. In addition to the environmental concerns posed by emissions and pollution, automobiles degrade the urban environment through congestion and associated infrastructure, including high-volume roadways and parking facilities (Balsas, 2003). Research also suggests that increased road capacity only increases demand, creating further congestion (Mogridge, 1997; Newman and Jennings, 2008; Van Hengel et al., 1999). Thus, automobile dependency, increased road capacity, and urban sprawl are locked into a feedback loop in which increased provision of automobile infrastructure is accommodating increased VMT's and further sprawl, resulting in the perceived need for more roadways (Hall, 1992; Kenworthy, 2006).

The immense land-cover associated with urban sprawl, and the automobiles we use to access it, are substantial factors in climate change (Kates and Wilbanks, 2003; Van Wee, 2007). Research by Jacobsen (2009) also suggests that increased automobile traffic has a direct impact on decreasing the likelihood of cycling and walking. Hall (1992) refers to these collective phenomena as the "transportation crisis."

Cities are physically shaped by mobility, and automobiles put urban expansion into overdrive. The *Marchetti Constant*, developed by European physicist Cesare Marchetti, is a time-travel budget that states urban dwellers will only allow one hour of travel in a day; meaning cities should not be more than one hour wide (Marchetti, 1994; Newman and Jennings 2008). This is just a model, and in reality some people travel less and others more than one hour. However, it can demonstrate how changing modes of travel (walking, trams, subways and cars) allows changes in the size of urban areas. High-volume roadways built throughout the world have allowed automobile commuters

to move farther and farther out, and the “one hour” city midway through the twentieth century was many times larger than its predecessor in the nineteenth century.

There is a substantial body of research on the relationship between population density, urban form and cycling (see Kenworthy, 2006; Newman and Kenworthy, 1989; Soltani et al., 2006; Van De Coevering and Schwanen, 2005; Moudon et al., 2005). Schiller et al. (2010) explain that expansive urban regions present problems for cycling in the regional context. Erickson (2006) examines regional pathway networks emphasizing their increased importance in the contemporary context. Schiller et al. (2010) conclude that quality infrastructure and multi-modal interaction with transit systems are necessary for effective regional-scale bicycling.

Automobile dependency has been linked to health risks (Edwards and Tsouros, 2006; Ewing et al., 2003; Higgins 2005; Van Wee, 2007) and environmental concerns, such as climate change (Hensher, 2008; Hillman, 2003; Newman and Jennings, 2008; Wray, 2008). The environmental benefits of cycling have long been advocated (Cradock et al., 2009; ECMT, 2004; McClintock, 2002; Pucher and Beuhler, 2005). Rising fuel prices, potential energy concerns, and increased environmental awareness are factors affecting public consciousness and creating a need for transportation alternatives in cities (Heinberg, 2003; Hough, 2004; Newman and Jennings, 2008).

Links between automobile dependence and social issues have also been identified. For example, Bullard et al. (2000) and Frieden and Sagalyn (1989) discuss race and class issues associated with cities built for automobiles. The general post-war pattern of development has produced the kind of environment that Relph (1976) famously referred to as “placeless.” Popular authors, such as Kunstler (1993) and Putnam (2001), have

expanded on these ideas, describing "placelesssness" and isolation in urban environments.

In the 21st century, sustainability has become the hallmark of planning literature (Daniels, 2009; Newman and Jennings 2008). Cycling offers an efficient, emissions-free form of transport that meets the criteria of sustainability, being equitable, livable, viable and conserving non-renewable resources (Black, 2010; Pucher and Buehler, 2006b; Schiller et al., 2010; Tanguay et al., 2010; Wilkinson, 1997; Woodcock et al., 2009). Consequently, a wealth of planning literature has developed espousing the merits of bicycle transportation (ECMT, 2004; Heinen et al., 2010).

Schiller et al. (2010, pp.93-94) outline the most important strengths that bicycling offers as a form of transportation. These include:

- *Capacity*: bicycles require little space for movement and parking compared to motorized modes, and make efficient use of the space provided to them.
- *Function and trip types*: most urban trips are of short to moderate length, bicycles, with proper infrastructure provisions, can be the most efficient vehicles for these trips.
- *Infrastructure needs and costs*: constructing and maintaining bicycle infrastructure costs a fraction of what's required for automobiles or transit, meaning bicycling facilities represent fiscally-responsible transportation investments.
- *Velocity and range*: bicycles can move at a variety of speeds depending on the cyclist and the conditions. Bicycles may effectively cover most urban distances with the proper provisions.
- *Environmental*: bicycling has limited negative environmental impacts, most of which are found in the bicycle's embodied energy.
- *Health and safety*: bicycling is a healthy activity and provides exercise and outdoor exposure for participants. Bicyclists and pedestrians also contribute to the public realm, serving as "eyes on the streets" in neighbourhoods. Bicyclists are exposed, however, to poor air-quality caused by motorized modes, as well as the risk of collisions.
- *Costs*: Bicycles are inexpensive to procure and maintain, while a range of options can be found to fit income and taste. Investments in bicycling can be seen as socially equitable.

In reviewing the above list, one can see the various ways in which cycling meets all three pillars of sustainability, as described by Roseland (1998, see Chapter 2.2).

Blanco et al. (2009) explores the "interesting relationship" that cycling facilitates between transport and non-transport related fields (p. 13). These interrelationships are demonstrated through the multi-disciplinary approach to encouraging cycling. For example, cycling has increasingly been embraced as a means to overcome sedentary lifestyles and as a tool to promote public health (Banister, 2005; Edwards and Tsouros, 2007; Bassett et al., 2008; Hendriksen et al., 2010); a tool for capacity building and overcoming social inequity, through initiatives such as community bike repair workshops (Banister, 2005; Furness, 2005; Pucher and Buehler, 2009); and as a means to improve health and mobility in an ageing population (OECD, 2001).

Any discussion of cycling's potential to combat automobile dependence and increase the sustainability of urban areas must be grounded in reality. Cycling is still largely regarded as a fringe mode in most cities, globally, and especially through North America (Kenworthy, 2006). Cycling can help address many of the issues related to automobile dependence, but it does not offer a silver bullet solution. While Black (2010) advocates all efforts should be made to encourage cycling, both Black and Hurst (2009) stress that expectations must be "kept realistic" (p.4). Realistic expectations will vary by location, but achieving substantial increases in cycling's modal share will take time and concerted effort.

2.5 Winter cities, the vernacular, and climate-responsive design

In order to understand how winter cities can encourage cycling as a year-round form of utilitarian transport, we must discuss human interactions with the natural

environment. In general, the western worldview "exempts human beings from any substantial environmental constraint" (Guterbock, 1990, p. 362). This is aided by technology that makes it possible to live comfortably in some of the harshest conditions.

Utilitarian cycling pits humans against the elements without the comfort climate-controlled surroundings. In order for cities with extreme climates to successfully mainstream cycling, it is important to provide cycling environments that are climate-responsive and tailored to unique local conditions. Why does this matter? Hester (2006) argues that cites should take advantage of their natural factors, explaining they "could save billions of dollars in energy, food, drinking water costs, and waste disposal while providing recreational amenities, local identity, and sense of place" (p. 2).

2.5.1 Winter cities

Cities located in regions with extreme climates, whether hot or cold, arguably have the most to gain from vernacular approaches to transportation. During the 1980s a substantial body of work emerged advocating the need to utilize distinct forms of planning and design in winter cities. The concept of creating climate-responsive, livable winter cities is based on embracing the winter season as an asset, and taking a "four-season approach" to planning and design (Kehm, 1985; Pressman, 1995; Zeidler, 1985). Pressman (1985) writes, "Creative and innovative responses in planning and development policies and projects must be sought to make winter cities more livable through the transformation of their natural, built and social environments" (p. 27).

Winter presents unique problems and opportunities to urban residents, and the Winter Cities Institute was formed in 2008 to "identify, promote and share the positive

attributes of winter living, new concepts in architecture and urban design and success stories from those places that are thriving in the north" (Winter Cities Institute, 2010).

According to Pressman (1985), discussions of climate and cities often focus on the micro-level, concentrating on efforts such as ensuring homes have adequate insulation.[7] Pressman argues this narrow view dominates the psyche of politicians, planners, and the general public. It directs attention away from examining larger-scale issues such as how transportation and land-use may complement, or be affected by, climate. Pressman states, "climate must be seen as a significant modifier of urban spatial form" (1985, p.14). He continues:

> …since we are no longer living in an era of cheap and plentiful land and energy, we shall have to plan and manage our cities by using a model of urban settlement which is highly integrated with the natural forces (ibid).

Guterbock (1990) argues that winter cities have a more compact land-use compared to southern cities because the costs associated with snow removal increase with lower densities. However, winter cities still experience the urban sprawl and generic land-use that are not conducive to active transport.

Chapter 2.4 introduced the concept of "placeless" environments. While there are aesthetic and social implications of placeless man-made environments, this trend has also ignored local and climactic conditions, resulting in serious sustainability issues. According to Pressman (1996), the trend has also resulted in:

> …steady-state, thermally neutral environments (constant temperature and humidity regardless of natural conditions) where indoors and outdoors are no longer connected or related (p.522).

[7] There has arguably been little change in dialogue in the ensuing decades since Pressman's writing.

While little of the winter cities literature addresses cycling specifically, the need to incorporate sustainable transportation and reduce automobile dependence is addressed. Zepic (1985) argues that good winter design should incorporate land uses conducive to public transportation and walking, stating "land use and transportation patterns which are climate-responsive are also energy efficient" (p.64). Active transportation and pedestrian issues also appear in academic studies (see-Coleman, 2001; Li and Fernie, 2010). Li et al. (2010) found that low temperatures had little impact on people's willingness to walk, but snow and ice conditions were mitigating factors. In this sense, curb and sidewalk designs that aid mobility and winter maintenance are seen as vital design components to increase winter pedestrian safety and comfort. This is especially important as populations are ageing. In regards to cycling, McKechnie (2008) discusses the need for complimentary efforts including Transportation Demand Management (TDM) to overcome the considerable physical and attitudinal barriers associated with active transportation during the winter months.

The importance of building climate-responsive winter cities is often overlooked in the contemporary context. Ryser and Halseth (2008) found that despite a stated desire to incorporate climate-responsive elements into urban development, a lack of political will, expertise, and knowledge often permeate the development process. Meanwhile, research by Kumar (2001) found that Canadian cities tend to overlook cold-climate issues in regards to urban design standards.

Pressman (1995; 1996) argues the tools for planning and designing livable, climate-responsive winter cities rest with developing a winter vernacular. Many authors, planning theorists and practitioners advocate the re-introduction of the vernacular into

city building, and stress the need to incorporate local factors into the design of cities and buildings (Crawford, 2009; Gober, 2006; Hester, 2006; Hough, 2004; Krier, 2009; Newman and Jennings, 2008).

2.5.2 The vernacular

According to Hough (2004), the term "vernacular" refers to urban and landscape forms that "grow out of the practical needs of inhabitants of a place and the constraints of site and climate" (p.9). Crawford (2009) explains that "vernacular" literally means "the native language of a region" (p. 65). Thus, when we discuss vernacular design we mean design that is native to a region and responsive to local conditions. A region's vernacular traditionally developed in response to problems of shelter and security. Pre-industrial cities were constrained by landscape, climate, agricultural capacity and water supply.

Historically, vernacular designs allowed functionality and comfort in cities around the world, including those in harsh climates. In harsh climates vernacular design was crucial because:

> Climate, more than any of the natural systems…transcends all the boundaries of nature and human activities…It is the fundamental force that shapes local and regional places and is responsible for the essential differences between them (Hough, 2004, p. 189)

Cities developed climate-responsive, vernacular design out of necessity. According to Pressman (1996), we must recognize there are specific discomforts related to local climates, hot or cold. The challenge is to address these discomforts appropriately, without relying completely on technology, or simply holing up in climate-controlled environments. Pressman writes:

> Archetypes commonplace in vernacular building frequently reveal triumphant solutions, turning natural liabilities into assets without resorting to clichés, trend or fashion in stylistic thought" (1996, p.527).

With the start of the industrial revolution a process of technological progress was set in place that eventually allowed the perceived subjugation of nature in cities around the world (Gober, 2006). Motorized transportation, climate control and other technologies allowed an erosion of vernacular design and increased the homogeneity of architecture and planning. Cities and regions began to shed the attributes that made them unique and garnered sense of place. In winter cities, there was an overall push to enable four-season livability. This manifested itself in the proliferation of overhead and underground passageways, often at the expense of street life, found in cities such as Montreal, Minneapolis, Calgary and Winnipeg (Boddy, 1992).

Hough (2004) outlines four effects of climate-control on cities. First, it freed buildings from the constraints of weather that once dictated architectural form and amenity. Second, climate control and cheap energy allowed urban form to develop with disregard for the natural; creating outdoor environments, such as bare windswept plazas, that are almost unlivable. Third, there has been a self-reinforcing neglect of pleasant outdoor spaces in favour of controlled indoor ones. And finally, people's perception of the outdoor environment has been skewed, as urban life has "become a series of air-conditioned experiences" (p. 195). This is demonstrated through the rise of Sunbelt cities (Gober, 2006; Luckingham, 1991), and the proliferation of uniform design found throughout the world, regardless of local climate (Lienberger, 2008).

In places with less access to energy, "the business of keeping warm or cool…is achieved by the necessity of accepting the limitations of the climatic environment and making the most of its opportunities" (Hough, 2004, p. 197). Throughout less developed countries, houses are still cooled by breezes and shading. Historical examples still remain

in the “developed world” including Middle Eastern courtyard houses, and the traditional form of Mediterranean cities that capitalized on sea breezes and utilized narrow streets for shading. Hough (2004) emphasizes that vernacular landscapes “hold crucial lessons for us today in our search for a relevant basis for urban form in the twenty-first century” (p.9). We must look both inward and outward to inform and influence how we build resilient and climate-responsive cities for the future.

In order to create livable, sustainable cities, we must reconnect our cities to a local vernacular. Hester (2006) stresses the importance of grounding city design in the “particular character of the surrounding ecology,” and finding associations with precedents from similar landscapes (p.9). Of particular interest to this research, he suggests, “it is sometimes useful to consider particular adaptations of resilient design from places often far away but with similar climate, vegetation, topography, or culture” (p.163). Craddock et al. (2009) also stress the importance of using precedents to inform local planning. The approach used to the planning and design of Oulu’s bicycle network could be of relevance to other cities that face similar climactic conditions, especially Canadian cities.

2.5.3 Transport vernacular

While vernacular forms are an important, if often overlooked, component of architecture and design, the relationship between the vernacular and transportation is less obvious. Some cities provide examples that are more clear-cut than others. For example, Venice Italy is a unique city based around water and a series of canals. The old city is car-free and transport is carried out on foot and in water-borne vessels. This is a vernacular transport dictated by the city’s location and form (Crawford, 2009). Other

cities are built around canals and waterways, but arguably none are as dependent on them as Venice.

Transportation can also reflect a cultural vernacular. For example, the Dutch propensity towards cycling could be seen this way. Wray (2008) argues the root of Dutch cycling's popularity lies with the traditional Calvinist Christian views, which emphasize the importance of work and effort.

An example of transport vernacular related to bicycling can be found in Trondheim, Norway where the city has constructed a bicycle lift called *Trampe*. The lift offers cyclists assistance traversing a steep vertical climb between the city centre and university (City of Trondheim, 2008). The *Trampe* represents a response to this natural obstacle, by allowing cyclists to skip the steep, strenuous uphill ride, receiving a lift from a small, simple unobtrusive piece of infrastructure. The lift opened in 1993 and is 150 meters in length. It moves users uphill at a speed of 2 meters per second and has a capacity of 300 riders per hour, with a maximum of five simultaneously (City of Trondheim, 2008).

The best way to address climatic issues as they relate to bicycling is to construct a quality urban environment offering shade, protection from wind and natural elements, and calmed traffic. In essence, vernacular cityscapes represent the vibrant, place-based design advocated in most contemporary, postmodern planning literature. This need not require fancy design treatments or traffic calming infrastructure. To quote Jones (2001), "the best cycling facility is a road with lots of other cyclists on it" (p. 11).

Sense of place and diversity have been established as an important components of urban sustainability (Hester, 2006; Talen, 2006). To quote Newman and Jennings (2008),

"place unites our social and ecological worlds. It is where real interaction occurs and stories unfold" (p. 145). It is about being connected to a location, and having feelings of engagement with people and the land. This concept pertains to both the quality of the built environment as well as the integration of ecological elements into the city. Hough (2004) emphasizes the importance of city dwellers' connection to the landscape and the visibility of natural processes, as these are "an essential component of environmental awareness and a necessary basis for environmental action" (p. 24).

Efforts to develop sense of place should be rooted in the vernacular. Hough (2004) argues that cities require flexible policies allowing communities to evolve in a unique fashion, as well as an environmental planning approach to curb sprawl, protect natural areas and farm land, reduce automobile dependence and restore air quality.

All too often, urban areas have neglected quality place-making and natural elements in their design. To quote Hough (2004), "design values which have shaped the physical landscape of our cities have contributed little to their environmental health, or to their success as civilizing, enriching places to live in" (p. 1). In terms of transportation, this is manifested through infrastructure that caters to only one mode of transportation. Modern cities cater to automobiles as opposed to people, culture, or history (Crawford, 2002). Pressman (1995) and others argue that the greatest, and most urgent, dilemma facing our time is to create genuine places stemming from geographic and cultural contexts.

Modes of transport can determine how people interacted with landscapes. Automobiles create a sense of detachment from one's surroundings, as speeds are generally higher, and motorists are encased within their vehicles in a climate-controlled

setting, often listening to music and/or the radio. Cultural geographers have long discussed this phenomenon, particularly in relation to tourism and long-distance travel (Appleyard et al., 1971; Gaudry, 2003). These theories also apply to the urban environment where cyclists and pedestrians help garner to sense of place, and contribute to the active street life advocated by Jacobs (1992), Scheurer (2007), and others.

2.6 Transport vernacular: The "pack donkey's way"

If we accept that winter cities require a transport vernacular to encourage cycling and sustainable transport, it is valuable to examine how such a vernacular may come about. In an urban environment, the most common transportation infrastructure is the roadway. Although not as imposing as an elevated freeway, most roadways are unable to safely accommodate non-automotive traffic. Crawford (2009) argues that streets constructed since World War II are the worst built in history. In the 1960s, under the modernist planning paradigm (see Chapter 2.1), planners attempted to segregate traffic, with the assumption that separating automobiles from cyclists and pedestrians would be safer and more pleasant for all parties involved (Hamilton-Baillie 2008). Unfortunately, almost all funding and effort was directed towards automobile infrastructure and the safe, segregated routes for pedestrians and cyclists never materialized.

These efforts were largely based on the theories of Le Corbusier. Berman (1982) recounts that planners and architects through the post-World War I and World War II periods followed Le Corbusier's mantra of rationalizing transportation, effectively killing the street as a functioning social entity. Thus streets assumed the primary role of efficiently moving motorized vehicles (Berman, 1982, Le Corbusier, 1987; Patton, 2007).

Historically, streets developed in response to natural topography, water features, and bursts of population growth, thus forming “complex irregular patterns” over centuries (Diefendorf, 2000). Le Corbusier lamented that 20th century cities still reflected these historic features, which he referred to as the “pack donkey’s way,” paths that had been in existence since donkeys carried goods. These narrow roadways, according to Le Corbusier, caused traffic congestion and crippled cities. He proposed a geometric solution to transportation consisting of wide, controlled-access roads stating. “the straight road is man’s way…[it is]…a reaction, an action, a positive deed, the result of self-mastery. It is sane and noble” (Le Corbusier, 1987, p. 12).

Figure 8: The "pack donkey's way." Freight movement in Fez, Morocco. Photo by author.

Le Corbusier's ideas, which date back to the 1920s, are generally regarded as having informed modern transport planning and the worldwide embrace of high-capacity, automobile-centric roadways. While high-speed, high-volume traffic corridors may provide efficient movement of people and goods over long-distances, these roadways proved detrimental in the urban realm. Appleyard (1982) discussed the social role of the street in a historical context, while Patton (2007) describes the purely functional role streets now play, writing, "infrastructure designed for traffic flow created subject positions" (p. 941) favouring motorists over other users. Hester (2006) explains that streets, as constructed throughout the post-war period, have become decisive forces that compartmentalize and segregate the city. Hester emphasizes that through "careful design, streets can be places of social interaction again" (p. 52).

The "pack donkey's way" literally and figuratively represents a transportation corridor that responds to the environment: vernacular transportation. It would prove foolish to advocate turning our backs completely on the technologies and efficiencies developed in the transport sector. Also, it must be stressed that transport and the economy are distinctly intertwined (Black, 2010; Hamilton et al., 2008; Rodrigue et al., 2006). However, elements of vernacular transportation corridors can help inform efforts to develop and enhance human-scaled, climate-responsive, place-based transport infrastructure, and sense of place in contemporary cities.

Through utilizing aspects of the "pack donkey's way" coupled with contemporary ideas and technologies, we can experience the best of both worlds in the urban environment. This will be vital in creating livable, efficient transportation corridors to foster a sense of place and embrace unique attributes of the urban realm. Two potential

tools for facilitating this return to a transportation vernacular are “complete streets” and context sensitive solutions (CSS).

2.7 Complete Streets

City life involves a complicated dance, what Jacobs (1961) described as the “intricate sidewalk ballet” (p.50). Cities function through movement, and to quote Patton (2007), “despite their different sizes, weights and speeds, pedestrians, bicyclists, bus-riders, and drivers…coexist through choreographed, often-strained, interactions” (p. 931). A “complete street” refers to a roadway that safely accommodates all users, in an attempt to reduce conflict (McCann, 2005).

Complete streets facilitate multi-modal transport, and in urban settings, inherently emphasize pedestrians and cyclists. McCann (2005) describes the strong role that bicycling advocacy groups have played in the development and proliferation of the complete streets movement in the United States. La Plante and McCann (2008) explain the complete streets movement “is about policy and institutional change” (p.24), meaning the goal is to move beyond the design of individual roadways and to overhaul the entire framework in which streets are conceived.

The term “complete street” was coined in the United States in 2003, but the origins of the concept are much older (McCann, 2005). These ideas are derived from the *Woonerf*, or Home Zone, which developed in the 1960s and 1970s in the Netherlands. Planners experimented by removing road signs and markings and created a “new vocabulary of street design rich in local references, surprise, and intrigue” (Hamilton Baille, 2008, p. 166). In 1976 the Dutch government formally adopted the *Woonerf* for low-speed residential zones (Hamilton-Baillie, 2008; Quimby and Castle, 2006).

Several factors spurred interest in new roadway arrangements, including environmental concerns, economic activity, health, safety, and quality of life (Hamilton-Baillie, 2008). Instead of accommodating more traffic volume with wider roadways, it was decided that traffic should be calmed, in an effort to bring about an overall reduction. This spawned the "slow traffic movement" (Newman and Jennings, 2008). Recent research has concluded that design features and physical characteristics of roadways, such as those utilized in complete street schemes, do increase safety by reducing free-flow vehicular speeds (Ivan et al., 2009).

The *Woonerf* was intended to be a place-based, unique, vernacular form of traffic management. Each community would find what worked for them. Research has shown these traffic schemes reduced average traffic speeds upwards of 40 percent, reduced accidents, and improved transit travel times (Hamilton-Baille 2008).

In some European cases, the concepts of shared space and the *woonerf* have been taken further to include simplified, or "naked", street schemes. In the "naked street" concept traffic signs and engineered traffic control are removed altogether under the assumption that chaos and intermixing of users will create a safe environment. This approach has been referred to as "safety through chaos" (McCann, 2005; Quimby and Castle, 2006). Research suggests these schemes are safer for pedestrians and cyclists (Newman and Jennings, 2008).

Most complete street projects range in scope from simple traffic-calming treatments to complete naked street schemes (Quimby and Castle, 2006). In the North American context, complete streets are generally a pared-down version of the European

model. Projects often involve the addition of marked bicycle lanes, and some traffic calming-elements.

Complete streets offer communities the opportunity to return a sense of identity and unique character to their streetscapes, incorporating elements of the local vernacular. Complete streets are intended to embrace unique solutions relevant to the location, land use and intended function of the corridor (LaPlante and McCann, 2008). As each project must find its own unique balance to be effective, complete streets represent an "important step towards widening the opportunities for communities and individuals to shape and influence the built environment in ways that encourage diversity, distinctiveness, urban quality and civility" (Hamilton-Baille, 2008, p. 162).

2.8 Context Sensitive Solutions (CSS)

Context sensitive solutions (CSS) is a technique to facilitate the development of transport corridors that, "serve all users and are compatible with the surroundings through which they pass-communities and the environment" (ITE, 2006, p.3). CSS emphasizes that transportation planners are responsible for community-building. In addition to geometric standards, they must "consider land use, environmental quality, community cohesion, and quality of life in their designs" (Tudor and Luzcz, 2006, p. 18), representing a step away from the rational engineering model.

CSS represents an established approach to facilitate the development of complete streets and vernacular transportation corridors. La Plante and McCann (2008) stress that CSS and complete streets are "complimentary movements" that aim "to create a complete and safe transportation network for all modes" (p.25).

CSS projects are characterized by interdisciplinary design teams and emphasize community collaboration, with local stakeholder groups being involved early in the process, and consulted throughout. CSS aims to balance safety concerns, protect the environment, and achieve community goals.

CSS establishes principles for projects within walkable communities that are intended to preserve and enhance these characteristics. They also present principles to create walkable communities in existing or new urban areas. The emphasis is always on place-making. In the end, "a successful CSS process builds consensus on the best possible solution and promotes community ownership in the results" (ITE, 2006, p.7).

The CSS approach acknowledges a range of factors that create context in transportation corridors. According to the ITE, these include land-use, site design and building design. The value of CSS is that it is driven by public consultation and stakeholder involvement. It is open to address climatic needs should the public value these issues. However, weather and climate should be included as elements that create context.

2.9 Cycling and climate

Transportation and climate are intertwined. A review of available literature reveals that weather and climate affect levels of cycling (ECMT, 2004; Myllyla, 2000; Parkin et al. 2008; Rietveld and Daniel, 2004). This relationship also exists with other modes of travel. For example, Kuby et al. (2004) suggest climate and weather reduce light rail transit ridership in the United States.

There is great variation regarding the extent of the influence weather and climate exert on cycling behaviour. Research in the temperate climate of Melbourne, Australia

determined that inclement weather (mainly rain and wind) had a profound affect on discretionary cycle trips but not regular commutes (Nankervis, 1999). These findings can be attributed to the fact that regular cycle commuters who are committed to riding have the experience and appropriate gear to account for most inclement weather.

Dutch researchers have found a direct relationship between the number of warm, sunny days and the overall mileage of cyclists, as trips were either foregone or switched to other modes during inclement weather. The same research also found statistical relevance between the inclement weather and injuries to cyclists. In gross numbers, however, the greater volume of cyclists in good weather resulted in higher numbers of injury and hospitalizations (FietsBeraad, 2007). Similarly, Kim et al. (2009), found that there is a direct relationship between inclement weather and darkness and increased cyclist injury severity in collisions with motor vehicles.

Graffon (2003) cites the high modal shares of some northern European cities as demonstrating that cold weather and climates need not preclude the bicycle's role in urban transport. Pucher and Buehler (2006) point out that, on average, Canadians cycle three times more than Americans, despite a population living in significantly colder climate than most Americans. The authors conclude: "just as a cool climate does not prevent cycling, a warm climate does not necessarily assure it" (p. 265). McClintock (2001) states that matters of weather and climate are over-exaggerated. This statement can be seen as revealing a bias towards temperate climates present in much of literature on this topic. There is little research on cycling in cities with extreme climates. Much of the available literature on winter cycling relates to the effects of snow and ice on real and perceived safety.

2.9.1 Winter Cycling

To bring cycling into the mainstream, winter cities face hurdles their counterparts in temperate climates do not. While winter conditions can be seen as a deterrent to bicycle use, they need not preclude active transportation, nor the provision of active transportation infrastructure.

Myllyla (2000, p. 151) outlines essential factors for winter cycling, covering the basics of infrastructure, maintenance, and personal choice:

- Route Structure
  - Bicycle paths separated from car traffic
  - Minimal grade changes
  - Adequate lighting (for shorter daylight periods)
  - Appropriate path surface (to reduce slippage and allow for maintenance)

- Route Maintenance
  - Proper planning and management of winter maintenance
  - Access to, and use of, localized weather information
  - Specialized machinery
  - Snow plowing
  - Leveling off of surfaces
  - Application of anti-slip agents (sand and/or salt)
  - Proper drainage

- Cylist gear
  - Snow tires (studs)
  - Lights to provide visibility
  - Adequate winter clothing and extremities

- Cyclist
  - Motivation
  - Winter tolerance
  - Heat generation from movement

Research conducted in Copenhagen found cycling levels were reduced in winter months with specific foul weather incidents reducing ridership by as much as 66% (City of Copenhagen, 2002; Nankervis, 1999). Research in Sweden found variations in ridership between summer and winter of approximately two-thirds (Bergstrom and

Magnussen, 2003). In Ottawa, Ontario winter ridership falls to as low as 5% of the summer average (Pucher and Beuhler, 2005). In Minnesota, the Department of Transportation concludes that only 0.2 percent of cycling occurs between November and April, but their *Modal Plan* cites media reports that more people can be seen cycling in Minneapolis in the winter than in Los Angeles at any time of year (MnDOT, 2005, p.20). Finnish research (MTCF, 2002) found that a significant segment of summer cyclists convert to other modes when winter weather begins. However, within the realm of winter cyclists, extreme temperature and weather events have little effect on deterring daily cycling levels.

In the Canadian city of Winnipeg, Manitoba, a cyclist survey and an active transportation study were administered that gleaned information on winter cycling (Marr Consulting, 2005; Hull, 2006). Similar to the data from Copenhagen, both studies found that the proportion of Winnipeg cyclists who cycle year-round shrinks by approximately two-thirds. The cyclist survey also identified the need for improved year-round maintenance of cycling routes and pathways. Respondents discussed issues of irregular and inadequate snow removal, snowpacks, slippery conditions, and the phenomenon of snow accumulating in the roadways and shrinking travel lanes (Hull, 2006).

Public transportation can play an important role in mitigating the effects of weather on cyclists (Halladay, 2002; McClintock, 2001; Myllyla, 2000; Pucher and Beuhler, 2005; Wray, 2008). Transit systems, whether bus or rail, can offer cyclists a means to escape extreme temperatures or icy roads. While transit can serve as a substitute during winter months or during inclement weather, it can also be used for trip sections, or bicycles can be used to access transit stations. Buses and trains outfitted with bicycle

racks are especially helpful in this regard: in some cities, however, bicycle racks are removed in the winter (Marr Consulting, 2005). Planners should always consider cycling and transit as complementing each other, not competing (Halladay, 2002; Myllyla, 2000).

European research indicates the foremost influence on winter cycling is the maintenance of cycling trails and routes (Bergstrom, 2002; Bergstrom and Magnussen, 2003; Coleman, 2009; MTCF, 2005). Frequent clearing of snow and ice, especially early in the morning before peak commuting times, and along the length of entire route networks appears to be of greater consequence than winter weather itself. In addition to the removal of snow, snow storage is another complicated issue, as snow from roadways often accumulates on bike lanes (Coleman, 2009). Of course, this scenario assumes that adequate cycling infrastructure exists, which is not the case in many cities. In cities that experience harsh winters, such infrastructure assumes greater importance as it protects cyclists from automobiles in icy conditions, both from sliding into a car's path and vice-versa. It is important that cycling infrastructure is able to accommodate snow removal equipment (ITE, 2006) and uses surfacing materials that provide traction in winter conditions (Myllyla, 2000; Crawford, 2009). After all, people can opt to cycle year-round and adapt their behaviour, clothing and gear to the weather, but to provide a safe environment for cycling requires adequate route maintenance (MTCF, 2005).

Some countries have adopted national policies to dictate winter maintenance of transport infrastructure. For example, the Finnish Road Administration (FRA) enacted a winter maintenance policy to establish a predictable level of service nation-wide, with the aim of achieving "uniform quality of the main road network" (FRA, 2001, p.7). The over-arching goal of the policy is to create conditions in which winter road travel is not

inherently more hazardous than in summer conditions. The policy pertains to the entire road network, and by default, pertains largely to automobiles. However, it emphasizes impartial treatment of all modes of transport and includes many provisions for cycling infrastructure.

The policy requires urban areas to maintain active-transportation facilities for year-round use. The multi-modal nature of Finland's transport policy is emphasized in the following statement:

> The purpose of winter maintenance is to ensure the functionality of transportation in winter. The level of winter maintenance has a direct, far-reaching impact on all of people's and society's functions that are linked to day-to-day travel on roads and pedestrian and bicycle paths…and the road network" (FRA, 2001, p.10).

Finland's policy accounts for regional variations throughout the country and differences in travel needs between urban and rural areas stating, "the objectives set for winter maintenance should clearly be based on society's activities, and operation should be flexibly controlled according to those needs" (ibid, p. 10).

Roadways are divided into 5 maintenance categories, reserving two extra categories for active transport facilities. Referred to as K1 and K2 these classifications are used to prioritize winter maintenance on routes that serve commuter traffic and access public transit. K1 routes are maintained to high standards and receive treatment in the morning before commuting begins, through the evening and on weekends. K2 routes, are essentially secondary to K1's and thus receive less attention. They receive maintenance following a weather event, and their condition may not be maintained to as high a standard until another weather event occurs. Cycle paths are required to receive anti-slipping treatment at 2-hour intervals, and snow removal at 3-4 hour intervals during inclement weather events (ibid, pp. 19-20).

The Finnish policy also allows for “precision maintenance” of lower category roadways and AT paths as local conditions require (FRA 2001, p. 17). Such practice allows extra maintenance on a heavily used section of a cycling pathway without having to increase the entire pathway to K1 classification.

In contrast, North American jurisdictions largely leave such policies to the local level, and these are generally lacking in quality. Minneapolis, Minnesota, which is highly regarded as an American leader in cycling policy, has a winter maintenance policy that merely aims to keep cycling facilities “reasonably free” of snow and ice. Snow removal and sanding are not required to be performed until the end of the next business day following a winter weather event (City of Minneapolis, 2009).

Increased bicycle use is one component of creating sustainable and livable cities. While cities that experience extreme climactic conditions may have a greater challenge encouraging cycling than those with temperate climates, this need not prevent bicycle use. Infrastructure and policies are important tools for mitigating the effects of climactic limitations. Well-maintained bicycle lanes, pathways, and shared streets are important, and in zones with high levels of pedestrian and cycling traffic, Pressman (1995) argues weather protection elements including canopies, awnings, arcades and colonnades may be warranted.

2.9.2 Cycling and extreme climates

Throughout the world there are regional and seasonal variations in cycling levels. Winter cities are subject to extreme cold, ice and snow, while Sunbelt cities are subject to extreme heat. While winter cyclists risk falls and frostbite, cyclists riding in high temperatures risk dehydration and heat stroke.

A gap appears to exist in the sustainable transportation literature concerning cycling in hot climates. One potential reason for this could be that winter cities must pay attention to road maintenance and other special considerations related to snow and ice. In cities with hot climates, since the rise of the automobile, there is little need for special climate-related considerations, for example, snow clearing. The onus is on the motorist to have air conditioning, or a window that can be rolled down to keep cool.

Figure 9: Cyclists brave extreme conditions throughout the world. Here, a cyclist braves a sandstorm in Rissani, Morocco. Photo credit: Author

Rietveld and Daniel (2004) identify heat as a factor in Cycling's lack of popularity in Southern Europe, versus the moderate climate of the Netherlands. However, the only academic literature concerning cycling and heat concerns the general field of cyclist dehydration and injury prevention (Cruz et al., 2009; Danenberg et al., 1996;

Mellion, 1991). No research could be found specific to commuting, or utilitarian cycling in hot urban environments, during a review of the literature.

Bicycles can be used year-round in almost any climate; harsh winters or extreme heat need not eliminate cycling from the urban landscape. In fact, winter cycling can be an especially beneficial activity (MTCF, 2005). While this thesis explicitly addresses cycling within a four-season context, winter cities need not preclude investments in cycling infrastructure in the face of potential winter abandonment. Investments in cycling infrastructure and pro-active cycling policy in winter cities is also important because winter cities must allow residents to "embrace and exploit" the summer months (Pressman, 1995, p. 148). According to Pressman (1985), so much time is spent indoors during winter months that it is "important to maximize the positive aspects of contact with the outdoor environment by extending the outdoor season" (p. 14).

Pucher and Beuhler (2008) argue that government policies are as important to cycling use as climate, topography and culture. Drawing on the winter cities literature, vernacular design theories, and available research on winter cycling this thesis can conclude that embracing climate and developing a climate-responsive transport vernacular is a worthwhile endeavor.

2.10 Cycling infrastructure

Before the introduction of automobiles, cyclists "ruled" the roads and were key players in the development of high-quality roadways. In the United States, The League of American Wheelmen (LAW) played a principal role in the development of the American highway system (Hugill, 1982). According to Ackerman (1993) LAW "was part social organization, part service organization, and part lobbyist-both for good roads and 'for the

rights of wheelmen'" (p. 11). The Canadian Wheelman's Association launched a similar movement in Canada, but they were generally less successful and cyclists did not play as critical a role in the development of Canadian roadways (Norcliffe, 2001).

Despite having initial road dominance, Ploeger (2003) describes instances of conflict between cyclists and motorists in the Netherlands dating back to the early 1900s. Similar instances have played out throughout the world over the last century, and occur in most cities on a daily basis. Cycling-specific infrastructure is often viewed as a means to ease conflicts between cyclists and motorists, increase cyclist safety and encourage bicycle use through enhancing the cycling experience. Infrastructure for cycling includes bicycle lanes, pathways, cycletracks and other rights-of-way for conveyance. Bicycle-specific traffic signals, left-lane turning boxes, wayfinding signage, and storage and parking facilities also comprise essential urban infrastructure for cyclists.

Cities throughout the world have been increasing the amount and variety of infrastructure available to cyclists, which is a marked result of the sustainable transportation paradigm shift. For example, Portland, Oregon increased its cycling network mileage by 300 miles between 1996 and 2006. Over the next 20 years that city's network is set to increase to over 900 miles (City of Portland, 2010). In Canada the City of Winnipeg recently spent over $20 million (CAD) on active transportation infrastructure as part of a tri-partite infrastructure agreement (City of Winnipeg, 2010). These are just two brief examples, and there are numerous projects of varying sizes and scales that could be listed.

Figure 10: Worldwide bike infrastructure. Bangkok Thailand (left), Tokyo, Japan (top), and Phoenix, USA (right). Photo credits: Author

Mainstreaming active transportation modes has numerous benefits for cities, addressing sustainability, health and livability issues. Active transportation infrastructure has been increasingly attractive in many jurisdictions due to its visibility (capital projects are very popular politically), and because it is "by far the most efficient transportation investment that can be made, with very low capital and operational costs when compared to investments in either roadway or transit capacity" (Courtney, 2009, p. 86). While there

is no conformity in methodology, studies throughout the world have found positive cost-benefit relationships on active transport projects, meaning in many instances, an economic argument for cycling and walking infrastructure can be made (Cavill et al., 2008). Worldwide data suggests that infrastructure, whether in the form of separated paths, bicycle lanes, or other treatments, encourages cycling and increases cyclist safety, although much debate surrounds these claims (Pucher, 2001).

In the United States the passage of *the Intermodal Surface Transportation Efficiency Act* (ISTEA) represented a watershed change in transportation funding. Beginning in 1991, ISTEA began a shift in the Federal Highway Administration from dealing almost exclusively with roads, as their name implied, to a multi-modal focus, including self-propelled transport (Balsas, 2002; Cradock et al., 2009; Golub et al., 2009; Shaw and Moler, 2009). It cannot be stressed enough, however, that the effectiveness of cycling infrastructure is closely tied to its quality. Unfortunately, some of what has been constructed, especially in the United States under ISTEA, has been of limited quality, and/or not tied into to continuous networks (Dill, 2009; Jia et al., 2007; Krizec and Roland, 2005; Pucher, 1997).

Infrastructure is an important amenity that increases cycling's attractiveness and safety. However, there is a long-standing debate over the direct relationship between cycling infrastructure and its ability to increase modal shares and alter the behaviour of existing cyclists. Aultmann-Hall et al. (1997) found that most bicycle commuters vary their ride little from the shortest option, primarily keeping to major road routes. Shafizedah and Niemeier (1997) found evidence that cyclists within a 0.5-0.75 mile range of an off-road cycling path would increase their trips to use the facility. Stinson and Bhat

(2003) similarly found that cyclists would alter their routes slightly, up to a 10 per cent increase in travel time, to access routes with very low traffic or designated cycling facilities. Meanwhile, Tilahun et al. (2005) present the most dramatic results, finding cyclists would increase their travel time upward of 20 minutes to access an off-road trail facility. According to Dill (2009), while only 8 percent of a city's roadways had marked lanes, over 50 percent of cycling trips occurred on these routes, indicating cyclists would alter their trips to avail themselves of infrastructure (Dill, 2009).

Krizec et al. (2007) further develop the relationship between infrastructure and cyclist behaviour, acknowledging that trip purpose plays a role in how far cyclists will travel to access available infrastructure. In general, cyclists will increase their trips to access off-road infrastructure, but this is especially true for recreational and beginner cyclists. Bicycle commuters, and those who cycle regularly for utilitarian purposes, were found to be far-less likely to alter their routes than casual and recreational cyclists (Krizec et al., 2007).

Patton (2007) describes the ongoing conflict between road users. Off-road pathways are often seen as the most attractive option for cycling, especially for recreational cyclists, less-experienced cyclists and women cyclists (Garrard et al., 2009). It must be mentioned that pathways are often shared-use and conflicts between cyclists, inline skaters, pedestrians and other users do occur. While a lack of motorized traffic is seen as providing a safer environment for cyclists, it is important to remember that on shared use pathways, cyclists do pose a danger to pedestrians (ECMT, 2004; Myllyla, 2000).

Jones (2001) warns that "perhaps the most basic principle, often forgotten, is that the bicycle is a vehicle requiring sightlines and turning radii for speeds up to 20 mph; considerably higher than the pedestrians with whom cyclists are often expected to mix" (p. 8). Myllyla (2000) addresses the dynamics of pedestrian-cyclist and cyclist-automobile relationships, emphasizing the role of quality design and engineering in minimizing conflict. He concludes the issue is behavioural, and not "a problem that can be solved by…technical means" (p. 148). Jia et al. (2007) also advocate altered design-standards for multi-use paths that better reflect user characteristics, such as safely accommodating side-by-side bicycle riding in each direction.

To be effective and serve the needs of cyclists, off-road trails should travel significant distances, meet user needs, and link nodes of activity. Krizec et al. (2007) found that cyclists are more willing to alter their route to use a trail if they will be following it for a significant distance. Trails that provide unimpeded travel, for example, between residential districts and the central business district, will have a greater draw than piecemeal stretches of trail within residential areas.

In practice, pathways may best serve inexperienced recreational cyclists. If the goal is to truly mainstream cycling the literature suggests that role of shared-use pathways may be limited (Tin Tin et al., 2010). In order to serve cyclists of all types and abilities, in accordance with Krizec et al. (2007), a comprehensive regional network of pathways serving the entire urban area would prove most effective.

According to research carried out in Edmonton, Alberta by Hunt and Abraham (2007), cyclists have listed designated lanes as their preferred form of infrastructure. Through a stated preference study, the authors determined that cycling on a roadway in

mixed traffic was 4.1 times more onerous than in a marked lane. Riding on a shared-use pathway with pedestrians was 1.4 times more onerous than in a marked lane. Krizec (2006) also concluded that cyclists prefer marked lanes over shared pathways, concluding that for a 20-minute commute, an on-street bicycle lane is worth an additional 16.3 minutes of travel. This compares to wide streets without parking being worth 8.9 minutes and off-street trails being worth 5.2 minutes of additional travel. Dill (2009) advocates for cycling networks comprised of marked lanes, shared use pathways and other cycling infrastructure, as well as mixed-traffic on low-volume streets.

Debates surrounding on-road infrastructure (e.g., marked cycling lanes), versus trails and bicycle paths have garnered considerable attention (Barsotti and Kilgour, 2001; Burgess and Burden 1978; Ochia, 1993). The debates often center on perceived cyclist safety, or lack thereof, which is one of the biggest deterrents to cycling (Jacobsen, 2009; Mouden et al., 2005). Women are less likely to ride a bicycle where cycling does not enjoy a substantial modal share and cycling infrastructure is not available (Garrard et al., 2009). Research by Cho et al. (2009) found that residents of low-density singe-family residential areas perceived cycling to be more dangerous that residents of dense, mixed-use urban neighbourhoods, despite actual crash rates being higher in the latter environment. Perceptions of safety become a “catch-22,” because research suggests that as the number of cyclists increase, roadways, in turn, become safer for cyclists (Jacobsen, 2003).

Jones (2001, p.8) provides five core principles for quality cycling routes:

- Coherence: Routes should form part of a wider cycling network, built to consistent standards throughout its length.
- Directness: The infrastructure should follow a route favoured by cyclists, avoiding serious detours and efficiently linking destinations.

- Attractiveness: The route should be well-lit, adequately maintained and equipped with wayfinding signage.
- Safety: Infrastructure should be designed to minimize risk of dangers.
- Comfort: Routes should be built to high standards, be well-maintained, provide gentle gradients and avoid features requiring complicated maneuvers and sudden interruptions.

While these core principles are nearly exhaustive, one crucial addition is that infrastructure is context-sensitive. The nature of the corridor within which infrastructure is constructed should dictate the form that the infrastructure assumes. For example, within a high-volume suburban arterial, parallel pathways or grade-separated cycletracks are likely to fulfill Jones' (2001) core principles more so than a painted lane. Context also applies to a location's climate. Winter cities, or cities in the Sunbelt, will require special attention in order to fulfill Jones' core elements.

Infrastructure is an important component of mainstreaming cycling. Ploeger (2003) asserts that quality infrastructure positions the bicycle to compete effectively with other modes of transport in terms of time, safety and comfort. According to Erickson (2006), 25 percent of walking trips in the United States occur on streets without sidewalks and 95 percent of cycling trips occur on streets without marked cycling lanes, which suggests there may be an overall lack of these facilities. While a need for safe infrastructure for cyclists and pedestrians may exist, infrastructure must be well planned, as ad-hoc treatments will likely not meet their full potential.

Scheurer (2007) discusses the "frustrating paradox" found in the dependent nature of transport networks. Infrastructure for non-motorized and public transportation contributes little to sustainability if people do not use them. Yet conversely, people have few options to travel in a sustainable manner without having such alternatives available.

Sound policy and public consultation can be seen as vital tools to guide and shape well-planned, and appropriate infrastructure networks to meet the needs of cyclists and other road users. Kenworthy (2006) writes, "public transport, and particularly non-motorized modes, have been the big losers in a planning process optimized for the automobile" (p. 81). But now, to quote Goldberg (2009), society must take seriously the task of constructing the "second half" (meaning active and public transport modes) of the transportation network.

The literature suggests that creating a good environment for cyclists is the most important factor. Whether through increased infrastructure provision, or traffic calming, the speed and density of automobile traffic reduces the likelihood that residents will cycle (Jacobsen, 2009). At the end of the day, infrastructure's role in mainstreaming cycling varies according to context and location, with infrastructure likely playing a more important role in winter cities. In general, however, the role of infrastructure is continually debated. To quote Heinen et al. (2010), "it remains unclear whether the presence and continuity of bicycle infrastructure increases bicycle modal share or frequency" (p. 65). This thesis, acknowledges that the overall urban form can play an important role in determining modal choice. While infrastructure provision may not be the sole determinant of cycling's modal share, it remains a key component of mainstreaming cycling, and certainly helps to facilitate bicycle use.

2.11 Applications for winter cities

The existing body of literature on cycling infrastructure is largely devoid of climactic context. One can assume, however, winter cities may have different infrastructure needs than cities in temperate climates. In temperate climates, cycling

lanes, then pathways, are the most desired factors to increase cycling followed by security and safety issues (Tin Tin et al., 2010). When one considers that winter weather creates slippery conditions for both motorists and cyclists, pathways could be seen as having renewed value in winter cities. Finland has pursued this approach, having concluded that in order to provide cyclists with safe winter cycling conditions, they should be separated from automobile traffic (Myllyla, 2000).

2.12 The role of "soft" policies

It is increasingly evident that infrastructure alone will not be enough to bring cycling fully into the mainstream. Research suggests infrastructure is important, but that it will take more to create an attractive environment for cycling (Dill, 2009; Jones, 2001; McClintock, 2001; McClintock 2002b). Jones (2001) even questions the necessity of cycling infrastructure. Thus, the role of "soft," or non-infrastructural policies must be addressed.

Soft policies include promotion, awareness campaigns and education and training. These tactics can, and should, be used in conjunction with each other (Balsas, 2002; Black, 2010; Harrison, 2001; Leinberger, 2008; Mapes, 2009; McClintock, 2002a; Pucher and Beuhler, 2005). Dill (2009) emphasizes the role of non-infrastructure programs, such as marketing, policy, and advocacy groups. These factors can help create a "bicycle culture" that encourages cycling, and shifts cycling from the fringes into the mainstream (p.105).

Increasing the sustainability of the transportation sector is a complicated task. Myriad factors affect how people and goods are transported, including economics and logistics. Increasing cycling's modal share will require a wide range of policy approaches

(Dill, 2009; McClintock, 2001; McClintock, 2002b). There are three main approaches that encompass all policy initiatives: increasing cyclist safety, making cycling more attractive and/or make driving less attractive (Noland and KunReuther, 1995).

Black (2010) further simplifies the role of policy, arguing policies can influence transportation in two key ways: make a particular mode more expensive, generally through taxes, tolls, or fees; and encourage alternate modes of transportation through subsidies, thereby making them less expensive. These approaches can be classified as the "carrot and the stick" approach (Black, 2010) or "push and pull" factors (Rietveld and Daniel, 2004).

While "hard" infrastructure facilities are a crucial component of mainstreaming bicycling, the presence of a bicycle lane or pathway does not ensure it will be used regularly, nor that it will meet the needs of cyclists. Careful planning and policy guidance is necessary to ensure infrastructure forms a cohesive network, and receives appropriate maintenance (Halladay, 2002; Jones, 2001; Krizec and Roland, 2005; Myllyla, 2000; Patton, 2007).

Mainstreaming policy requires public officials committed to the goals of sustainable transportation, willing to make tough decisions, and understand the implications of their actions (Banister, 2005; Bulkely and Rayner, 2003; Sirkis, 2000). Public officials and politicians determine the policies that are created, ensure their implementation, and direct the provision of infrastructure. For example, official attitudes determine whether cyclists are considered pedestrians or vehicles. This is important because the needs of cyclists are different than pedestrians; cyclists cover longer distances at higher speeds, often up to 30km/h (Blanco et al., 2009). According to

McClintock (2002a), failure to recognize bicycles as vehicles can lead to dissatisfaction with facilities that were intended to fulfill infrastructure needs. Thus, while cycling and walking provide many of the same benefits to urban dwellers and policy-makers, they must be considered separately when planning infrastructure, and often, policies (Blanco et al., 2009). How bicycles are legally recognized within a jurisdiction's transportation policy may also have serious safety implications for road users (Culley, 2001).

The above discussion highlights that infrastructure and policy cannot be separated (Courtney, 2009; Pucher, 1997). Policy is a tool with which to guide and complement infrastructure provision. Other policy initiatives such as transit service, marketing, education, and safety campaigns further complement infrastructure investments. At the macro-level, policies and land-use directives to develop a corresponding urban form must also be considered for long-term sustainability (Leinberger, 2008; Myllyla, 2000).

Policy is a crucial component of the mainstreaming process. Crafting effective policy can be a challenge. However, even with policy documents, achieving action and results can prove elusive (Bulkely and Rayner, 2003; Jones, 2001; McClintock, 2001; Ryley 2001; Waddell, 2011; White, 2007). In order for cycling polices to be effective, they must be institutionalized and prioritized in the planning process (Wray, 2008). Such an approach ensures road improvements and new developments accommodate cyclists and pedestrians from the beginning, eliminating the need for expensive alterations or delayed developments. It will also prevent gains made in one area from being mitigated elsewhere in the system (Chifos, 2007; McClintock, 2001; Wray, 2008).

Implementing policies that result in desired actions is a universal problem (Courtney, 2009; Gaffron, 2003; Jones, 2001; Ryley, 2001; Tuominen and Himenen,

2007). It is encouraging to note that combinations of infrastructure and policy have been successfully implemented, bringing about change in countries such as Germany. Pucher (1997) advocates that "with the right set of policies bicycling can be increased almost anywhere" (p. 31).

Harrison (2001) argues cycling policy must achieve two key goals to be successful. First, conditions must be improved for existing cyclists, including increased safety and better infrastructure. Second, cycling's modal share must be increased. Much of the literature has identified an apparent disconnect between policy and action (Courtney, 2009; Jones, 2001; Tuominen and Himenen, 2007). This can be addressed by crafting policies, integrated into the overall planning process, to guide the provision of infrastructure and program development (Hoch, 2009). Doing so will require a greater understanding of how policies enacted at various levels of government interact with local policies to influence change on the ground.

2.13 Policy tiers and bicycle policies

Effective policies will be crucial for mainstream bicycling as a utilitarian form of urban transportation. According to Pucher and Buehler (2008) government policies are as important as climate, topography and culture. Policies that provide "carrot" and "stick" functions, as well as education and promotion, need to work in conjunction with quality infrastructure to influence changes at the personal level. This following section briefly addresses the role of bicycling policies at the international, national, state/provincial, and local tiers.

While policies to encourage bicycling and sustainable transport may be formed at any tier, there is an emphasis on local-level planning. According to Courtney (2009), the local-level emphasis for bicycle and active-transportation planning exists because:

> Effective bikeway planning requires information regarding popular cycling routes, streets with high levels of car-bike collisions and priorities amongst local cycling groups. Municipalities are more likely to have this information at their disposal, which would suggest this planning is better done locally, rather than regionally (p.86).

To quote Rosen (2001), "the way that discourses of sustainability and public consultation or involvement are played out locally helps shape the kind of sustainable transport systems that will emerge" (p. 131).

Highlighting local-level community-based planning fits within the shift towards postmodern planning as described by Hirt (2005). The local approach allows municipalities to develop route networks that respond to their unique characteristics and conditions, and develop a sense of place (Newman and Jennings, 2008). This stands in stark contrast to the uniform highway design standards throughout the continent.

This should not be seen as precluding the need for, or importance of, national and state/provincial cycling policy. Upper and middle tier policies are important for guidance and coordination, and providing official recognition of the bicycle as a valued and important more of transportation. In the United States and Canada there is room for increased involvement at these tiers.

Mid-level policy is especially important for establishing best practices and providing guidance to ensure smaller municipalities can address bicycling issues. As demonstrated with ISTEA in the United States (see chapter 2.10), because money was devoted to bicycling projects did not mean all jurisdictions chose to, or were able to,

access these funds (Cradock et al., 2009). Blanco et al. (2009) assert that local municipalities are often at a disadvantage for procuring federal funding. Also, jurisdictions that accessed ISTEA money for bicycling and pedestrian projects did not always build infrastructure to a high standard, or as part of continuous cycling networks (Dill, 2009; Erickson, 2006; Halladay, 2002; Jones, 2001; Krizec and Roland, 2005). This dynamic emphasizes the need for standards and guidance for local-level planning. Upper and middle tiers of policy also facilitate the establishment of long distance, inter-municipal cycling networks.

National policies are important as they determine how projects receive money, but in the current context it's up to local governments to decide if and how they use these funds (Cradock et al. 2009). The great variations in bicycle use between jurisdictions demonstrates the above dynamic. Kates and Wilbanks (2003) and Keeling (2009) urge that all levels of policy action eventually influence local actions. After all, "despite global, national and regional forces, at the heart of the matter "the demand for, and supply of, transportation is grounded in the local" (Keeling, 2009, p. 516).

In conclusion, strong local policies and actions are required to increase cycling's modal share, while upper-tier efforts play an important role in facilitating funding and quality control, and providing support for local-level initiatives. Upper tiers of policy making can also play a vital role if cycling is to become mainstreamed in more than a few select jurisdictions. Meanwhile, advocacy and promotion efforts must exist throughout the continuum, ranging from grassroots organizations to large national organizations (Vanderslice, 2003). At the end of the day, successful attempts to mainstream cycling in urban transportation will require cooperation between the various tiers of government.

According to Balsas (2002), walking and cycling will only reach their full potential if governments and organizations "at the national, state and local level…respect, compromise and educate each other" (p. 94). In addition to inter-governmental cooperation, there must be dialogue and engagement with citizen groups and the public (Batterbury, 2003). Capacity-building must occur between all tiers of government, and between jurisdictions, so best practices and successes can be shared.

2.14 Literature Review summary and conclusions

After establishing a planning framework and a definition of sustainable transportation, this literature review explored concepts climate-responsive design, transport vernacular, mobility and various aspects of cycling. In terms of planning practice, the importance of cycling infrastructure and policies were discussed in detail.

While bicycle infrastructure can play an important role in mainstreaming bicycling, supportive policies are crucial. According to Black (2010), "for policy approaches to be truly effectual, they must exert forceful control over human behaviour or be accompanied by stringent enforcement mechanisms (p. 186). While Black fears many policies are "draconian," most goals can be accomplished with the "carrot" without resorting to the "stick." An overall emphasis on infrastructure development has meant that other 'soft' policies to encourage bicycling have often been ignored. Regardless of infrastructure developments, cyclist safety should be paramount. Therefore educational resources are necessary. In winter cities, cyclists face further dangers include slipping, frostbite and exposure to the elements.

According to McClintock (2002b), "soft" policies concentrate on the positive aspects of cycling while "hard" infrastructural approaches may have negative

connotations with the public[8]. Many cities could increase cycling through soft measures. This approach could build momentum and community support for the more expensive "hard" infrastructure projects. In addition to education, marketing and promotion, soft policies can be used to enhance the cycling experience. For example, Minneapolis, Minnesota runs a "guaranteed ride home" program that serves as a safety net for cyclists. If you ride your bike to work three times a week or more, you are eligible for free transit or cab fare home in the case of an emergency such as inclement weather or mechanical failure (City of Minneapolis, 2010). Such measures require little investment and can mitigate some of the drawbacks associated with commuting via bicycle.

[8] This can be especially true when proposing reduced road space for automobiles in favour of other modes.

Figure 11: Bicycle infrastructure as part of an overall multi-modal system. New housing district of Stockholm, Sweden. Photo credit: Author

According to Blanco et al. (2009), cycling policy is inter-related to other policy fields, transport and non-transport alike. Efforts to promote cycling and active transportation can complement policy initiatives from various camps including public health, environmental organizations, climate change, and congestion reduction efforts, to name a few. Synergies can be found between various governmental departments, non-governmental organizations, citizen groups and planners.

Cycling is a powerful tool to address environmental issues and potential energy scarcity, and unlike technological approaches, or extensive investments in public transport, a shift towards cycling could occur immediately. There are millions of bicycles sitting underused, or unused. While other approaches are necessary, cycling is inexpensive, and research indicates there is already latent demand (Leinenberg, 2008). To quote Wray (2008), "the basic infrastructure is already there. Millions of bicycles already sit unused in garages and basements (p. 207)."

While a modal shift to cycling could begin immediately, the overall shift to sustainable transportation will not happen overnight. This shift will require significant changes in how we move and appropriate environments, both urban and rural, to support these modes. Tuominen and Himanen (2007) argue that global climate and atmospheric issues cannot be solved solely within the confines of transport policy, because the problems are "based on or are consequences of more fundamental issues like population growth and changes in consumption patterns and mobility" (p. 397). The aesthetics of environment rest on the reciprocity of people and place, and according to Berleant and Carson (2007), "humane environments require time to grow and should grow out of local needs, conditions and traditions" (p. 91).

Cycling can be a year-round activity in almost any climate. In cities that experience temperature extremes there will likely be seasonal variations in cycling, but this need not preclude a commitment to cycling policy and infrastructure. According to Pressman (1995):

> While it is not realistic that winter cities should experience the same levels of year-round outdoor activity between seasons, options and opportunities must be made available, with a focus on year-round usability, contact with nature and cultural continuity (p.228).

Embracing one's surroundings and developing a transport vernacular is one way to increase the livability and sustainability of cities.

3. Local Context and Background for Field Research

3.1 Finland

Finland is unique among European Union (EU) nations because it covers a vast area of 338,000 square kilometers whilst possessing a small population of 5.2 million. The population is unevenly distributed with over 1.2 million people located in the greater Helsinki "Capital Region," and a small proportion in the northern third of the territory (Juahniainen, 2006; Rikkinen, 1992). Finland experienced widespread urbanization later than its European counterparts, only gaining an urban majority in 1969 (Allardt, 1989; Antikainan and Vartiainen, 2005; Kolbe, 2006; Lavery, 2006; Rikkinen, 1992). By contrast, over two-thirds of Germany's population was urbanized by the 1930s (McElligot, 2001).

In Finland, a distinct "internal migration" has been occurring with the largest urban centres experiencing significant growth at the expense of smaller towns and the rural countryside (Antikainan and Vartiainen, 2005; Juahniainen, 2006).

When employing an international case study, it is important to address unique cultural phenomena. A study of winter cycling in Oulu with the intention of providing lessons for Canadian cities must address potential cultural differences. For example, the potential role of Dutch Calvinist heritage in the Netherlands, as described by Wray (2008- see Chapter 2.5.3), is presented as a potential influence on the Dutch propensity to cycle. While a detailed examination of Finnish history and geography are outside the

scope of this thesis, certain aspects of the country and its culture, however, are pertinent to the discussion of Oulu's success mainstreaming cycling. The following sections will discuss aspects of winter and winter recreation in Finland in an attempt to better understand implications for winter cycling in that country.

There is always a danger in making "cultural" generalizations, especially in our era of immigration and globalization. However, Finland, along with the other Nordic countries, is historically homogenous in terms of race and religion, and a welfare state in which social policies have largely diminished the differences between social classes (Allardt, 1989). Finland has fewer immigrants than its Nordic neighbours, and European counterparts. Until the 1980s the country was a net exporter of immigrants, and only recently has immigration to Finland increased. Many new immigrants come from former Soviet republics while increased world pressure has led Finland to accept refugees from throughout the world (Lavery, 2006).

Figure 12: Map of Finland. Source: Public Domain.

3.2 Winter in Finland

Finland is a northern country. The landmass stretches longitudinally from the Baltic coast in the south, past the Arctic Circle, almost as far north as the Barents Sea, where Finland Borders Norway. Winter is an inescapable part of life in all of Finland's regions. According to Mead and Smeds (1967), "it is a season that has called for a variety of adjustments in day-to-day life. Men have retreated from it, mounted assault upon it and taken advantage of it" (p. 15).

Helsinki sits at the same latitude as southern Greenland and North America's permafrost regions, however, the Gulf stream moderates temperatures to more bearable

levels. This favourable geographic situation allows Finland to be home to 35% percent of the world's population living above the 60th parallel (Rikkenen, 1992).

While the aforementioned Gulf stream moderates temperatures, all of Finland experiences a winter season with significant snowfall. Northern Finland has over 150 days of snow cover and mean temperature of -16 degrees Celsius in the coldest month, and 19.5 Celsius in the warmest month, with a 60 degrees total temperature variation (Jauhianinen and Monkkonen, 2005).

One defining characteristic of Finnish winters is reduced daylight hours. Northern Finland's largest city, Oulu, experiences only three and a half hours of daylight and three hours of twilight at the winter solstice, but has over 22 hours of sunlight at the summer solstice (Jauhianinen and Monkkonen, 2005). Such conditions prompted Mead and Smeds (1967) to write, "the character of Finland's winter is very much a question of latitude" (p. 30), meaning while the Gulf stream moderates temperatures enough to allow extensive urban development and agriculture, the solar cycles serve as a reminder of Finland's far-northern location.

Unsurprisingly, winter factors heavily into the Finnish psyche. The Finns have a long and storied history of embracing winter. While the propensity to be outdoors skiing and enjoying the winter landscape is now commonly regarded throughout the world, earlier in history this caused great confusion. Mead and Smeds (1967) explain, "the legend of the Finnish winter has been compiled and sustained by generations of travelers, traders and sailors from more temperate climes" (p. 16). In 1539 Olas Magnus wrote of his travels to Finland and produced a map of the country, the *Carta Marina*. He was

particularly taken by northerner's ability to, not only cope with, but to embrace winter. Magnus wrote:

> The inhabitants move about with an amazing speed using boards of a certain kind which are bent like a bow in the front. These are strapped to the feet, and the people use a stick to steer themselves and move at will…Sometimes they perform these feats of valor in the fervor of hunting and sometimes merely to in order to compete in resourcefulness and skill like runners on a racecourse in pursuit of a promised prize (quoted in Rikkinen, 1992, p. 48).

Magnus depicted what he had seen on his map, illustrating people skiing and riding horses across the frozen sea. When he presented these images to the Pope, they were regarded as being dreamed up or imagined, as the Pope had never seen frozen seas, and could not conceive of these activities (Mead and Smeds, 1967; Rikkinen, 1992).

The Finnish approach to winter is reflected through urban design. Pressman (1995) discusses the use of heated sidewalks throughout the Nordic countries. Heated sidewalks melt snow and ice, allowing a more walkable pedestrian environment. One may wish to contrast such an environment with the underground, and overhead climate-controlled walkways employed throughout many North American cities, as described by Boddy (1992). These interior corridors remove people from the streets as they seek shelter indoors, instead of enjoying the outdoor street life.

The attitudes towards winter in Finland may be more positive than those found in North America. However, as early as the 1960s Mead and Smeds warned:

> [T]he only problem [with technology's ability to reduce winter's harsh effects in the urban environment] is that the inhabitants of contemporary Finland are so accustomed to their artificial climates that many of them are no longer acclimatized to the natural conditions of winter (p. 99).

A contemporary manifestation of Finland's culture of winter can be found in the country's most popular 21st century export: heavy metal music. Makela (2009) discusses

Finland's heavy metal phenomenon, arguing the country has become a "metal nation" (p. 367). Makela places this within the context of building a modern national identity, going so far as to argue heavy metal is the new Finnish folk music. While Makela does not address winter specifically, Finland's northern heritage and seasonality is common theme evident throughout the genre. Heavy metal bands boast names such as *Norther*, *Sonata Arctica*, *Wintersun*, and *Snowblinds* and exploit the imagery of constant darkness that descends upon the northern latitudes in the winter months. Meanwhile, Nordic themes abound within Finnish metal music and album art often features northern landscapes and winter imagery.

3.3 Winter Sport in Finland

Finland is home to a strong sporting culture. As a small nation with limited world influence, Finnish sport culture was spawned by, and still revolves around, the Olympic games (Savola, 2002). Finnish sporting culture blends competition with recreation, and is firmly rooted in traditions of cooperation. However, just as important is the personal sporting culture embodied through swimming, running, cross-country skiing, fitness and a love of the outdoors (ibid).

The love of the outdoors is embodied in Finnish town planning through forest urbanism (Hankonen, 1998). Menin (2001) describes how forests are a central part of Finnish psyche, which is reflected, for example, in the work of Alvar Aalto's work and the Finnish propensity to humanize modernist design.. According to Singleton (1989), the love of the outdoors is reflected in Finnish modern architecture, and its "ability to cooperate with nature and to bring together artificial and natural products in a way which stamps modern Finnish products with a unique character" (p. 175).

Outdoor activity is important traditionally important to the Finnish people with two thirds of the population engaging in outdoor recreation throughout the year, at least once a week (Landauer et al., 2009). Cross-country skiing is a key component of the Finnish national identity, and this is the most important way Finns embrace winter (Landauer et al., 2009; Pouta et al., 2009). To Quote Mead and Smeds (1967), "Finns have been literally born on skis" (p. 109). The connection between Finland and skiing is found in ancient folklore (Mead and Smeds, 1967; Rikkinen, 1992). So strong is the Finnish affinity to skiing that 94 percent of adults can ski, and 40 percent of the population skis at least 19 times during the winter season (Landauer et al., 2009).

Competitive skiing emerged in all three Scandinavian countries in the late 19th century. By the early 20th century in Finland a skiing renaissance was underway in which competitive, recreational, and military skiing all increased immensely. These factors set the groundwork for the contemporary ski culture that still exists, and has spread beyond Finland and Scandinavia to North America.

3.4 Planning in Finland

Despite northern latitude, and relative geographic isolation, Finland has established a reputation as being progressive and dynamic, especially in terms of planning and architecture (Singleton, 1989). Historically Finland has utilized the state-centered, "strong state" mentality, in which the national government was heavily involved in many local matters. In recent decades the strong-state mentality has eroded and municipalities now posses strong self-governance (MTCF, 2005).

Although reforms took place beginning in the 1960s, Finland's national planning role and focus were completely overhauled in 2000, with *The Land Use and Building Act.*

This mandated the downshift in planning responsibility as well as a focus on quality of life, sustainable development, and participatory planning (Commin, 2007).

At the national level, land use planning falls under the jurisdiction of the Ministry of the Environment, which provides general guidance, and ensures that national guidelines are carried out at the lower levels. Regional-level planning is intermediary and serves as the State's influence at the local level. Local municipalities are responsible for all detailed planning within their jurisdiction (Commin, 2007). Policy development and decision-making have been decentralized over several decades, but the National government has expressed concern it is increasingly difficult to influence local action (ECMT, 2003).

Since the early 1990s, at the national level, there have been attempts to increase sustainability in built form. Rautsi (1992) explains national-level attempts to employ sustainable urban planning, stating:

> Sparse settlements in the countryside will be brought under planning; irrational spreading of shopping along motorways will be prevented; [and] measures to improve the environmental quality of the urban centres will be created (p.159).

In 1994 Finland adopted the urban region as a basic level of planning and administration (Andersson 2008; Antikainan and Vartiainen, 2005). This was a new development in a nation that is sparsely populated, and slow to urbanize compared to the rest of Europe. Finland's urban regions are classified by function, including university, industrial, administration, and coastal manufacturing functions, to name a few. According to Andersson (2008):

> The Finnish urban region is a smaller unit than the traditional province, and comprises a commuting area, an area of municipal cooperation, an area with identifiable expertise in terms of both traditional and new skills, a concentration of social interaction, an initiator and developer of networked society and a space

for planning and power (p. 213).

Helsinki represents the primary, large, multi-modal metropolitan hub. Finland's other urban regions have much smaller populations.

Universities are closely tied to urban development in Finland. In fact, universities are mandated to play a role in regional development (Antikainan and Vartiainen, 2005). Not surprisingly, the largest tiers of urban regions outside Helsinki are large university regions. These regions comprise Finland's "second cities" including Tampere, Turku, and Oulu (Andersson, 2008).

Finland has mandated local input in all facets of urban planning (Commin, 2007; Yli-Pelkonen and Kohl, 2005). Tampere, Finland's second-largest city, introduced *Valma*, a groundbreaking web-based citizen participation forum (Anttiroiko, 2004). Finnish cities, including Oulu, were also early to utilize the internet as a format with which to connect with citizens (Anttiroiko, 2004).

The Ministry of Transport and Communications (MTC) is the body responsible for the development of Finland's transportation system, overseeing regulation, budgets and funding, and research and development. The MTC also oversees specific national planning instruments such as public transport strategies, environmental guidelines, traffic safety programs, and cycling and pedestrian initiatives. Municipalities are responsible for local-level planning and policy implementation (ECMT, 2003).

Finland has emphasized the integration of environmental and transportation policies, recognizing the inherent relationship between them (ECMT, 2003). The national government attempts integrated planning and acknowledges the relationship between transportation and land use, using the 1999 *Land Use and Building Act* as a vessel to

encourage non-motorized transport through land use planning (ECMT, 2004). Through this act, local master plans incorporate public and non-motorized transport, and demonstrate that these modes have been accounted for in the zoning process (Commin, 2007; ECMT, 2004).

According to the ECMT (2003), the main objectives of Finnish transport policy are public transport development and the promotion of non-motorized transport so as to reduce congestion and environmental pressures, and promote safety. Public transport ridership in Finland has remained relatively steady since the 1970s. The modal share of public transport, however, has decreased slightly in this period, as total passenger traffic has increased, with automobile use growing to 78 percent. Public transport in 2003 accounted for 20 percent of total passenger transport, and 80 percent of urban transport (ibid).

Table 1: Modal shares for Finland's major urban centres.
Source: Finland National Traffic Survey. Compiled by author

City	Bike	Walk	Transit	Automobile	Other
Helsinki	4.8	32	25.2	36.6	1.4
Tampere	7.1	29.1	10.3	52.3	1.2
Turku	10.6	21.4	55.8	8.6	3.6
Oulu	19.5	24	4.7	50.8	1
Jyvaskyla	10	32.5	7.5	43.8	6.3

Bicycling is integrated into Finnish transportation planning at both the local and national levels. In 2003, 78 percent of Finns owned bicycles. Nationally, cycling had an 11 percent modal share for journeys and comprised 2 percent of national transport

volume. The cities of Oulu and Kerava stand out with 20 percent modal shares for cycling (ECMT, 2003).

Unlike the Netherlands or Denmark, one must use caution before labeling Finland a national success in planning for cycling. Bicycling is more prevalent than in North America, but "there is considerable seasonal and geographic variation" in Finland's cycling numbers" (ECMT, 2003, p. 54). Table 1 displays transportation modal shares from cities across Finland. It is within this context that the city of Oulu becomes an intriguing case study.

In the national context, the MTC partnered with local municipalities between 2001 and 2004 on the *Jaloin*[9] project. This was a multi-pronged research project to promote walking and cycling as transport modes and to ensure walking and cycling received equal attention to other modes of transport in planning and decision making (ECMT, 2004; MTCF, 2005). *Jaloin* called "for a national comprehensive transport plan to that can "influence transport choices and influence sustainable transport" (MTCF, 2005, p.10). Another goal was to develop a "model municipal practice," or best practices, to guide municipalities. "Municipalities may choose how to develop sustainable transport in accordance to their needs and goals" (ibid, p.10).

[9] *Jaloin is a Finnish word that can loosely be translated to mean "walking," "by your feet," or "self-propelled"*

Figure 13: Bicycling is considered in Finland's planning. Bicycle-specific traffic signals in Helsinki. Photo credit: Author

As part of the *Jaloin* program, the MTC collaborated with local jurisdictions to undertake detailed research on winter cycling (MTCF, 2002; MTCF, 2005). Research conducted as part of this initiative provides great insight into the many facets of winter cycling. According to a survey administered as part of *Jaloin*, winter cyclists in Finland stated temperatures above -20 Celsius had little effect on their decision to cycle (MTCF, 2002).

The most popular motives for winter cycling were physical exercise, cycling was the fastest option available, and cycling was the least expensive option. The most prevalent deterrents to winter cycling for those who regularly cycle in the summer were that conditions were too slippery, the temperature was too cold, and that conditions were too dangerous.

Approximately 20 percent of summer cyclists would not attempt winter cycling, but the remainder indicated they would be open to trying winter cycling. The three primary factors that could help facilitate a winter modal switch were listed as better winter maintenance, owning a decent winter bicycle[10], and shorter distances between destinations.

Despite generally strong planning, and an emphasis on linking land use and transportation planning, Finland has been rapidly urbanizing without substantial population growth, and sprawl has been an issue. Peripheral urban development has been constructed, and automobile use has steadily increased (ECMT, 2003). It is also important to remember that change takes time. After all, the planning efforts outlined earlier in this chapter are relatively new to Finland, and will require planning, policy and action to be successful (MTCF, 2005).

Hankonen (1998) argues Finland's embrace of high technology has influenced traffic engineering and urban planning through the early decades of the post-war period. This manifested itself through planning based on computer modeling and heavy reliance on other technologies, and an embrace of the automobile and high-volume motorways. Consequently, analysis by Taraveinen (2009) argues that Finland is engaged in "weak" approaches to sustainability. Conversely, Antikainan and Vartiainen (2005) advocate that Finland's technological approach has resulted in a balanced urban system. The case study of Oulu will demonstrate how traffic engineering in Oulu has been used to forward a balanced, and multi-modal transport network.

[10] The available documents did not specify what is meant by "winter bicycle." One may assume, however, this refers to a bicycle with winter tires, and that the owner is willing to expose to winter conditions such as sand and salt, as these can be detrimental over time to a bicycle's components.

3.5 Oulu

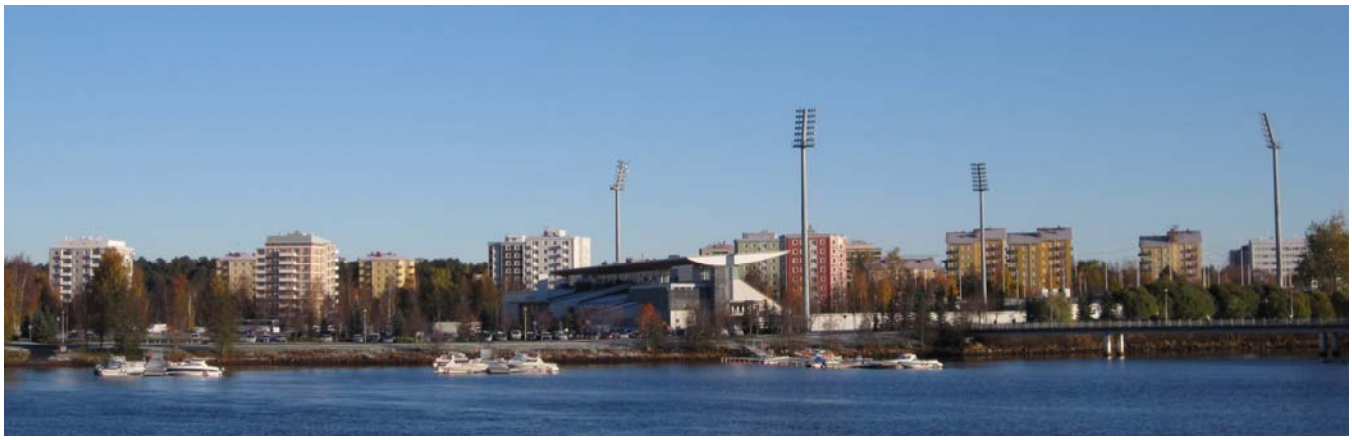

Figure 14: Oulu's waterfront. Photo credit: Author

3.5.1 History and local context

With a population of 130,000, Oulu is Northern Finland's largest city. Located at 65 degrees latitude in Northern Ostrobothnia, the city sits at the mouth of the River Oulujoki on the Gulf of Bothnia (Rikkinen, 1992). Oulu is one of Finland's fastest growing urban centres, and is the country's sixth-largest city. The city is internationally renowned as a hub for high-tech innovation.

In recent decades Oulu has experienced a dramatic transformation. Referred to as the "Oulu Phenomenon," the city has evolved from a northern resource town into a bustling urban centre home to a large university and many high technology firms (Donnelly and Hyry, 2004). This is particularly impressive given Oulu's location. The city is 220km south of the Arctic Circle and over 600km north of Helsinki, and according to Van Winden (2008), it is the only small, isolated city in the world to successfully transition to a knowledge economy.

Traditionally a resource town, Oulu has long served as the regional centre for northern Finland. In the early 19th century it was Finland's largest exporter of tar. Oulu is

located far north of Finland's traditional manufacturing region. A rail link to southern Finland was completed in 1886, and Oulu grew as a manufacturing centre and exporter of wood products. This provided the town's real foundation for early economic development, and served as the basis for urban expansion. Oulu eventually became a centre for pulp production, a nitrogen works and a large hydro-electric power plant (Hentila, 1996; Lavery, 2006; Rikkinen, 1992; Singleton, 1989; Wourinen, 1965).

Oulu once boasted the world's largest assemblage of wood buildings, but a combination of Red Army bombing, urban revitalization schemes, fires, and public apathy have left only a handful of traditional Finnish wood buildings (Karkalainen and Suikkari, 2001; Kotila, 2001).

Figure 15: Cyclists ride through an infill housing area near central Oulu. Photo Credit: Author

By the early 1990s Finland had transformed into a knowledge economy, and was widely regarded as a leader in technological development and education (Antikainan and

Vartiainen, 2005; Arter, 1989; Jauhianinen, 2006; Rikkenen, 1992; Teravainen, 2009). Finland, however, is a country of geographic and economic extremes. Much of the shift towards an economy based on technology and knowledge occurred in the Helsinki region and in the southern portions of the country. Oulu is an exception. It has some of Finland's highest rankings in capital, innovation and research and design investments. Meanwhile the rest of Northern Finland ranks lowest in the above categories, creating a huge divide (Jauhniainen, 2006).

The city's transformation from resource town to high-tech hub is the direct result of policy and government action (Antikainan and Vartiainen, 2005; Jauhianinen, 2006; Van Winden, 2008). The University of Oulu was opened in 1958 as part of a plan to address large-scale migration to Helsinki and other southern centres (Donelly and Hyry, 2004). The university provided a functional base from which to launch a high-tech revolution (Andersson, 2008). According to Van Winden (2008), through such measures Oulu became the most definitive example of a confluence of national and local public policy shaping a successful major ICT cluster.

In the 1970s Oulu chose not to support declining resource-based industries and pursued a new course based on collaborations between university institutions and industry. Complementary national policy saw the establishment of the University of Oulu, a national research centre and technological business park. National policy at that time also encouraged northern development, and Nokia began producing radio products for military use in Oulu. In the mid 1970s Nokia was producing modems in Oulu, and in the early 1980s digital production began for mobile phones (Steinbock, 2001; Van Winden, 2008).

By 2008 Nokia's mobile phone and networks divisions were employing 4300 people. Numerous electronics and software firms also set up shop throughout the decades, creating the preeminent Nordic high technology industrial cluster. Oulu gained prominence for cooperative information sharing and research and development expertise. Eventually foreign firms, such as Ericsson, established themselves in the city's science park. Oulu's current challenge is diversifying its economy from the ICT and R&D industries (Van Winden, 2008).

Oulu's immense economic growth resulted in corresponding population increases. Between 1980 and 1995 Oulu's population grew by 32.3 percent, surpassing even the Helsinki region's 25 percent growth in the same period (ECMT, 2003).

3.5.2 Cycling in Oulu

Despite its northern location and harsh winters, Oulu's modal share for cycling is approximately 20 percent of total trips, compared to 11 percent nationally (City of Oulu, 2007). Oulu was the first Finnish city, and the first winter city, to join the European Cycling Federation's *Cities for Cyclists* network (Myllyla, 2000). Oulu is unique within the Finnish context and has been recognized by the ECMT (1999) as "a city outperforming the rest of its national counterparts, thus serving as a benchmark for other cities in Finland" (p. 50).

The City's hallmark is an extensive network of active-transportation routes, which are integrated into new developments to facilitate cycling as a utilitarian form of transportation. Oulu's pathway network has evolved over four decades of "consistent, and extensive co-operational development efforts" and "considerable economic investments" (Myllyla 2000, p. 147).

The city has constructed bicycle routes at a ratio of 2:1 to vehicular roadways (City of Oulu, 2007). There are over 600 km of pathways with more than 100 underpasses and bridges, and over 100 raised crossings. This is the highest per-capita route network (km per person) in Finland (Helsingen Sanomat, 2010). To ensure access to the central city, new suburbs are designed with cycling paths from the outset (ibid). According to Myllyla (2000), "the main objective has been to create a pedestrian and bicycle network that covers the entire urbanized area and the network extends to the neighbouring municipalities" (p. 150).

Figure 16: A cyclist navigates a pathway in suburban Oulu. Photo credit: Author

Since 1972 Oulu has had a special fund in place for the construction of pedestrian and cycling infrastructure. The City has also utilized funds allocated for streets and highways for expanding the pathways. These highway funds were specifically used for expensive capital projects including constructing underpasses and pathways (Myllyla,

2000). Between 1973-1994 over 10 percent of all street improvements were dedicated to the cycling and pedestrian network. There were two factors that kept costs down: building shared use pedestrian and cycling pathways instead of sidewalks and utilizing short stretches of low-traffic residential streets where possible. In 2000 the net value of Oulu's cycling and pedestrian path network was valued at over $75 million USD, or approximately 25 percent of the total net value of the City's entire road transport network (Myllyla, 2000).

Beginning in the 1990s Oulu's "bicycle traffic enhancement program" saw a commitment to reducing discontinuities in the central city, and re-surfacing sand and gravel pathways with tarmac. Commitments were also made to efficient winter maintenance, concentrating on slip-reduction and intersection maintenance. Bicycle parking facilities were increased with more covered protection in the winter. Efforts were started to enhance co-use of cycling and transit (for year-round benefit), increase and promote bicycle rental, develop a public bicycle map, establish guided bicycle tours. Finally, the City began international cooperation, including presenting at conferences and joining the *Cities for Cyclists* network, to intensify and promote cycling (Myllyla, 2000).

Oulu's 20 percent modal share for cycling is an enviable statistic in almost any climate, let alone in a city at 65 degrees latitude that experiences harsh winters. Throughout Europe, Oulu has been recognized for overcoming unfavourable climactic conditions, and demonstrating that inclement weather need not preclude cycling as a utilitarian mode of transport (ECMT, 2004). According to Pressman (1995), climate is means of defining culture and character. Oulu exemplifies this as the City's official

website declares, “winter cycling in extreme temperature is what makes you an Oulu resident” (City of Oulu, 2009).

Oulu was bombed during World War II and, as in other European cities, this afforded the opportunity to further accommodate automobiles in the central city (Donnelly and Hyry, 2004; Maddox, 2001). Much of Oulu’s success in encouraging cycling stems from a 1972 traffic plan that redefined the city’s transportation network (Helsingen Sanomat, 2010; Hentila, 1996; Myllyla, 2000). The plan intended to:

> Increase traffic safety, diminish noise and pollution in the city centre, create new pedestrian and cycling routes especially in the city centre, improve the quality of public outdoor spaces and reconstruct part of Kirkkokatu, the city’s main downtown shopping street, as a pedestrian area that could form the heart of the city and have a sense of place (Hentila, 1996, p. 170).

Oulu has emphasized both design and connectivity in its cycling network. The 1986 redesign of Kirkkokatu into a pedestrian street, referred to as *Rotuaari*[11], serves as the nucleus for Oulu’s cycling network, creating an anchor and strengthening the city’s core. The redevelopment of this central pedestrian area was seen as a catalyst for the continuing vibrancy of the central shopping district, and was largely successful. Hentila (1996) explains that special emphasis was placed on developing unique activities, such as street performances and festivals, that would remain popular all year-especially through the winters. Today, over 15,000 cyclists enter the city centre daily (Helsingen Sanomat, 2010).

In Oulu, citizen participation was seen as vital from the beginning of their bicycle planning project. In the period of 1969-1972 cyclists were represented on the pedestrian and bicycle transportation planning team. After 1972, citizens associations were

[11] *Rotuaari*, basically means “pedestrian street.” It is a Finnish mash-up, based on the French word for sidewalk, *trottier*, coupled with *aria*, which is Finnish slang for “pedestrian.”

integrated into the planning process, which garnered “favourable response from the public” for traffic calming efforts and infrastructure (Myllyla, 2000, p. 148). Throughout the process local school officials were consulted. In 1996 a working group was established to enhance cycling in Oulu. This multi-disciplinary team was comprised of representatives from the fields of traffic planning, traffic safety, tourism, physical health and fitness, bicycle retailers and the local law enforcement (ibid).

Hentila (1996) cites the extensive infrastructure, flat terrain and large number of university students as being important factors to the city’s high cycling rates. It bears mention that universities are largely seen as generators of cycling trips in the academic literature (Balsas, 2003; Bonham and Koth, 2010; Garrick, 2005; Pucher, 1997; Shannon et al., 2006).

Myllyla (2000) concludes that Oulu recognized matters of sustainable development are intertwined with land-use and transportation planning at an early stage. Cycling was identified as being an integral part of this. Reflecting on the accomplishments in Oulu, Myllyla writes, “the computer has not been the most important planning tool for the traffic engineer. It has been the bicycle” (ibid, p. 150).

3.5.3 suitability as a case study

Oulu presents a fascinating case study. The city’s cycling infrastructure stands out within the Finnish context, and internationally. Oulu’s efforts to create a safe and attractive environment for year-round cycling are commendable. That residents continue to cycle in substantial numbers despite changing patterns of urban development and increased automobility is worthy of investigation.

The European Conference of Ministers of Transport (ECMT) recognizes Oulu an example of a city outperforming the rest of its national counterparts, serving as a benchmark for other Finnish cities (ECMT, 1999). The Finnish *Fit For Life Program* awarded Oulu the 2010 Sustainable Transport Act prize recognizing the City's long-standing commitment to fostering a safe year-round environment for cycling and being an example for other Finnish cities (Eltis, 2011; Kunnossa Kaiken Ikaa, 2011). This thesis asserts that lessons learned from Oulu's experience may be applicable beyond the Finnish and European contexts, and could provide valuable insights for winter cities in Canada and the northern Unites States.

According to Pressman (1995), Canada and Finland share similar settlement patterns and climate. Cities in Finland urbanized late by European standards, and assumed a development pattern first dictated by the railroad boom of the 19th Century and later in the post-war period of automobility (Kolbe, 2006). Nationally, Finland is sparsely populated with settlement patterns located along transportation infrastructure and watercourses (Rikkenen, 1992). Therefore Finland's pattern of development closely mirrors that found through much of Canada.

Urban population densities in Finland are lower than those found throughout much of Europe, as cities often encompass large areas with settlement clustered within forested areas (Hentila, 1996; Rikkinen, 1992). Housing clusters are generally comprised of apartment flats, and to a lesser degree, single-family homes. This distinctly Finnish form of settlement is often referred to as forest urbanism, and was a hallmark of post-war town planning (Hankonen, 1998). Forest urbanism creates an interesting contrast in Finnish cities. Much of the urban housing development is quite dense, with over half of

Helsinki Capital Region residents live in apartment flats, yet, the urban area assumes an overall dispersed character (Hankonen 1998; Myllyla, 2000).

Oulu experiences a harsh winter similar to many Canadian cities. The winter season is quite cold, but is contrasted by a warm summer with substantial average temperature variation (Rikkenen, 1992). Oulu's average January temperature is -10 degrees Celsius compared to 16 degrees Celsius in July, meaning the city experiences an average temperature range of 26 degrees (Weather Base, 2011)[12]. Table two contextualizes Oulu's climate through a comparison with international winter cities.

Case studies can provide valuable insights for informing similar efforts in other jurisdictions (Craddock, 2009; Hoch, 2009; Pucher, 1997; Wray, 2008). Garrick (2005) asserts a causal relationship between bicycle planning and bicycle use, and this research attempts to address Oulu's planning efforts. Meanwhile, Ewing (2007) stresses the role of underlying factors in case studies, including historical and cultural developments. This study will also attempt to accommodate these factors, particularly as they pertain to Oulu's distinct shift from a resource-based economy to one based on high technology- the aforementioned "Oulu Phenomenon."

[12] There are many sources of climactic and temperature information available. For ease of use and consistency I chose to use the website Weatherbase.com

Table 2: Average high and low temperatures for world cities, with bicycling modal share.

City	**Average High** (Warmest Month)	**Average Low** (Coldest Month)	**Average Temperature Range**	**Bicycling Modal Share (%)**
Oulu, FI	16 (July)	-10 (Jan)	26	19.5
Helsinki, FI	16 (July)	-6 (Feb)	22	4.5
Minneapolis, USA	22 (July)	-10 (Jan)	32	2.4
Ottawa, CA	21 (July)	-10 (Jan)	31	2.1
Saskatoon, CA	20 (July)	-16 (Jan)	35	1.6
Winnipeg, CA	18 (July)	-17 (Jan)	35	2.4
Amsterdam, NL	16 (July)	2 (Feb)	18	40
Copenhagen, DK	17 (July)	0 (Feb)	17	37

All temperatures in degrees Celsius, compiled by author from weatherbase.com

4. Research Methods and Analysis

4.1 Case study

The largest component of this research involves a case study. Case studies are an effective tool for process tracing, which involves identifying how present conditions came to be. Process tracing allows a researcher examines the interplay of multiple variables, and attempts to provide a comprehensive understanding of the research field (Gerring, 2007; Tellis, 1997; Yin, 2003). According to Yin (2009), case studies are unique and useful because they allow "investigators to retain the holistic and meaningful characteristics of real-life events" (p. 4). This thesis encompasses an "explanatory case study" as it considers at "how" and "why" questions within each context. Research of this nature allows one to "see an issue evolve, a conflict emerge, or a social relationship develop" (Neuman, 2000, p. 148).

According to Lundberg and Enz (1993), case study research must pass through six steps. The first, is gaining familiarity with the subject. I have gained familiarity with these issues in both-real world and academic contexts. I am an avid cyclist with many experiences that have informed and encouraged my research into urban transportation. I

also have many years of academic experience looking at issues of cycling, urban transportation and sustainability. In 2006, I attended the *International Youth Summit on Sustainable Transportation*. My familiarity with the topic was further enhanced through continued literature review and document research, as well as the semi-structured interviews.

The next steps a researcher proceeds through are recognizing patterns, identifying goals, conducting analysis and diagnosing the issues. These steps formed the backbone of this thesis. Data (in this case qualitative) was collected and analyzed, patterns were identified and conclusions were drawn. The final step, according to Lundberg and Enz (1993), is "action planning." This was less relevant to my research, as I presented a picture of how Oulu mainstreamed cycling. This thesis makes general recommendations that will be useful for other cities hoping to mainstream cycling policy.

4.2 Semi-structured interviews

As part of the case study I carried out semi-structured interviews with key players, including traffic engineers, planners, and other key informants in Oulu and Helsinki. In spring of 2010 I was awarded the Maxwell Starkman scholarship through the University of Manitoba. This allowed me to visit Oulu and Helsinki to conduct face-to-face interviews in October, 2010.

The interviews utilized open-ended questions to allow a maximum level of information to be conveyed. Neuman (2000), details the advantages of the open-question interview format. Such interviews permit an unlimited number of answers, allow respondents to answer questions in detail and clarify points, allow for unanticipated findings, permit creativity and richness of detail, and reveal a respondent's frame of

reference. This was particularly useful as I had information conveyed to me that would be available in print, if I was fluent in Finnish.

According to Zeisel (2006), interviews involve asking questions to systematically "find out what people think, feel, do, know, believe and expect" (p. 227). This provided a reliable and efficient means of understanding the local conditions and initiatives within Oulu and across other relevant jurisdictions. This information would have been impossible to obtain strictly through document reviews. While I garnered a great deal of information by examining policy and planning documents, interviews with key players provided insight into the "who," "how," and "why" elements, as well as the emotional factors influencing decisions. Preliminary contact with contacts in Oulu was positive from the outset, demonstrating a genuine interest on their part to share their experiences.

Interviews move predictably through stages (Neuman, 2000). Zeisel (2006) states that interviews have five key characteristics. First, the interviewees have been involved in a particular concrete situation. In this case, they are professionals who were involved in cycling initiatives in Finland. Second, the researcher has conducted a "situational analysis" to ensure they are familiar with events and contexts prior to the interviews. This allows them to ask focused, informed questions, and form a hypothesis about what aspects are worth exploring. Third, the researcher will develop an interview guide to outline key areas of interest and inquiry (see appendix A). Fourth, an interview attempts to ascertain the subject's understanding of issues under study. Finally, the researcher will use a series of probes to guide the interview. Probes are "questions that interviewers interpose to get a respondent to clarify a point, to explain further what…[they]…meant,

to continue talking, or to shift the topic (Zeisel, 2006, p. 230). Probes are most effectively used when accompanied by strategic pauses (Neuman, 2000).

I used photography as a means of enhancing my interviews. Images were particularly useful in overcoming language barriers and identifying sites, as I was an outsider. The use of images in qualitative research, specifically interviews, is espoused by Collier and Collier (1986) and Mason (2002).

In Finland, most educated professionals are fluent in English. All of the key players I contacted spoke English fluently, and none were unable to participate because of language issues.

4.3 Literature and document review

Reading and immersing oneself in background information and reviewing other studies is a cornerstone of good research (Neuman, 2000). A detailed literature review was an integral part of this project. Literature reviews are "based on the assumption that knowledge accumulates and that we learn from and build on what others have done" (Neuman, 2000, p. 445). Literature reviews have four main goals. First, they demonstrate the writer's "familiarity with a body of knowledge and establish [their] credibility" (p. 446). Second, they demonstrate a relationship between the research at hand, and previous works. Third, they provide a comprehensive summary of available literature on the chosen topic. Finally, they allow researchers to learn from their peers, and stimulate further exploration into the topic (ibid).

Zeisel (2006) stresses that researchers must be familiar with subjects and situations before engaging in interviews, focus groups, surveys and other primary forms of qualitative and quantitative research. Literature and document reviews are an essential

component of this process, providing context and background for both the researcher and those who read the final product. The familiarity I gained with Oulu through the literature and document review proved a valuable asset as I conducted my interviews.

4.4 Photography

Visual research methods, such as photography and video, have gained widespread acceptance in qualitative research (Mason, 2002; Zeisel, 2006). Photography in particular is often used in qualitative research, and has been especially prevalent in the fields of social and urban studies (Harper, 2005). Beyond general qualitative research, Wates (2000) discusses many of the applications of photography used in participatory community planning. Mason (2002) explains:

> …the idea that everything we are interested in exists is language or text, or is expressible in those ways, and that we can explore it using words or using text, can be argued to be a rather limited and uncreative one (p.104).

Photographs fulfilled three important roles in this project. First, they aided field research, providing visual reminders of what I saw in the field, and assisting in written descriptions. Second, images convey what I saw to those who read the completed document. Third, images were used during my semi-structured interviews to enhance communication and comprehension between interviewer and interviewee.

When conducting field research photography is a vital tool. Cameras present a "mechanical memory" not available with the human mind, lending themselves to effective field reconnaissance. This is particularly useful for later analysis and to aid recollection after the researcher has returned from the field (Collier and Collier, 1986). In this sense, "photography offers the stranger in the field a means of recording large areas

authentically, rapidly and with great detail and a means of storing away complex descriptions for future use" (ibid, p.16).

Most "soft" polices related to mainstreaming bicycling can be accurately conveyed through textual description. Infrastructure, and the fruits of infrastructure-related policy, are best conveyed through imagery. In this thesis photographs are used to provide examples of infrastructure in Oulu, as well as its context within, and relationship to, the surrounding urban fabric.

Photographs and images are useful for semi-structured interviews (Harper, 2005). Photographic images were used to enhance these semi-structured interviews in two ways. First, I entered the field as an outsider so photographs proved useful for ensuring the interviewer and interviewee were discussing the same phenomenon. Collier and Collier (1986) discuss the importance of photographs for this purpose. Second, I used photographs as a facilitation tool for drawing out information to filling any gaps that may have existed between my preliminary research and the reality of the field. Essentially, photographs served as what Zeisel (2006), refers to as a "probes."

When discussing photography as a research tool, one cannot fail to address the potential partiality of images. Winston (1998), discusses the sometimes controversial role of photography is qualitative research. While photos were initially regarded as representing "scientific evidence," this idea was refuted to the eventual point of general suspicion towards images in the academic community (Winston, 1998). Now images and photography are once again an important part of qualitative research (Mason, 2002). Photographs must be used appropriately, and researchers must be aware of the potential ethical dilemmas that can arise from this medium. Potential issues include misleading

readers with staged images and revealing the identity of unwilling subjects. Winston (1998) discusses the critical nature of these problems, but emphasizes the important role images can play in qualitative research, especially when researchers have the required background and supplementary knowledge to use photographs ethically and effectively as research tools.

In this project, photographs were used in a manner that presents low ethical risk. Photographs in this study do not depict people's faces, and they are primarily used to ensure accurate communication between involved parties, and to convey the physical conditions that exist for cyclists in Oulu. I remained cognizant of how cameras can "lie" to the viewer. Angles, and timing can certainly portray situations in a favourable light, and care was taken to prevent such manipulation.

4.5 Ethnography

Ethnography involves researchers immersing themselves in, and experiencing, the phenomena they are studying, while "collecting whatever data are available to throw light on the issues that are the focus of the research (Hammersley and Atkinson, 2003, p.1). LeCompte and Schensul (1999) explain that ethnographic studies are "designed for discovery," and the researcher's primary tools are their ears and eyes (p.2). They explain:

> Ethnographic researchers learn through systematic observation in the field by interviewing and carefully recording what they see and hear, as well as how things are done, while learning the meanings that people attribute to what they make and do (ibid).

Ethnography assumes particular importance in an international case study, such as this, because people, and their behaviour are shaped by place. To quote Madden (2010), "Humans are placemakers and places make humans" (p. 37).

Schensul et al. (1999) describe fieldwork as the "hallmark" of ethnographic research (p. 69). My field visit to Oulu afforded the opportunity to experience the infrastructure and witness first-hand the results of mainstreamed cycling. Through observing and recording my surroundings with field notes and photography, I was able to delve into ethnographic research and provide further clarity on Oulu's unique accomplishments. Many of my personal observations are interspersed throughout this document in the form of "ethnographic field notes."

Madden (2010) explains that field notes basically come in two forms. First, there are "scratch notes," or "shorthand notes," which are quickly written in the field, usually messy, and concentrate on "jotting down as much information as possible in as brief a form as possible" (p. 123). The second type of note is referred to as the "full field note." These are generally written at the end of a day, or soon after an event, and compared to shorthand notes, "expand the description and might have a more reflective and/or analytical tone" (ibid). The ethnographic field notes portrayed in this thesis will be based on my "full field notes."

4.6 Analysis

Qualitative data consists of written words and images, as opposed to the hard numbers found in quantitative studies. However, "this does not mean that qualitative data analysis is based on speculation or on vague impressions" (Neuman, 2000, p. 417). The analysis of qualitative data involves systematic and rigorous interpretation.

The first stage of qualitative data analysis is concept formation. Researchers conceptualize data as they examine it, and pose questions to themselves (Neuman, 2000). After all data was collected, I began the coding process as described by Neuman (2000)

and Zeisel (2006). The process began with "open coding," essentially a first pass over the data to find themes by identifying key phrases, critical terms etc. To quote Neuman, "open coding brings themes to the surface from deep inside the data" (2000, p. 422).

After open coding I entered the second phase, referred to as "axial coding." This involved concentrating on the themes identified during open coding as opposed to the data itself. At this point:

> A researcher asks about causes and consequences, conditions and interactions, strategies and processes, and looks for categories and concepts that cluster together" (Neuman, 2000, p. 423).

Finally, after identifying the major themes I entered the "selective coding" stage of conceptualization. This stage involved finding the cases that best illustrate themes and contrasts within the data.

5. Analysis and Findings

The following chapter outlines the findings from the fieldwork conducted in Oulu between 6-15 October, 2010. It begins with a reflection on the research experience and outlines some strengths and weaknesses of the methods employed. After these reflections, the findings from the semi-structured interviews are presented according to themes determined through coding. Throughout this chapter a series of ethnographic field notes will be presented in text boxes. These are intended to convey the experiences and impressions of the researcher, as fieldwork was conducted.

5.1 Research experience

Engaging in international field research was an enlightening and enriching experience, although the term "trial by fire" certainly comes to mind. I had an interview scheduled in Helsinki less than two hours after I was due to arrive at Vantaa airport. A

delay unloading my flight's luggage left me cutting it close. Finland is a nation that embraces technology…so much so that there are no public telephones to be found in the entire country. It is also a friendly country. Thankfully someone allowed me to use their mobile phone and I was able to ensure my first interviewee would give me a little extra time to arrive.

After my first interview I caught a night train to Oulu, arrived early in the morning and had my second interview at the beginning of the workday. I remained in Oulu for six days. The rest of the trip maintained this fast pace, all the way to my last day in Helsinki as I departed directly from an interview to catch a flight home.

All interviewees were excited about the project and happy to participate. One scheduled interview was cancelled by a participant, but for the most part, the research trip progressed smoothly.

5.2 Strengths and weaknesses

I conducted my field research in October of 2010. One of the first questions I was confronted with by my advisor was "Why are you not going in the winter?" This was a valid question, and it should be addressed. First and foremost, a visit to Oulu in January would leave only three hours of daylight in which to conduct my outdoor fieldwork. There was also greater likelihood that travel could be disrupted by foul weather or other complications. Working on a tight timeline, such an incident could prove seriously disruptive.

Had I been addressing this issue as a researcher from a temperate climate, a winter visit to Oulu would have proved vital. As an experienced winter cyclist from Winnipeg, I was more concerned with visiting as many informants as possible, and

seeing as much of Oulu's pathway network as possible during daylight hours. In the end this proved a valuable experience, and I did encounter snow and ice conditions while visiting in mid-October.

Another potential weakness is that I was unable to meet with any residents of Oulu who were not "key informants." While it would have been valuable to gain a better understanding of the network through the eyes of users, I was unable to do this for a variety of reasons, including language and ethics protocol issues.

The semi-structured interviews went well and I received plenty of valuable information with which to answer my research questions. The language barrier proved to be of little concern as all interviewees spoke English very well. Any misunderstandings or confusion were short-lived.

In total, I conducted six interviews with five participants. The first was conducted with one participant on October 6, 2010 in Helsinki. Beginning October 7, I held a series of interviews over three days with one participant in Oulu. On October 11, I conducted what could be referred to as a "mini focus group" with two participants in Oulu. Finally on October 15, I conducted my final interview with one participant in Helsinki. One interview, to be held in Oulu, was cancelled due to unforeseen circumstances on the part of the participant.

5.3 Findings

The backbone of this research included a series of semi-structured interviews conducted in Oulu and Helsinki during October, 2010. A number of professionals from the private and public sectors discussed the concept of mainstreaming bicycling as a form of utilitarian transportation in Oulu, Helsinki, and Finland, with a strong focus on

accounting for winter conditions.

The following section will present the fruits of these discussions to provide insight into how Oulu has mainstreamed cycling, and what lessons that city's experiences can provide for other winter cities. In the first interview, a participant explained that cycling is very popular in Finland but has primarily been promoted and planned for as a recreational activity, and transport for children. They explained that Finnish cities have largely lacked the ability to incorporate cyclists with traffic and mainstream cycling as a utilitarian mode. In this sense, Oulu stands out as an exception within Finland.

5.3.1 Roots of the network

A crucial aspect of the semi-structured interviews was to gain a better understanding of how and why Oulu's pathway developed. The origins of Oulu's pedestrian and cycling planning can be traced back four decades to the late 1960s. At that time, Oulu was a small city with approximately 100 cars per 1000 people (the figure is now closer to 600 cars per 1000 people). Automobiles were not yet prevalent, and most people rode bicycles. As car ownership increased, motorists and truck drivers began complaining about impeded traffic flow, especially on bridges. Through this conflict, there was the perceived need to separate "light traffic[13]" from automobile traffic. One traffic engineer named Mauri Myllyla was responsible for "dealing with" the new traffic issues (Helsingen Sanomat, 2010). Unlike the approach taken in many European and North American cities, Oulu decided light traffic should be accommodated, not marginalized. The approach taken was to construct a parallel, and largely separated, transport network for bicyclists and pedestrians.

[13] The concept of "light traffic" permeates Finnish planning and traffic engineering literature. The term refers to cyclists and pedestrians.

According to interview participants, one of the key elements of Oulu's extensive pathway network is that it took time. It has been developing over four decades. One participant noted:

> The background of our light traffic system goes back many years, there are no rapid or short ways to this development…it needs time. If Oulu has something good, or something bad, you can blame time.

Oulu's pathway network began development in an era where the bicycle was being abandoned throughout the western world, and thought of as an inferior mode. When asked if there was any initial opposition to the pathway network, one respondent replied, "there was many people and examples of doubts of this kind of system [sic]" but the participant recounted that there was no real opposition. One example of doubt in the initial stages was a colleague who claimed, "you construct underpasses for rapists [sic]."[14]

Interview participants noted that there were mistakes made in the early stages of planning and building the pathway network that had to be repaired. The mistakes were largely design-based, and included constructing underpasses that were too narrow, thus creating safety issues. One reason cited for the general public approval of the pathway network was that creating great cycling conditions has rarely been at the expense of automobile traffic. In fact, the complete separation of traffic has proved beneficial to motorists.

While discussing the early development of the pathway network, one participant noted, "I think the sad part of that is that it is largely due to the work of one person

[14] North Americans often inquire about Oulu's extensive use of underpasses and routing trails through forested areas, and the implications for safety and apparent deviance from CPTED principles. Interview participants continually downplayed such matters. It is also worth noting that Nordic countries in general, and Finland in particular, are regarded as a "safe society with a low level of crime" (Lappi-Seppala, 2000, p, 38).

(Mauri Myllyla).” Regardless of how the network began, it is an extensive, well used and an integral part of the community. According to one participant:

> Today most citizens of Oulu are thinking that they have the world’s best light traffic system…if they travel in different countries and cities they come home and say…‘this is a very good thing’…there are feelings of gratitude.

In this sense, that Oulu’s pathway network is largely the result of one person’s initiative, could be considered truly visionary.

5.3.2 Public policy and planning

Oulu has seen bicycling and pedestrian issues mainstreamed within local policies and planning. Interview participants stressed the importance of cooperation in the local planning process, as being integral to their success. Finland’s planning environment is based on master planning of large areas, with traffic engineers carrying out most transport-related aspects. In Oulu, traffic engineers work closely with master planners to ensure cycling routes are integrated into new housing areas from the outset and not as an afterthought. This cooperation also occurs between engineers, planners and the public. Oulu’s planning emphasizes the importance of citizens and politicians participating in the planning process.

Figure 17: Wayfinding signage is found througout Oulu. Photo credit: Author

One participant explained, "city planners are in a very important role in planning traffic systems, but they can't do it alone. They need help." This collaboration began in the 1960s, and the cooperation between planners and engineers is entrenched in Oulu's planning framework. One participant, referring to both professional-to-professional and professional-to-public interactions, stressed "we need to help each other and work together."

In addition to cooperation, commitment was another key factor. When asked how to ensure plans are adhered to over decades, one participant noted:

> You can't require everything from your politicians and deciders, but you have to remember that these persons [sic] are changing in the short term…after four years you have different politicians that don't know, or remember, that they are responsible for [what happened in] past time. That means there has to be something else…interested in what kind of system you'll have in the future [sic]. In my thinking, I really emphasize the meaning of planners...Without them politicians cannot do anything…they cannot change the system without these

tools [that planners and engineers provide].

Another participant chimed in:

> I agree, what is required is long-term planning where everybody is dedicated to it. Otherwise it won't work if you have to fight for every little piece of it…you'll get this thing done this year, and so on. So…whatever you are developing or trying to get done requires…time, money, and the will as well. If that is not there, or it changes every four years…nothing really gets done.

Perhaps Oulu's efforts were best summarized when an interviewee stated frankly:

> City planning is more than car planning…the human being is the main concern. If you acknowledge this fact, the pedestrian and bicycling system is in a leading role.

5.3.3 Policies: Hard and soft

To mainstream bicycling, policy is a key component. Culture, and infrastructure are vital, but unless the appropriate policy manifestations occur, such as strategic infrastructure provision, laws to protect cyclists, and appropriate education, can cycling really be said to be of the mainstream?

The "hard," infrastructure-related, policies in Oulu are particularly impressive. Oulu has an extensive pathway network of over 620 km, most of which is separated from automobile traffic, and meticulously maintained in the winter months. Oulu's maintenance practices, in particular, facilitate year-round cycling.

Figure 18: Grade separation in Oulu. Pathways converge, pass underneath a roadway. Photo credit: Author

New housing areas are required to be part of the pathway network. Neighbourhoods often have more linear kilometers of pathway within them than vehicular roadway. According to one participant, these requirements are helpful because incorporating the pedestrian and bicycling network, "comes automatically, and we don't have to debate it."

New suburbs emphasize connectivity and are designed with pathways as the most direct routes within them. In new housing developments automobile parking is often clustered around the edges with residents walking from parking areas to their residences. Bicycle parking, on the other hand, is located at the front door. To ensure these facilities are incorporated into developemnts the City pays for their construction. This ensures pathway infrastructure is not neglected by developers in an attempt to limit expenditures

and increase profits.

Maintenance was identified as a crucial component of Oulu's success in mainstreaming cycling. The City's maintenance policy consists of two classes of pathway. Class 1 pathways are cleared by 7am, while Class 2 pathways are cleared later, usually by 10am. Unlike in Helsinki, where the City struggles to fulfill its maintenance policies, Oulu strictly adheres to its requirements. Half of Oulu's bikeways are Class 1, and according to interview participants, most residents' daily ride will only have a short section on a Class 2 pathway.

Despite impressive infrastructure and "hard" policies, "soft" policies were noticeably lacking in Oulu. Promotional campaigns to encourage cycling, in particular, were identified as a serious need. Such efforts periodically occur, emphasizing the health and environmental benefits of cycling, but there are no continual campaigns. Participants noted that some local high-technology firms encourage employees to bicycle to work, often using health as an impetus for these efforts.

Interview participants identified health issues as being a primary candidate for continued promotional campaigns. Noting the direct exercise benefits of cycling, coupled with improved air quality with less automobile use, one participant described the relationship between health and cycling as being "multi-dimensional."

One interview participant relayed an unsuccessful attempt to craft policy that embodied this multi-dimensional aspect. In the past, they attempted to have the local health department provide money for winter pathway maintenance. This attempt was grounded in research indicating such an effort could save health care dollars in the long run, both due to increased physical activity and because improved maintenance would

reduce winter injuries caused by slipping. In the end, they could not get politicians on board for this initiative. The participant reflected:

> It's a very tough decision for politicians to actually say 'okay, let's take some funding from our healthcare and put it in maintenance,' even though there's proof that there are benefits.

Interview participants acknowledged the missing dimension of promotional and educational campaigns in Oulu, and noted these were worth pursuing. Regarding the need for soft policies, one participant noted, "I think there's still lots to be done." Another participant explained there is a western inclination to use the "easiest mode" for travel. Therefore the City must try even harder to make cycling attractive and "easy." On the topic of city planners' responsibilities, another participant stressed:

> Cities are responsible for offering inhabitants good conditions for cycling and walking…at some time you will reach the point where this [pathway] system is needed, and in these kind of conditions [referring to contemporary issues of climate change, environmental concerns, unstable fuel prices] it is very important that people can change their mode rapidly. Nowadays we are thinking of climate change, which may [eventually] be creating a compulsory situation in which people have to change their mode, or at least think to change their mode.

One participant lamented that despite increasing environmental awareness, little change is occurring in cycling's modal share. They (referring to the City and politicians) need to "sell it [cycling] differently," and promotional campaigns based on health, and healthy lifestyles, could prove a more effective means for encouraging cycling compared to environmental tactics.

Soft policies including promotional and educational campaigns, while currently lacking, are recognized as being vital to Oulu's future success. According to one participant, in order to mainstream cycling, "it's not only the [pathway] network, you should ensure the people are using it." Another participant explained:

> In Oulu, in the traffic planning now, it's [bicycling that is] taken for granted. I think we should emphasize it more…[or else] it might happen that there's a decline in the future.

5.3.4 Physical infrastructure

Oulu's pathway network is the centerpiece of the city's transport system. Cycling was historically a popular mode in Oulu, and the development of the pathway network prevented the decline in cycling's modal share that happened elsewhere. The statistics related to the network's length and features are continually in flux, and over 20km of new pathway were added in 2010. As of October 2010, an interview participant who is well versed in these matters, described the network as being over 620km in length. Wayfinding signage is located throughout the network indicating directions and distances for neighbourhoods and destinations in the region.

Figure 19: A cyclist uses one of Oulu's raised crossings. Photo credit: Author

The network has some mixed traffic, mostly on low volume residential streets, but it is primarily separated. Oulu's pathway network boasts over 100 underpasses and bridges, with all high-capacity roadways having grade-separated crossings. Additionally there are 150 raised crossings, and 100 crossings utilizing islands at mid-point to increase safety at at-grade crossings. These latter two design features are used where pathways cross lower-volume roadways. One participant explained:

> The [pathway] system as we have nowadays is unique. You won't find that system anywhere else in the world…a separate bicycle network built to this extent doesn't exist.

Oulu's network can be seen as a reflection of the local conditions and characteristics of a northern community in Finland, and thus a vernacular transport network. Pathways are orientated to traverse through parks and forested areas. Wherever possible, pathways are located at a distance from high-traffic roadways and motorways to provide a peaceful riding environment. In this sense, the pathway network fits perfectly within the dispersed urban structures of Finnish forest urbanism. One participant noted:

> It's all about space, we were able to build new areas around pathways, and the existing urban fabric does not affect this option.

Yet, Oulu's pathway network has roots in the modernist, rational engineering-based traffic planning of the 1960s and 1970s. The strict separation of modes is based on the rational modernist model, and this deviates from the mantra of shared space permeating much of the contemporary planning literature. Interview participants acknowledged this and hypothesized that if someone started planning a bicycling system today, "it would lead to a quite different kind of system," and within existing urban fabric, there "likely wouldn't be the space to do a separated bicycle network." However, they also emphasized the importance that modal separation has played in facilitating

winter cycling.

Ethnographic Field Note 1: Forest urbansim and Oulu's pathways

Large portions of Oulu's pathway network travel through forested areas, often at a distance from major roadways. It provides a surreal experience, where despite a great deal of wayfinding signage, it can be very hard to orientate oneself as there are very few landmarks. This is especially true for an outsider.

While Oulu's pathway network has emphasized a strict separation between "light traffic" and automobile traffic, it is a shared-use concept in terms of pedestrians, cyclists and other users (such as in-line skaters and Nordic walkers). As discussed in the literature review, in such a network there is the potential for conflict (see Jones, 2001). With these factors in mind, interview participants were asked if Oulu's pathway network has had any issues with user conflicts. Participants reflected that the real issue was not between cyclists and pedestrians, but with moped users. Mopeds were formerly allowed on the pathways, but as their use "exploded" in recent years, they have had to be banned from most of the network. The only exception to this ban is on sections of the network that parallel high-volume roadways with speed limits above 60 km/h.

When asked specifically about conflicts between cyclists and pedestrians, respondents answered that it "hasn't been a problem," because the pathways are well designed and wide, and generally do not see traffic jams or congestion. Interestingly,

Oulu has seen user conflicts arise where they have attempted to separate cyclists and pedestrians. In this scenario, the two user groups tend to infringe upon each other's designated space, causing conflict, although "not any serious accidents."

When asked why Oulu's shared-use pathway concept has worked so well, one participant noted, "this is always how it was." This statement refers to the habits, of both cyclists and pedestrians, reflecting over 40 years of learned behaviour using a shared-use pathway network.

Figure 20: Oulu's pathways traverse forested areas where possible. Notice the lampposts providing light in Oulu's long, dark winters. Photo credit: Author

5.3.5 Bike culture

Bike culture in Oulu is an interesting example of the unique set of challenges that arise in a city where cycling is part of the mainstream. Chapter 1.1.4 discusses bike culture as it relates to advocacy. Interestingly, in Oulu, advocacy and activism are noticeably absent. There is no formal bicycle association or coalition in the city. When

asked about these issues one participant looked confused and answered, “everyone is the association.” Another participant noted:

> We are all citizens, and I would like to say that bikers are the best planners…and you can see that Oulu has been influenced by bikers. But there are not any strong [advocacy] organizations today in Oulu.

While there is no advocacy per se, there is much citizen involvement in cycling issues. Open lines of communication exist between the public and City staff. There are community meetings, attended by planners and traffic engineers, and the phone lines to City staff are always open. It was also explained that there is a general expectation in Finland that some basic level of bicycle infrastructure will be provided, although this occurs to varying levels of quality throughout the country.

Ethnographic Field Note 2: Activism and subculture in Oulu

One afternoon while walking through central Oulu I happened upon some cycling-related graffiti. A sticker was affixed to the back of a street sign reading: “We [graphic of a bicycle] Oulu.” While there are no formal cycling advocacy groups in Oulu, cycling has strong and persistent roots in subculture. Oulu houses a large student population, and as explained by Bonham and Koth (2010), there is a strong relationship between university students and cycling culture.

This discovery demonstrates the universal undercurrents of subculture in cycling. It also highlights one potential weakness in my research, as I was unable to delve deeper into the world of Oulu’s residents (and students) and their perceptions of Oulu’s cycling culture.

To provide context, it was mentioned that some Finnish cities do have bicycling advocacy and activism groups. Helsinki has a cyclist association, and Finland will soon have a national cyclist coalition, much like other European countries. Noting this difference, one participant noted:

> In Helsinki cycling is more extreme. Here [in Oulu] it's just a mode to get from A to B, and often it's the best way.

According to another participant, cooperation is key, and "cycling culture is born through friendly interaction between cyclists and motorists."

Oulu's bike culture is a reflection of the mainstream. Bicyclists work together with City officials to plan and improve infrastructure, and they enjoy a safe, extensive pathway network. Despite how great this sounds, one participant warned of its implications, lamenting, "we need a subculture. Presently cycling is not cool, it's just a normal everyday activity." This reflects the importance of bicycle culture and subculture related in Chapter 1.1.4.

Figure 21: An apartment block is equipped with covered bicycle parking. Photo credit: Author

Cycling is a critical component of life in Oulu, and the City has created a unique environment for year-round cycling. The City's official website espouses Oulu's fantastic

cycling facilities, and boasts a modal share almost double the national average (City of Oulu, 2009). Yet, Oulu's bicycle culture arguably does not take the prominent position that it could. For example, one interview participant said no bike shops in Oulu sell cargo bikes. Another recounted how, as part of a new campaign to market Oulu, they suggested the City emphasize its unique, world-class light traffic system. This idea was not viewed favourably, because:

> The marketing campaign organizers were looking more at technology and this Nokia-related stuff, because it's cooler, and I don't think they really see that [cycling's a major part of Oulu], and that's a shame.

Yet, it should be noted that some participants see a positive association between Oulu's high-technology reputation and cycling. They explained that high-tech firms often have change rooms and shower facilities to encourage cycling. Some high-tech firms independently undertake promotional campaigns. According to one participant:

> High-tech employees are more likely to cycle than mill workers…especially because many [firms] place an emphasis on fitness.

Through these interviews, it appears that Oulu's cycling conditions and amenities may be taken for granted among the public. Addressing this issue one interviewee explained in terms of cycling, Oulu is still "ahead at the gates" compared to other cities, both in Finland and abroad. However, they also emphasized this does not mean they should settle or stop working on improvements. Referring to Oulu's pathway network and high modal share for cycling, one participant stated, "I think we should be proud of it." Other participants concurred.

5.3.6 Winter cycling

It has been stated that, "winter cycling in extreme temperature is what makes you an Oulu resident" (City of Oulu, 2009). Oulu's cycling accomplishments are

commendable for any city, but when one considers its location and cold winters, these accomplishments become that much more unique. Even in the Finnish context, Oulu's year-round cycling modal share stands out. According to one participant:

> In Oulu it's quite normal that you go by bike places, upwards of 10km away, even in the winter. In Helsinki if I did this distance in the winter, they would think I'm out of my mind for doing that…In Helsinki there are people who do that, but they're more extreme, they think more extreme about the cycling. They say, 'this is what I do, and I do it everyday' because…they're cyclists…but for me it's just a way to go from A to B, and I find it's the best way...so it's not a big deal. I think it's more built-in here [in Oulu], it's quite normal and it's the way we transport ourselves [sic].

Another participant referenced data from a 2003 study showing 33 percent of Oulu's cyclists continue riding through the winter. Other smaller Finnish cities maintained similar shares, including 30 percent in Jyvaskyla and 30 percent in Rovaniemi, the latter of which is located 6km south of the Arctic Circle. These numbers are substantial compared to the 13 percent of Helsinki cyclists who continue cycling through winter. The interview participants hypothesized that people in the northern communities, "are used to the winter and do not fear it." In this sense, one can conclude that a large part of Oulu's bike culture can be found in winter cycling.

Figure 22: A pathway parallels a high-volume roadway. Photo credit: Author

Chapter 5.3.3 discusses Oulu's winter maintenance practices. Interview participants noted that winter maintenance is a critical component of winter cycling. Referring to Oulu's winter maintenance, one participant recounted:

> Through the years its always been really good…I can't remember very many times where I've had [to not go] by bike because the paths were not maintained.

Another participant, describing the logistics of Oulu's winter maintenance said:

> It's very expensive to maintain the network and provide snow clearing and ice prevention, but it's worthwhile to do so.

In both Helsinki and Oulu, emphasis is placed on continual improvement of winter maintenance practices and techniques. Helsinki engaged in scientific research on the technical aspects of using sand versus gravel in winter maintenance, and which material is better for pedestrians, cyclists, or both.

The physical design of Oulu's pathways is another important factor in their winter use. The network was designed with winter in mind, and actually facilitates winter maintenance. The downtown section of Oulu's network along the *Rotuaari*, uses granite blocks as pavement. Although they are more expensive, according to one participant, "these are harder than asphalt and stand up [better] to snow removal equipment."

Figure 23: Oulu's attempt to separate cyclists and pedestrians. Photo credit: Author

One participant explained that shared facilities found in other cities, especially marked lanes, present difficulties for winter maintenance. Oulu's pathways are meticulously cleaned in the winter with special machines. The pathways are not prone to becoming depositories of snow and slush from roadways, as often happens to painted cycling lanes. Helsinki, on the other hand, experiences difficulties because they lack the special snow-removal equipment that Oulu uses. Helsinki also has a combination of pathways, marked lanes and cycletracks located between the roadway and sidewalk.

Helsinki's different forms of infrastructure, with varying widths, create the need for several types and sizes of snow removal equipment.

The need for adequate and quick snow removal is compounded when cycling is mainstreamed. One participant explained that when you have thousands, or tens of thousands, of people commuting daily by bicycle, a serious weather event can force a mass modal shift, with ensuing chaos as other modes are flooded. Serious winter weather events occur numerous times per season in Finland.

One participant stressed the importance of Oulu's separated pathways in facilitating winter cycling, as not having to mix cyclists with automobile traffic increases safety and comfort for winter cyclists. A simple and practical benefit of the separated network, they noted, was that it helped winter cyclists stay clean, and prevented excessive splashing from passing automobiles. One participant stated:

> In order to construct quality cycling infrastructure it is vital to understand how it interacts with pedestrians, motorists, and other users.

When one considers Oulu's winter conditions, this statement takes life, as cyclists need not fear icy conditions and the associated safety implications. This is especially important considering the high stakes of bicycle-automobiles collisions.

Participants explained the relationship between Oulu's high cycling modal share and sub-par public transit is well known. One participant shared that on a really cold day, when the thermometer dips to -25, he still found cycling afforded more flexibility and was faster than having to wait for the bus. That being said, transit use does see an increase in winter ridership while cycling's modal share is reduced. Another participant reinforced the connection between cycling and a lack of other options, explaining:

> In Helsinki they have better public transportation...and more options [buses,

> trams, metro, commuter rail]…so why would they actually ride a bike in the winter?

In Oulu, and Finland, there has been some extensive research on winter cycling. In said research, respondents always give obstacles for why they do not cycle in the winter. According to one participant, "they are just excuses, but you can help people not use these excuses."

Figure 24: Bicycles overwhelm available racks along the Rotuaari in central Oulu. Photo credit: Author

When asked whether Oulu's winter climate is viewed as a barrier or opportunity for cycling, participants unanimously agreed the winter climates should, and can, be embraced. One participant shared an anecdote in which they were questioned about winter cycling at a conference in Continental Europe. Someone asked them:

> When it's colder than minus fifteen can you actually bike, because doesn't your lungs freeze [sic] and you die? [laughs].

The participant continued, "I think it [winter cycling] should be used as a benefit.

There's a big group of people who stop cycling when the winter comes..." They explained that the various obstacles cited in research for not cycling in the winter are surmountable with proper equipment, facilities and maintenance. The participant concluded:

> I see there's a bit of a barrier for certain people, but you definitely should see the positive aspects of it…and the year-round exercise.

5.3.7 Technology

One of the more fascinating topics discussed in the semi-structured interviews was technology. Technology has played a major role in Oulu's growth and transformation into a modern urban centre. Technology also plays a vital role in Finland's future sustainability goals (Teravainen, 2009). While a great deal of sustainable transportation literature sees high technology as a *panacea* for sustainability issues, this has often been at the expense of promoting inherently sustainable, emissions-free modes such as walking and cycling.

In Finland there appears to be a unique integration of high-technology, notably pairing concepts of intelligent transportation systems (ITS) with active transportation. Myllyla (2000) demonstrates the Finnish bias towards technology in discussing the need to increase cycling. He emphasizes that because cycling has no relationship to technology it requires special attention:

> [The] majority of available resources are still used to benefit other modes of travel, such as car traffic and public transportation. As neither the bike nor bicycle routes can be regarded as the creations of high technology, we need other scientific approaches as sources of motivation and recognition (p.153).

Interestingly, in the decade since that was written bicycle planning has embraced technology, especially using global positioning systems (GPS) to track cyclists' routes (see- Pratte, 2010). In Finland, efforts have moved beyond GPS tracking, and there are

efforts to harness bicycle planning with ITS.

Figure 25: Bicycles parked outside Oulu's train station. Photo credit: Author

Helsinki has launched a new internet-based, interactive mapping program called *Fillari Kanava* (translates to *Cycle Channel*). The program is map-based and interactive. It serves as an online feedback service/resource for cyclists to interact with planners and identify problems in the network. The *Fillari Kanava* is fully interactive and hooked in with social networking sites such as *Facebook* and *Twitter*. According to one interview participant, "It's a great invention which brings planners and cyclists closer together and helps point out problems in the infrastructure." Endeavors such as this build off of the long history of interactive Finnish planning technologies such as *Valma* (see Chapter 3.4).

The most interesting example of a unique technological approach, especially as it has implications for winter cities, is a winter warning service for pedestrians and cyclists.

This warning-system for active transportation operates in several Finnish municipalities. The core of the service is based around SMS text messages that alert pedestrians and cyclists when slippery or dangerous conditions have developed. Maintenance personnel report conditions from the field, while conducting maintenance, to a centralized service centre. Those who sign up for the service can receive "real time" updates (ie, plow operator may send it out a 3am) or set-time updates at 6, 7, or 8 am. The project first launched in 2007 in Lahti, a city located northeast of Helsinki. It has since expanded to seven cities, including Oulu and Helsinki. Oulu has over 1500 participants in the program. In the 2009-2010 winter there were seven warnings sent for Oulu.

The system is relatively inexpensive to operate, costing less than 20,000 euro (approximately $28,000CAD) annually. According to one interview participant, "the cost is very inexpensive compared to the health costs associated with injuries." The service's website boasts that it costs less to administer than one hip replacement (Loppu Liukastumisille, 2010). One participant explained that costs associated with this service could decrease, as they may shift to an email-based system. This is becoming feasible due to the proliferation of email-equipped smart phones.

The warning system is used by over 10,000 people nationally, and is only in its fourth year of existence[15]. It is used by a broad spectrum of demographics, including seniors. According to one participant, the "middle age group has proven to be the most prone to injury as they are generally rushing to work and meetings."

[15] Lahti has been using the program for four years. Other cities have joined in subsequent years. Thus the program is quite new for most Finns, and will likely increase in popularity.

Figure 26: Cyclists utilizing the pathways. Photo credit: Author

5.3.8 Issues

Despite Oulu's impressive modal share for cycling and extensive pathway network, the city is facing some serious issues. As discussed in earlier sections, interview participants noted a lack of soft policies as a serious issue and argued that the City of Oulu and its residents could do more to embrace and develop their cycling culture. This section will delve deeper into the issues that Oulu must address for the future.

There are day-to-day issues that planners and public officials must attempt to deal with in Oulu. As previously noted, the City banned mopeds on much of the network after a series of incidents. Another continual complaint is that some motorists use pathways as shortcuts within, and between, neighbourhoods.[16] When asked if the City ever installs

[16] Recall in Chapter 3.5.2 the configuration of new residential suburbs was described as being more easily navigable by bicycle than automobile.

gates to prevent this, one participant stated, “our goal is to build good bikeways not a series of gates that can impede cycling.”

Chapter 5.3.1 discussed the initial development of Oulu’s pathway network, and noted a lack of early opposition to the network’s development. In the contemporary context, one participant noted that, “opposition has been changing.” One emerging issue is that some affluent residential areas are opposed to inclusion in the network. One participant explained, “it’s very difficult to plan anything in [those] areas…they are against anything that may damage their homes (laughs).” The participant continued, emphasizing that “you can’t do anything easy” and these issues, conflicts and oppositions “belong naturally” to city planning.

Chapter 5.3.4 discusses Oulu’s pathway network as it relates to forest urbanism, and how it represents distinct Finnish conditions. It must be noted, however, that there is a fundamental problem with this aspect of Oulu’s cycling network: as the city’s urban footprint expands outward, and the cycling network grows to accommodate it, the network becomes less efficient. For long-distance trips to the city centre, pathways are generally less direct than vehicular roadways, making it increasingly difficult for cycling to be the “easiest mode” for longer trips. At the macro level, the pathways can be indirect and inefficient. While this dispersed urban structure over time has made cycling less attractive an option, it has also made the provision of public transit very difficult.

Figure 27: A pathway serves as a bicycle expressway east of Oulu's city centre. Photo credit: Author

One participant explained that Oulu has counted transport modes since the 1960s at bridges and other choke points within the pathway network. In 2010 the City purchased two automated bike counters to be used on bridges. Since the 1960s the number of pedestrians crossing these points has decreased (although in recent years an increase has emerged), cycling has largely remained steady, and automobiles have increased. These figures are raw numbers, not percentages of total traffic. Thus factoring for Oulu's population growth, from 90,000 to 130,000 over the last few decades, cycling's modal share has actually decreased. Oulu now claims a modal share of around 20 percent, while in 1995 it was reported to be as high as 35 percent[17]. On the topic of these reduced modal shares, one participant noted, "this is changing for the worse in my

[17] Myllylya (2000) gives the figure of 35 percent in 1995, while the National Traffic Study from 2004 cites 19.5 percent. The City of Oulu conducted a traffic survey in 2009 placing the figure at 21 percent.

opinion."

Despite highly developed pathways with grade-separated crossings at major roadways, a field visit to Oulu revealed that the city's pathway network does not always efficiently cater to longer trips, as certain routes can be somewhat disjointed and indirect. This was confirmed in the interviews. To quote one participant, Oulu's network is "not the optimal system for longer trips." When one considers the above dilemma of a continually expanding urban fabric, the weight of the issue becomes apparent.

Figure 28: A new housing district in suburban Oulu where cars are parked at the periphery, but bikes are parked at the doorstep. Photo credit: Author

Oulu has not set a specific goal for increasing cycling's modal share. Commenting on this, one participant said, "Oulu does not have any clear traffic policy." One participant explained the City constructed an elaborate and extensive network of pathways, but meanwhile also:

> …constructed and planned very good conditions for people to live in different areas, and Oulu is spreading all the time wider and wider…in a way that [means] the car is needed, it is necessary. The car network has been developed to a high level…we have very good motorways and main roads, and people can drive their cars in very free conditions.

This inherent traffic planning contradiction, and absence of a "clear direction," is noted as a serious problem, and obstacle to cycling as trip length is continually increasing.

It is easy to identify an issue, but how can it be resolved? Some participants argued that Oulu's urban footprint has expanded to the point that public transit needs to be improved. One participant stressed, "this is the case at the moment, we need to think about bicycle and pedestrian traffic with public transportation."

The topic of whether or not Oulu should address increased automobile dependence with related policy was a popular topic of discussion. Participants noted:

> This is part of the worldwide pattern. People have more money. Cars and gas are comparatively less expensive. Finland is no different.

Another participant agreed, stating, no matter where you are in the western world "the problems are the same."

Another explained:

> The rhythm of life is getting quicker and quicker…and you have to…(snaps fingers)…get from point A to point B as fast as possible, and this kind of tendency is always working against cycling…so there are some huge challenges.

But how should Oulu go about addressing these issues? Interview participants discussed that removing space from automobiles is "poison" for politicians. One participant observed that at every planning conference in Finland there is much discussion of "light traffic." It is often the main topic, and according to another participant, professionals love to debate, "where is the place of pedestrians, and where is the place of bikers…and everybody has an opinion on this…" However, the topic of replacing car traffic with

"light traffic" which, according to that same participant is the "real issue," is avoided because it is an "unhygienic question." Carrying on the colourful descriptions, another participant noted that despite the progress that has been made in Finnish "light traffic" planning, removing space from automobiles still amounts to "political suicide."

Ethnographic Field Note 3: Shared-use trails and mixed traffic

While some academic literature suggests shared-use trails may have limited effectiveness for utilitarian transportation, this concept appears to work well in Oulu. The success of shared-use trails is likely due to a combination of cultural and behavioural factors.

Learned behaviour has developed through four decades of experience using these trails, and Oulu's residents have thus developed appropriate etiquette between pedestrians, cyclists and other users. Meanwhile, cyclists have developed realistic expectations for speed and functionality.

Kaiser (2005) describes cultural factors among Finnish people, including a mutual respect and propensity towards teamwork. One could also apply these traits to the effectiveness of shared-use pathways in Finland. Another manifestation of these cultural traits is that people lock their bikes with only a small brake lock that disengages the rear wheel. Most people do not secure their bikes to racks, railings or other secure objects. In fact, you often see bikes leaned against bus stops and left there for the duration of a workday.

The interview participants who were not employees of the City of Oulu stressed that City staff are doing a great job with the resources they have available to them. The issue is that there are not enough people working on these issues, considering cycling as a mode of transport accounts for 20 percent of the city's travel. Interestingly, one participant shared that Helsinki is the only city in Finland with a full-time bicycle planner (there are two). In Oulu, there are four traffic engineers, of which only one is responsible

for the entire "light traffic" network. Thus, it is not surprising that City staff do not have enough time for planning issues such as soft policy initiatives.

Participants advocated for a widespread policy initiative, and the need for soft policies. They also suggested Oulu may need to address the "unhygienic" question of limiting the continual expansion and increased-capacity of the roadway network, and re-examining land use practices. On this note, participants stressed Oulu has been experiencing substantial infill developments within the city on old industrial and harbour sites. According to one participant:

> There is already lots of good information and the tools you can use for the decision-makers to demonstrate that this [active-transportation] system is good…you should link different [positive] elements for the decision-makers, and I think…health is one very important aspect, as is climate change as well.

After discussing some of the issues faced in Oulu, it was emphasized that the participants are pleased with the work that has been done, and realize that they are still in an enviable position for cycling, compared to other Finnish and international cities. According to one participant, "I think the situation is really, really good, so it will be easy for us to develop further the system [sic]." Regarding the ability to influence the travel behaviour and modal choice of residents, he continued, "I'm not sure if we're taking enough action to promote it." Another participant acknowledged the work that's been done, and Oulu's many successes, but was concerned about the health and activity levels of children, cautioning:

> That doesn't mean I'm happy with the situation, I think people should do it [bicycling] more because people are beginning to move their children everywhere by cars…then when they grow up they'll travel by car.

Discussing Oulu's need to improve upon its success and tackle these issues, another

participant stated, “there’s always steps forward…moving beyond the easy solutions.” These are the steps that must be taken in Oulu for the city to build upon its successes and overcome obstacles.

5.3.9 Implications for other winter cities

Through the semi-structured interviews participants expressed what they felt other cities can learn from Oulu’s experience. One participant, who had been involved with the development of Oulu’s cycling network from the beginning, reflected that, “the most important thing is to select a system and start to construct the system.” He emphasized that you require time and money, but you need to make a long-term commitment, stating, “there is no rapid way to do this elsewhere, it requires time.” Oulu achieved its accomplishments over four decades, and this participant emphasized that change will not happen overnight. When asked how Oulu’s commitment to the cycling network has survived through 40 years of changing political administrations, respondents emphasized the importance of, and power of, the plans that were made.

Participants also stressed the importance of sharing information and expertise. One participant has authored a textbook (in Finnish) about Oulu’s experience, some have worked internationally, others have presented at conferences, and most have engaged in research on matters of bicycle network development and winter cycling. In the 1970s and 1980s Oulu was held up as an example in Finland, and other cities tried to emulate Oulu’s success. In Finland, this has tapered off, and participants conveyed that most Finnish cities, for example Jyvaskyla, have done a good job addressing cycling needs. Jyvaskyla’s *City of Atmosphere* plan directs a unique place-building project and climate-responsive transport vernacular. The goal of the project is to capitalize on the city’s

unique attributes and build a city that is “dense and ecological” and provides residents “barrier free mobility” (City of Jyvaskyla, 2008).

Ethnographic Field Note 4: Oulu's pathways as a form of vernacular transport

In this thesis I argue Oulu’s pathway network can be considered an example of vernacular transport. The network provides year-round access, is specifically designed to allow efficient winter maintenance, and provides lighting for the dark winters. Cyclists are also afforded the opportunity to traverse much of the urban area without crossing the path of an automobile, while cycling through beautiful forested areas.

The development of the pathway network was enabled by Oulu’s urban form. Over four decades the growth of the network and Oulu’s urban form re-enforced eachother. While some issues are emerging because of this pattern of development, Oulu remains blessed with a world-class pathway network. Such a system may not work elsewhere, but it works in Oulu.

Cycling is generally taken seriously in Finnish transport planning, and this has been the case for upwards of 20 years. Despite national successes related to cycling, interview participants stressed that Finland is nothing like the Netherlands or Denmark. Oulu still stands out amongst its peers, but there has been a national change towards sustainable transport and active transport. Of particular interest to this research are the City of Jyvaskyla’s “quality corridors.” These are a series of nine active transportation routes radiating from the city centre into suburban districts to provide “pleasant, safe and fluid bicycling routes” (City of Jyvaskyla, 2008, p. 17). Sections of these quality corridors have no grade-level crossings shared with automobiles, and were heavily influenced by Oulu’s network. This increases cyclist safety, especially in winter conditions. These routes function for both recreational and utilitarian purposes.

Ethnographic Field Note 5: Connectivity and network density

Perhaps the most impressive aspect of Oulu's pathway network is the high level of connectivity in some places. At the intersection of Highways 20 and 847 the pathways utilize flyovers, similar to those found on a vehicular expressway, to span eight lanes of traffic in each direction and railway tracks. Cyclists and pedestrians are able to navigate an otherwise inhospitable area without crossing traffic at-grade.

6. Case Study: Summary of Findings and Conclusions

This thesis sought to answer two key questions: How can winter cities successfully mainstream cycling?' And, what lessons can be learned in Oulu that may have application elsewhere? Using the above questions as an over-arching goal, three research questions guided this inquiry:

1) What were the most significant factors in mainstreaming bicycling in Oulu?

2) Through what process has cycling policy been translated into action?
    - Who were the key players-people, institutions etc.?
    - What relationships exist between key players?
    - Priorities, budgeting, enforcement?

3) What lessons (if any) can North American winter cities learn from Oulu's experience?

Using Oulu as a case study, this project embarked on a far-reaching examination of Oulu's experience planning an extensive, year-round pathway network. Chapter 1.1 explained that bicycling, as part of the mainstream, has three components: policy, infrastructure and culture. The literature review, and research findings indicate that cycling can be mainstreamed when accounted for in policies, both hard and soft, infrastructure and culture. These strategic components of mainstreaming should thus be manifest through modal share.

The document review and interviews establish that cycling is part of the mainstream in Oulu. The City has many policies in place, although there is a focus on "hard" policies and maintenance. The pathway network in Oulu is world class, engineered to a high level and thoroughly extensive. Oulu's cycling culture is a reflection of being in the mainstream. So much so, there is a lack of advocacy and activism. This is a manifestation of Oulu's integrated cycling policies. Finally, the city has a substantial modal share of 20 percent, high for a city in any climate, let alone a winter city.

The *three domains* as presented by Schiller et al. (2010, see Chapter 2.3) will provide a framework for the pertinent qualitative data to be organized. The *three domains* prove particularly useful for this research because they encompass the strategic components of mainstreaming cycling (policy, infrastructure and culture) while also accounting for historic and cultural variables, which are pertinent for an international case study. While this research discussed the inherent tension between policy and infrastructure, infrastructure is guided by policy and all factors interact, as demonstrated in the policy wheel (see Chapter 1.1.5).

Within Domain 1, there will be differentiation between "hard" and "soft" policies (McClintock 2002b), but a detailed examination of Oulu's infrastructure will occur under the heading of Domain 3: Technical and infrastructural factors. Domain 2 will address cycling culture and other historic factors that could account for cycling's prevalence in Oulu. This will be of particular importance in framing the context of this international case study.

Chapter 7 will specifically address the third research question, and present lessons and applications for other winter cities.

6.1 Domain One: Planning and policy factors.

6.1.1 Critical event

Oulu's long history of planning for cycling can be traced back to a critical event. In the 1960s as the city was forced to confront the emerging conflicts between motorists and cyclists. Tasked with addressing emerging traffic conflicts, a traffic engineer pursued a multi-modal approach to traffic management. Instead of ignoring the important role that bicycles had played in Oulu, they would continue to be accommodated on safe, separate

right-of-ways, instead of being forced to compete with traffic, diminished to recreational status, or discouraged altogether as a means of transport.

6.1.2 Policy makers, integrated policy-making, policy adequacy

In Oulu, planning and policy for bicycling was an integrated process and planners, engineers, stakeholders and the public were all involved. The policy was adequate enough to make Oulu a sterling example of a winter city with a high modal share for cycling and extensive, meticulously maintained pathway network. However, there are indications that soft policies, and policies to discourage automobile use, have been lacking and may be necessary in the future.

6.1.3 Citizens and community leaders

Citizen participation has been a cornerstone of planning in Finland, and Oulu's bicycle network has relied heavily on this. Community leaders and politicians also bought in to the plan, as they ensured Oulu's pathway network was developed and improved over four decades. Citizen advocacy was not an integral part of the developments that occurred in Oulu.

In order to ensure cycling maintains, or increases, in popularity politicians will be faced with difficult decisions in the future. There are great opportunities for advocacy and activism to play a role in the future of Oulu's cycling initiatives. Only time will tell if citizens and leaders are up to this task.

6.1.4 Careful analysis, economic evaluation, impacts

Analysis and research are inherent in Oulu's traffic planning environment, as it is deeply rooted in rational engineering. The city has calculated the economic value of its pathway network, and makes detailed inventories of facilities and expenditures. In order

to advance Oulu's planning for cycling and walking, these efforts should also be used to formally determine the environmental benefits of Oulu's pathway network.

6.1.5 Appropriate planning structure, motivated staff

The planning structure in Finland was an asset in Oulu. While not all municipalities use it to the same extent, national policy encourages active transportation. The master planning of residential communities also ensured pathways form an integral component of new suburbs.

Staff are motivated and competent. Both municipal staff and private consultants were passionate about Oulu's pathway network and cycling environment. There was some indication that if Oulu wishes to truly advance the quality of the network and increase cycling's popularity more staff, including a planner dedicated to active transportation, will likely be required.

6.1.6 Good data/evaluation

Oulu keeps meticulous records of pedestrian and bicycle counts at key bridges and intersections dating back to the 1960s. The city recently purchased two portable optical counters that differentiate between cyclists and pedestrians. These will increase the accuracy and detail of their counts. The ability to increase the accuracy and scope of pedestrian and bicycle counts will allow Oulu to improve monitoring and evaluation of their "light traffic" system over time.

6.1.7 Deliberative planning

The planning of Oulu's pathway network has been a deliberative, concerted effort to provide a safe, efficient, year-round cycling environment. From the roots of the system in the 1960s there has been continual improvement of physical infrastructure and

maintenance practices. Interview participants stressed the importance of time and commitment to the development of the pathway network. Such an endeavor must be carefully planned, and will not manifest itself overnight.

6.2 Domain two: Background factors

Oulu's history, natural setting and decades-long experience planning for cyclists and pedestrians are vital to this research. The literature review discussed many background factors, however, interview participants also discussed these matters, and felt they were relevant.

6.2.1 History, heritage, culture and values

Oulu has developed into a dynamic, high-tech city with a growing population. Four decades of investment in cycling infrastructure have led to the development of a cycling culture and the integration of cycling into many of the city's policies. Cycling is not an afterthought in Oulu.

The city is home to a large university and student population. These factors have been identified as being related to higher cycling levels, both by interview participants and in international academic literature.

The prominent role of sport ensured that cycling has remained a popular form of recreation in Finland. Oulu has developed a network and cycling culture far beyond the norm in the Finnish context. Winter is an integral component of the Finnish psyche and outdoor winter sports, specifically skiing, are central to the culture. There is no clear data connecting these intangible factors to a propensity for winter cycling, but this thesis asserts there is likely some connection.

6.2.2 Geography and topology

Oulu's flat topography is repeatedly referenced as one reason why cycling has fared so well, but many of Oulu's geographical traits could be seen as hindrances to cycling. Oulu sees average January lows of -10 degrees Celsius, and is very much a winter city. While temperatures are moderated by the Gulf Stream, Oulu's latitude leaves it in darkness for much of the winter, with only three and a half hours of daylight at the winter solstice.

6.2.3 Accountable governance systems

As previously discussed, the Finnish planning system places high priority of citizen input. At the macro-level, interview participants expressed concern that there may not be full accountability for national-level policies. The *Jaloin* project was identified as an exciting initiative that undertook some valuable research, but in the end, one participant noted that many of the recommendations "gathered dust" on shelves. This thesis' literature review on Finnish planning policy uncovered many progressive policies related to sprawl abatement and sustainable transport, but a casual visit to the Helsinki Capital Region or other Finnish cities reveals development patterns occurring similar to many of those in North America.

At the local level, however, Oulu has had great success adhering to, and being accountable for, planning and policy objectives. The city has spent four decades building and investing in a pathway network spanning the entire region, which is commendable. Most of the objectives from the "bicycle traffic enhancement program" have also been fulfilled.

What remains to be seen is whether local citizenry will demand that Oulu pursue a greater commitment to making the macro-level, or regional, urban form more conducive

to bicycle travel, and further enhance the pathway network for efficient longer-distance travel.

Ethnographic Field Note 6: Crazy Days!

Stockmann department stores are a shopping institution and national icon in Finland (not unlike The Bay in Canada). *Hullut Paivat* (aka "Crazy Days") is a large annual sale and promotion spanning several days in October. I had the pleasure of experiencing the pandemonium that surrounds this event first-hand.

There was also an unexpected research benefit of this fortuitous timing. While cycling on Oulu's pathway network I was able to informally track the bright yellow Stockmann "Crazy Days" bags. This was a unique glimpse into the travel patterns of Oulu's residents as they cycled from the city centre to their various domiciles and places of employment.

6.2.4 Social organization

While a detailed investigation of Oulu's social organization is outside the scope of this research, there are a few notable characteristics. In general, Finland's population is aging, but Oulu has a slightly younger population make-up than the national average. Oulu is home to a large student population. Interview participants also noted a propensity of tech-sector firms to encourage cycling, and propensity towards cycling in tech-sector employees.

6.2.5 Existing transportation and land-use system

Oulu is in the enviable position of having its existing transportation system contain an extensive pathway network that essentially serves all areas of the city. In addition to the marquis pathway network, Oulu is also home to a highly developed roadway network for automobiles.

Oulu has a compact centre focused around the *Rotuaari*, which serves as the focal

point for shopping and entertainment. Meanwhile, overall urban land use is dispersed, and new residential neighbourhoods have sprawled outwards through a period of tremendous growth. Interview participants noted that Oulu's dispersed land use and density provided the space in which the pathway network could be developed.

Most importantly, Oulu's pathway network began its development forty years ago. Helsinki, and countless other cities, are struggling to incorporate cycling infrastructure into dense historic centres and existing neighbourhoods. Oulu, on the other hand, has built decades worth of urban fabric that accommodates active transport. Despite the dispersed nature of Oulu's post-war urban development, the pathways have been incorporated into the urban fabric. Unfortunately as travel distances have continually lengthened, automobile travel has become increasingly attractive.

6.3 Domain three: Technical and infrastructure factors

The third, and final, domain is technical and infrastructure factors. The extensive pathway network is Oulu's hallmark, therefore these factors can be seen as particularly important to cycling's prominent role in Oulu, and its presence in the transportation mainstream of that city.

6.3.1 Appropriate infrastructure and energy sources

Oulu began developing its pathway network before the city was inundated with automobiles, and the infrastructure to accommodate them. Interview participants noted that when the city began planning the bicycle network, cycling was a very popular mode of travel. While most other cities relegated cycling as a fringe mode and embraced automobiles, Oulu decided to accommodate cyclists and pedestrians with a parallel network. Thus, Oulu actually maintained cycling as a mainstream mode.

The infrastructure has proven to be appropriate for the climate and winter conditions in Oulu. Interview participants repeatedly identified the separation between motorized and “light traffic” as an integral component of the network’s success. Where crossing occur at-grade raised platforms and centre medians facilitate safe passage, while calming automobile traffic. There were also several design elements specific to winter maintenance and snow/ice removal, including uniform width and durable materials. Lighting was integrated into the network to account for the long, dark winters experienced at 65 degrees latitude.

6.3.2 Availability of appropriate hardware

This study did not delve too deep into the details of equipment and computer systems. As discussed throughout this research, however, Finland has embraced technology. Inevitably, interview participants shared some of the planning tools at their disposal. Oulu has detailed computerized inventories and locations for all transport infrastructure, right down to the location of every one of their ubiquitous blue shared-use signs.

Figure 29: Finland's ubiquitous shared-use signage. A staple throughout urban and rural areas. Photo credit: Author

6.3.3 Appropriate standards and measurement

Oulu has engaged in meticulous measurement and analysis of their pathway network. There was a general understanding amongst interview participants that in order to move forward, and increase cycling's modal share, new forms of measurement and analysis may be required. For example, detailed environmental considerations and measurements of level of service and performance of pathways over longer distances.

6.3.4 Orientation and skill sets of technical personnel

Historically, this could be the most important factor in the development of Oulu's pathway network. In the 1960s the city found itself at a crossroads and chose a transportation future that included cycling. Beyond merely choosing this path, professionals and technical personnel utilized planning practices rooted in rational

engineering, but based on cooperation and integration, both on a professional-to-professional, and professional-to-public level. These factors were noted as a cornerstone of Oulu's success.

6.3.5 Existing built environment

When Oulu began the development of its pathway network the city was small, and automobiles were not yet mainstreamed. The pathways were not competing for space in the same way they would be if construction started today. Interview participants listed Finnish land use practices, as a key factor of how their network developed. Unlike cities in older, more densely built nations, Oulu had room to build separate pathways through forested areas and parallel to roadways. Participants acknowledged this was a major advantage, and would not have been possible in other countries, or even Helsinki.

Oulu experienced immense growth through the 1980's and 1990's, and thus, the city grew while integrated pathways were a cornerstone of local policy. Despite the complete integration of the pathway network, Oulu's built environment may be approaching a physical extent beyond the carrying capacity of what the system can efficiently handle. Moving forward, the shape and structure of Oulu's existing built environment, and how it relates to the pathway network, will require attention.

6.3.6 Technical aspects of environmental impact assessment

In Oulu environmental impact assessments (EIA) have not been carried out for pathway projects because they tend to be small projects (compared to highway construction). There have been no formal calculations of the environmental "value" of the network, for example, in terms of reduced carbon dioxide emissions.

Ethnographic Field Note 7: Helsinki's cycling network.

Unlike Oulu, Helsinki is playing catch-up when it comes to providing infrastructure for cyclists. It must be noted, that Helsinki's facilities would still make most North American planners green with envy. In Oulu, the separated pathways are highly developed and provide smooth travel with many grade-separated crossings. Few of Helsinki's pathways function at this level.

As an older, larger city Heslinki has had to accommodate cyclists into existing urban fabric with little room for increased corridor width. Helsinki has engaged in two bicycle planning tactics not seen in Oulu: separating pedestrians and cyclists, and mixing cyclists with automobile traffic. Helsinki's cycling network incorporates shared-use pathways, cycle-tracks, and painted bicycle lanes. Complicating matters, are Helsinki's miles of tire-snagging tram tracks.

7. Applications and Best Practices for Other Winter Cities, Oulu Looking Forward, Research Paradoxes and Areas for Further Research

7.1 Applications and best practices for winter cities

One of the key goals of this research was to inform efforts at mainstreaming bicycling in other winter cities, especially in Canada. This thesis attempted to account for any cultural, historic, and/or geographic conditions within Oulu and Finland that may account for their success. There are cultural factors, including the role of winter in Finnish culture, and a cultural propensity towards outdoor activities such as cycling. The planning environment in Finland also may be more conducive to planning for cyclists and pedestrians. Despite these factors, Oulu is a unique case within the Finnish context. Oulu boasts a substantially higher modal share for cycling, better maintenance practices, and a pathway network that is far more extensive, and better functioning, than most of its Finnish, Nordic, and European counterparts. This thesis portrays Oulu as overcoming the six barriers to bicycle use as explained by the *European Council of Ministers of Transport* (ECMT, 2004). These are:

- Cycling's marginal status.
- Lack of coordination between key players in promoting cycling.
- Safety and fear of injury.
- Lack of technical understanding for cycling-specific infrastructure.
- Lack of road-space to accommodate different modes of transport.
- Cycling is regarded as a recreation or sport activity, not utilitarian transport.

Therefore there are lessons and recommendations that can be drawn from the experience in Oulu for other winter cities.

7.1.1 Infrastructure

While there has been much debate in cycling literature as to what extent, if any, infrastructure plays in encouraging cycling, Oulu demonstrates that in a winter city

infrastructure assumes great importance. The city's pathway network is extensive, well-maintained, contains wayfinding signage, and features grade-separated crossings at major roadways. The pathway network ensures a safe and attractive environment where cyclists need not fear incidents ranging from severe (for example, a collision with an automobile), to inconvenient (such as being sprayed with slush from a passing motorist). The pathways are also designed with winter maintenance in mind, utilizing materials and dimensions that facilitate snow removal and ice remediation.

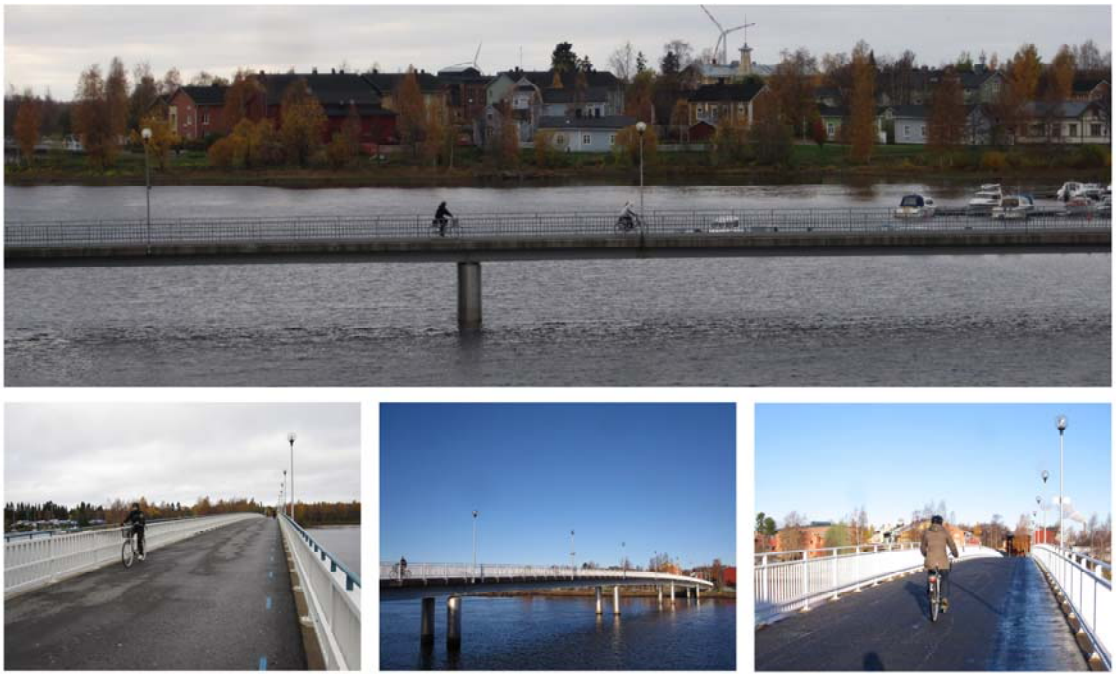

Figure 30: Bridges leading into central Oulu. Photo credits: Author

The Finnish concept of "traffic" versus "light traffic" is steeped in the rational engineering thought, while the contemporary paradigm calls for shared space and integration in urban corridors. Oulu demonstrates that in winter cities separation of "light traffic" from motorized traffic assumes greater importance. It should also be noted that Oulu's network is context-sensitive (see Chapter 2.8). The central city, along the

Rotuaari, is based on "naked street" concepts with cyclists and pedestrians sharing space, thus speeds are naturally reduced through congestion. As the pathways move outwards from the centre they assume a form more conducive to speed and movement, functioning like bicycle expressways (see fig. 24, Ethnographic Field Note 8).

Oulu's pathway network serves as a model for cities with variable land-use patterns, especially in North America. The forest urbanism model functions in a manner not unlike the development patterns found in Canada. This pattern of urban development allowed the formation of the pathways that extend throughout the urban area. In this sense, Oulu's pathways can be seen as representing a transport vernacular, reflecting the climactic and cultural conditions in northern Finland.

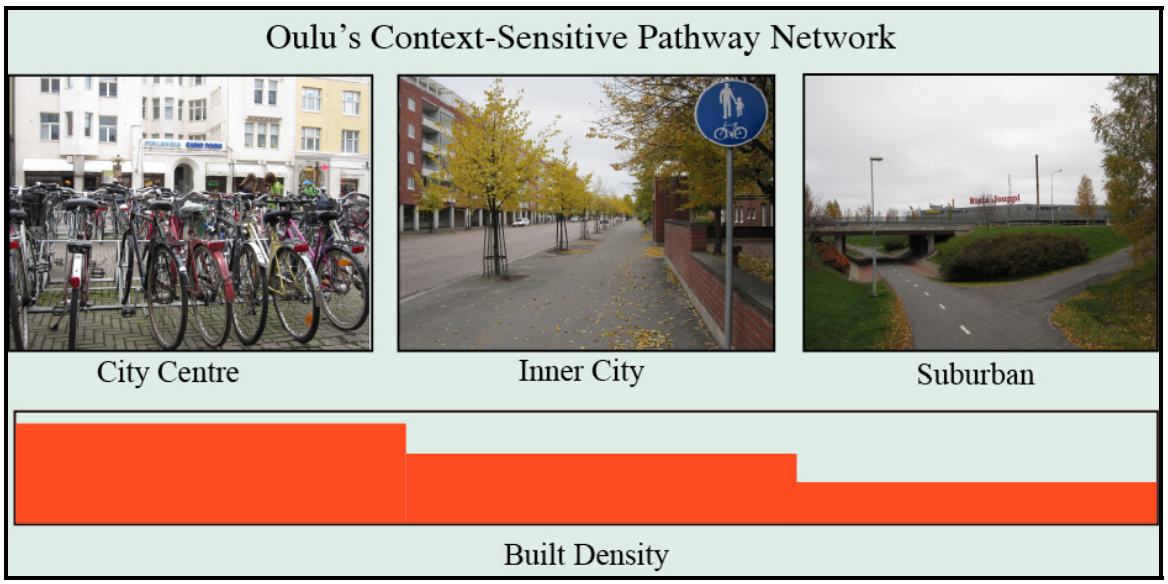

Figure 31: Oulu's pathways as a context-sensitive network. Graphic by author. Photo credits: Author

Oulu also demonstrates the importance of quality infrastructure. As urban areas expand outward, it becomes increasingly difficult for cycling infrastructure to remain competitive. While sections of Oulu's pathway network operate at a very high level, with

grade-separated crossings and other features, other portions are not as conducive to the longer-distance travel that becomes necessary as urban regions expand.

While Oulu's pathways are extremely successful and a model worth replicating elsewhere, the experience does underscore the limits of infrastructure and the need for complementary policies.

Ethnographic Field Note 8: Grade separation and bicycle expressways

In some areas, Oulu's pathways literally give the feeling of being on a bicycle expressway. As you navigate these sections, you pass underneath and over, roads, water and railway tracks. Smaller pathways join the main routes providing access to housing areas. Near major thoroughfares small spurs, almost like off-ramps, extend from the pathway providing access to bus stops.

Almost all of the pathways traverse major traffic thoroughfares with grade-separated crossings. When pathways cross roads at-grade, motorists always seemed to expect and respect cyclists at crossings. The raised crossings and islands employed for at-grade crossings appear to be effective.

7.1.2 Policy

Oulu's "hard" policies could serve as best practice and precedent for most other jurisdictions. Pathways are required to serve new developments, and the focus on quality infrastructure and connectivity is a marvel compared to the experience in many other jurisdictions in Finland, Europe, North America, and the world.

Oulu has in place funding mechanisms ensuring significant proportions of road improvement expenditures are allocated to pathway infrastructure. Over a two-decade period, between the 1970's and 1990's, 10 percent of the road budget was earmarked for pathways. This has been paramount to the continued expansion and upgrade of the pathway network and could serve as a best practice for other cities.

Maintenance practices in Oulu are also worth replication. Oulu's maintenance policy is ambitious and thorough. Most impressively, it is also adhered to. The policies focus on having major cycling routes cleared prior to the morning commute, ensuring cycling remains a viable and reliable transport option throughout the year.

7.1.3 Cooperation

Interview participants largely credited Oulu's success on cooperation and coordination within the municipal structure, and between the municipality and the public. It is important that planners, engineers, public health officials and local residents do not work in "silos," but that they find where common goals overlap and work collaboratively for change.

7.1.4 Patience and realistic expectations

Perhaps the two most important factors winter cities should keep in mind if attempting to mainstream cycling are that it will take time, and to keep realistic expectations. Oulu has been developing their pathway network over four decades, and this has been an ongoing process. While the city has seen great success, there were several instances where mistakes had to be corrected, sometimes at great cost. In the 1990s Oulu engaged in a series of improvements under the "bicycle traffic enhancement program." At present, Oulu finds itself at another crossroads where improvements and enhancements to infrastructure and policies are becoming necessary.

Figure 32: Growth and improvements. The network is upgraded in Oulu (left); and Jyvaskyla adds new pathways in an existing neighbourhood (right). Photo credits: Author

Expectations must be realistic and grounded in the local experience. Oulu boasts a cycling modal share of 20 percent, and also very impressively, a further 24 percent pedestrian share. This research explored possible cultural factors that could affect the propensity to cycle in Oulu, but perhaps most importantly, Oulu intervened and began planning for cycling before its modal share was seriously eroded by automobile use. In essence, Oulu worked to maintain cycling as a mainstream mode of transport. Cities working to correct damage that has been done, and attempting to mainstream cycling where it is currently a fringe mode, must expect incremental success. Especially in the North American context where most cities, whether located in temperate climes or winter regions, are rarely able to crack a 5 percent modal share (Pucher and Buehler 2005; Pucher and Buehler, 2006a; Transport Canada, 2010). Thus, realistic goals and expectations must be in place.

7.2. Oulu looking forward

Oulu exemplifies a winter city that has mainstreamed cycling. In harnessing its distinct local character, cultural and geographic traits, coupled with a world-class

pathway network and maintenance regime, the city has largely overcome the climatic conditions that hinder cycling in other jurisdictions. In reviewing the above findings, it becomes apparent that despite Oulu's great success, the city is facing some serious issues. Oulu seems to exemplify the diminished returns of developing alternate modes of transport while simultaneously investing heavily in automobile infrastructure.[18] The city's pathway network is extensive, and generally built to a high quality. In terms of mileage, pathway development has often outpaced roadway development. However, the misleading aspect of that statistic is that Oulu's roadway network has increasingly improved in quality and capacity, creating an environment where automobile travel has become an attractive and efficient option as the city has expanded outwards. This is especially true given Oulu's lack of quality public transportation.

[18] Another example of this is seen in some American cities where light rail is added to a highway right-of-way while the same highway's vehicular capacity is increased through additional lanes. For further explanation see Litman (2010).

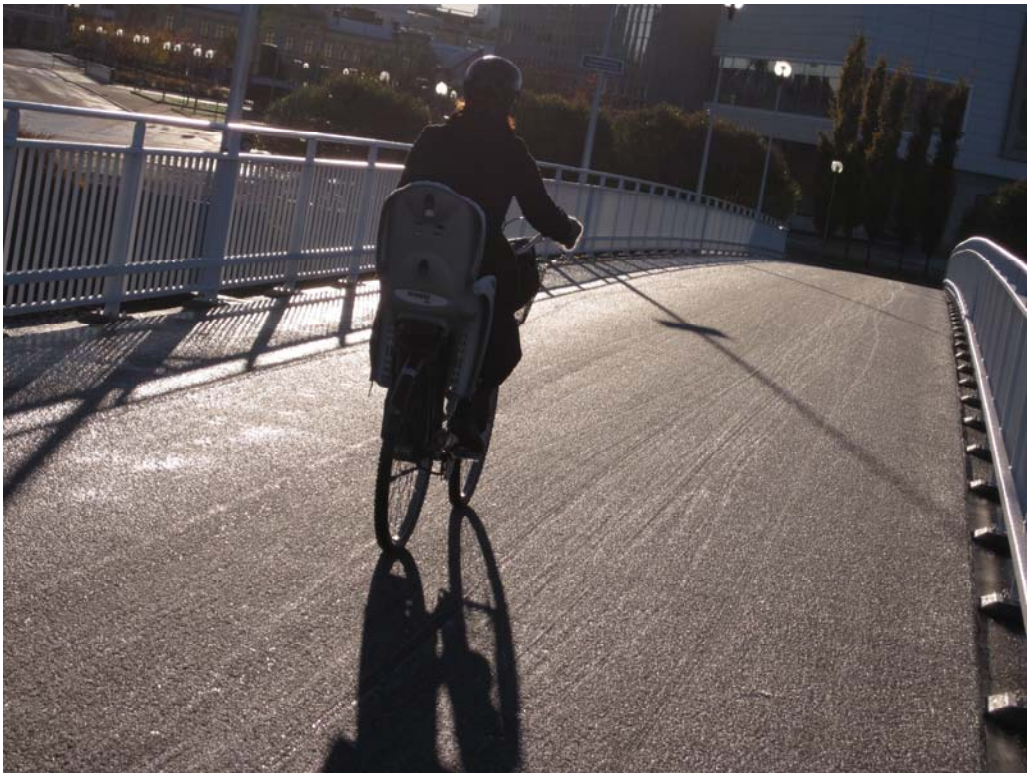

Figure 33: A cyclist crosses a bridge into central Oulu on an icy October morning. Photo credit: Author

Much like in the 1960s when the city faced increasing conflict between motorists and cyclists, Oulu needs to make choices regarding its future. As addressed in the interviews and literature review, the key issues facing the city are as follows:

- Stagnant or declining modal share for cycling.
- Continual physical expansion of urban area.
- Inability of pathway network to efficiently service expanding urban area.
- Lack of "soft" policies and promotional campaigns.
- Need for enhanced bike culture.
- Ineffective transit service

In Schiller et al.'s (2010) domain one, there were several components that were not addressed in the semi-structured interviews and the available documents. These factors included: scenario building, evaluation of all options, creating a vision of a preferred future, backcasting to inform planning, and a soft path/mobility management orientation. The absence of these factors could be attributed to a manifestation of Oulu's

engineering focus. It is through these factors that Oulu's residents, politicians and planning/engineering professionals can address the issues that are facing Oulu's cycling environment.

Another apparent issue is that Oulu's bike culture has become so mainstreamed, it may not ensure cycling issues are at the forefront of planning and public dialogue. Interview participants noted this issue. Through efforts related to "soft" policies and "social activities" (see chapter 1.1.4), such as public cycling events, Oulu's bike culture could receive a boost.

One potential approach for addressing and confronting the issues facing Oulu's pathway network would be to enter a community visioning process. Community visioning is a planning tool that "brings together local people to debate and articulate local community values, identify current issues and future opportunities, and develop specific plans to achieve their vision" (Cuthill, 2004 p. 429). Such an exercise could not only facilitate improvements to Oulu's cycling network, it could also allow residents to articulate what their pathways, and cycling in general, mean to the community, thus enhancing local bike culture.

Soft policy initiatives should be explored in Oulu. The health benefits of cycling were addressed in interviews as an area with potential value for policies. Another area for immediate attention may be embracing the environmental benefits of Oulu's pathways. Interview participants addressed climate change as a potential motivator for increased cycling, yet Oulu has not officially quantified the environmental benefits of its cycling and transportation network (see Chapter 6.3.6). The health benefits and environmental value of the pathway network represents a huge opportunity for its further enhancement

and increased importance in the eyes of local residents.

As cycling and walking account for a significant portion of Oulu's modal share, the addition of a full-time staff person to deal with active transportation issues would be worthwhile for the City of Oulu. At present, one traffic engineer deals with "light traffic" in addition to other responsibilities. As the technical components of the pathway network operate at a high level, the multi-disciplinary skill-set of a planner to compliment the exemplary engineering staff could prove particularly useful. Such an addition to City staff could prove especially valuable in implementing "soft" policy initiatives and facilitating collaboration between environmental, health and other interests related to cycling and pedestrian issues.

Interview participants discussed the city's insufficient transit service, and it has repeatedly been listed as a factor in Oulu's high modal share for cycling. As Oulu's urban area has increased in size, there will likely be a larger role for transit to play, unless automobile dependence continues to increase. Whether a transit system can be designed to enhance, or compete with, cycling remains to be seen.

Cycling issues are inherently multidisciplinary. In the 1960's Oulu's traffic engineers looked outside the confines of their field and explored multi-modal transportation solutions to traffic congestion. The result was a unique "light traffic" system. The City's future successes could be built on newly developed cooperation between advocates for the environment, livable cities, healthy living, public health and others.

7.3 Research paradoxes

In undertaking the research for this thesis the author operated under certain biases and assumptions (see chapters 1.3 and 2.1). As this project unfolded, however, there were certain findings that deviated from the author's hypotheses. The following sections showcase some of these paradoxes.

7.3.1 Modernist planning paradigm as a sustainable planning tool?

This thesis operated under a postmodern planning paradigm. Oulu's pathway network, however, finds its roots in a top-down planning environment steeped in modernist principles of separation, thereby largely deviating from postmodern concepts, including those related to complete streets. The modernist planning paradigm has largely resulted in automobile-centric urban environments. Chapter 2.2.1 explains that modernist planning and traffic engineering are largely responsible for reductionist solutions to traffic solutions, which prescribe more roads and road capacity as solutions to traffic problems.

Oulu, serves as an example of the modernist paradigm coupling with traffic engineering to construct a high-quality active transportation pathway network. As conflicts arose between cyclists and motorists, the City pursued a unique approach, engineering a high quality active transportation network parallel to the automobile network. A strong engineering focus, coupled with Finland's planning structure, has ensured the execution of Oulu's high-quality pathway network. Thus, this thesis reflects a bias in which the postmodern planning paradigm is associated with accommodating the needs of cyclists and pedestrians, yet paradoxically, the modernist paradigm provides a preeminent example of active transportation planning in a winter city.

7.3.2 Bike culture in the mainstream

That Oulu possesses no formal bicycle advocacy organizations came as a surprise to the author. Strong advocacy movements often exist in jurisdictions where cycling is a fringe mode, yet they also flourish in countries with mainstreamed cycling, such as the Netherlands[19]. One can see these differences reflected in a location's bike culture, as described in chapter 1.1.3. For example, many North American bike cultures focus on subculture whilst some European cities personify cycling as a classy, stylish mode of transport. Oulu, on the other hand, represents a case in which cycling is part of the mainstream, and basically always has been. In this sense, Oulu possesses a mainstream bike culture that appears to preclude the existence of a politicized subculture. Helsinki, on the other hand, has a cycling advocacy movement, and a Finnish national advocacy group is currently in development.

7.3.3 Oulu's pathway network as sustainable transportation?

Oulu's pathway network functions best in suburban areas. In these settings cyclists enjoy travel along grade-separated segments, functioning like freeways, without interacting with vehicular traffic. Dispersed land use patterns facilitated the development of this quality pathway network (see chapter 6.3.5). However, increased travel distances ultimately undermine the bicycle's efficiency and suitability as a transportation device. While cycling is undeniably a sustainable form of transport, can such an urban structure truly be considered sustainable?

[19] The Netherlands is an internationally recognized leader in bicycling planning and policy. Cycling is very much within the Dutch mainstream, yet there also exists a strong advocacy movement. In existence since 1975, the *Fietsersbond* is the Dutch Cyclists' Union which boasts 130 local chapters, over 32000 members and a long history of advocating for better cycling routes and cyclists' rights (European Cyclists' Federation, 2011).

7.4 Areas for Further Research

While this research brought clarity to many issues and successfully answered the key research questions, many other queries and opportunities for further exploration emerged along the journey-both practical and theoretical. This chapter will outline some of these areas for further research.

7.4.1 Detailed user-analysis of Oulu's pathway network

Using available technologies, such as GPS devices, a detailed user analysis of Oulu's pathway network would be a vital component to guide further enhancements to the city's infrastructure. Such an endevout could help demonstrate how the network is used, and where it works best. In a previous work (Pratte, 2010), I discuss a Canadian project called *Ottocycle*, in which hundreds of cyclists logged data with GPS devices to determine the most-used cycling routes. Such an initiative could serve as a model. Oulu may wish to model a system after Helsinki's *Fillari Kanava* (see Chapter 5.3.7), to enhance the interface between cyclists and planners/engineers.

Further research into the dynamic of user conflicts, or lack thereof, between cyclists, pedestrians and other pathway users would be of immense value. Interview participants stated user conflicts were not a serious issue. Would regular trail users agree? Are cultural factors responsible for the lack of conflict, or learned behaviour through four-decades of using an extensive shared-use pathway network?

7.4.2 Further research into Intelligent Transportation Systems' applications for active transportation

Intelligent Transportation Systems (ITS) is often viewed as a "soft" or "weak" path towards sustainability. However, using ITS applications to enhance active transportation could be an emerging frontier of technical approaches to sustainability.

Finland's warning service for pedestrians and cyclists (see Chapter 5.3.7) offers a potential basis for further research. Do other similar initiatives exist? What are the benefits of such as system? Could this be easily replicated elsewhere? This is an area of exploration that appears to have no existing academic literature to date.

7.4.3 Winter cycling

The available literature on winter cycling is minimal. This is an area that warrants further research. While a limited number of preference surveys exist about what prevents fair weather cyclists from cycling year-round, there are myriad other directions worthy of further exploration. For example, user-preference surveys from winter cyclists, preferred infrastructure treatments, evaluating maintenance practices, and the success of "soft" policy initiatives to encourage winter cycling would be some key areas to explore.

7.4.4 Cycling in hot environments

Part of this thesis was written whilst on a planning exchange at Arizona State University in Tempe, Arizona. While the irony of researching winter cycling while situated in the Sonoran Desert did not escape me, I attempted to parallel issues faced in winter cities with those faced in the "Sunbelt." This was difficult as there was no literature specific to cycling in Sunbelt cities. Yet, the heat of cities in the arid south in the summer can be as big a hurdle as the cold and snow faced by cyclists in winter cities. Despite this, cities such as Tempe, Arizona are investing in cycling infrastructure and programs. This is a topic that bears further attention. Further research addressing "how cities in hot climates can facilitate and encourage cycling through climate-responsive planning?" is warranted.

7.4.5 Vernacular transport

In doing the literature review for this research I became fascinated with the idea of *vernacular transport*. In contemporary times, many facets of our lives are becoming increasingly generic. I propose that, considering many aspects of history and culture, Oulu's cycling network could be considered a vernacular transport infrastructure. This concept could warrant further study, including a search for other transport vernaculars.

7.4.6 Urban extent and active transportation

Interview participants identified Oulu's continually expanding urban footprint as contributing to the relative decline in cycling's modal share. As Oulu continues to grow and expand, chapter 7.2 identifies upgrades to the pathway network and investments in public transit as being options worth exploring and Chapter 2.4 introduced the *Marchetti Constant* as a model to understand travel patterns. Further research into how far cyclists are willing to commute on bicycles is a topic worthy of further exploration, and Oulu's unique pathway network could provide the appropriate setting for studies of this nature.

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Appendix A: Interview Questions

These interviews will be conducted with knowledgeable leaders in their respective fields. The interview will utilize open-ended questions to allow a maximum level of information to be conveyed. Neuman (2000), details the advantages of the open-question interview format. Such interviews permit an unlimited number of answers, allow respondents to answer questions in detail and clarify points, allow for unanticipated findings, permit creativity and richness of detail, and reveal a respondent's frame of reference.

What were the most significant factors in mainstreaming bicycling in Oulu?

Through what process has cycling policy been translated into action?

- Who were the key players-people, institutions etc.?
- Could you please explain the work of Maurri Myllyla and the 1972 Traffic plan?
- What relationships exist between key players?
- Priorities, budgeting, funding, enforcement?
- What was the role of citizen advocacy?
- Was the University of Oulu involved?
- Where do you see the needs of policy in the future?

How are cycling levels measured in Finland? Census etc.?

What lessons do you feel other jurisdictions can learn from Oulu's experience?

- Do you share your successes and interface with other jurisdictions and locations?

Do you see Oulu's climate as a barrier to cycling or an opportunity?

- What have you done to address winter conditions?
- Does cycling decrease dramatically during winter months?
- What policy and measures does Oulu have for winter maintenance?

Was there any cooperation or interaction with other levels of government?

- Did these help or hinder your work?

Can you identify any serious barriers to further progress?

Have you faced any negative public reactions or opposition to your efforts?

Is safety for cyclists considered a serious issue?

- What safety considerations are taken?
- Are there "training programs for youth etc?

Have any "soft" steps been taken to increase the appeal of cycling?

- Promotional campaigns?
- Special events?

Appendix B: Consent Forms

UNIVERSITY OF MANITOBA | Faculty of Architecture

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Consent Form
City 7350 City Planning Thesis
Fall/Winter 2011
Researcher: Jeffrey Pratte
Research Advisor: Dr. Rae Bridgman
Project Title: Mainstreaming cycling in winter cities: The case of Oulu, Finland

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

Project Description:

In the recent decades public interest in environmental and urban issues has increased substantially. Bicycles offer an efficient, emission-free mode of transportation, particularly ideal for shorter distances in urban areas. Consequently, bicycling is increasingly being perceived as a viable and important part of the urban transportation mix. Despite increased progress and attention, few cities have successfully incorporated cycling as a key feature of their urban policy, or substantially increased cycling's modal share. Meanwhile, research suggests that climate and weather influence cycling and transportation in urban areas, with cold climates in particular reducing the likelihood of cycling. Despite this obstacle, some winter cities have found success encouraging cycling, and others are attempting to do the same.

This research will examine how bicycling can be mainstreamed in urban transportation, thereby improving cycling conditions and increasing modal share. Particular emphasis will be placed on challenges faced in winter cities. Oulu, Finland, will serve as a case study. This medium sized city in northern Finland has a twenty percent modal share for cycling. A close examination of political forces, local conditions, citizen advocacy, and the work of planners will be presented and synthesized to help inform similar efforts in other locations. The confluence of policy initiatives originating at the national, provincial/state, and local levels will be central to this research. The goal is to present Oulu, Finland's experience in bicycle planning as a model for other winter cities, particularly in Canada.

Audio-Taping:

With your permission, activities, interviews or other kinds of sessions may be audio-recorded and transcribed at a later date for research purposes, so that analyzing the material at a later date will be completed with greater ease and efficiency. Such audio-

recordings will be kept in a secure place, and destroyed after they have been transcribed. Your name or any other personal information will not be included in the presentation or report materials arising from the study. Where information occurs within a session transcript that will be included in the final project report or presentation, names and other personal information will be omitted.

Use of Data, Secure Storage and Destruction of Research Data:

Information collected from participants will be used to inform a thesis for completion of a Master of City Planning (MCP) at the University of Manitoba. All confidential information including audio recordings and notes will be treated as confidential and stored in a locked box in my office. These materials will be destroyed upon completion of the project (on or before August 31, 2010).

Access to data summary and final research report:

Upon completion, the final report will be available online through the Government of Canada's online Thesis and Dissertation portal (http://www.collectionscanada.gc.ca/thesescanada/index-e.html). If you would like to receive a summary of the research findings, please indicate so at the bottom of this form.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the course project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and /or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

Contact information:

This course project has been approved by the Joint Faculty Research Ethics Board (JFREB) of the University of Manitoba. If you have any concerns or complaints about this project you may contact the above-named persons or the Human Ethics Secretariat at A copy of this consent form has been given to you to keep for your records and reference.

Thank you for participating in this project. Your cooperation and insights are very valuable, and are greatly appreciated.

I, _____, consent to the dissemination of
[Name of Participant: *please print*]
material provided to the student researcher for the completion of a Master of City Planning (MCP) thesis. I understand that the information I provide will be incorporated into a presentation and report by the student. I understand also that all research data will be treated as confidential, stored in a private and secure place, and subsequently destroyed at the end of the course by the student researcher.

Please provide me with a summary of the research findings: ☐ Yes ☐ No

_____
Signature of Participant Date

_____
Signature of Researcher Date