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“The word bike (and byke) in Scottish predates the bicycle yet its meaning and use is somehow similar: ‘a crowd or swarm of people’ ”
-David Perry

“The word bus comes from ‘Omnibus’ which means ‘for all’ in Latin”
-London Transport Museum



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Environmental and Infrastructure Planning Master Thesis

Developing the Fundamental Infrastructure and Weaving the Realized Interactions for Bicycle and Bus Transportation Networks in Asheville, North Carolina, USA

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Abstract

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Asheville, North Carolina, USA 'Land of the Sky' -watercolor by Ann Vasilik

Asheville, North Carolina, United States is teetering on the potential for a realized multi-modal transportation network. The steadily declining mobility, namely due to vehicle congestion, is producing momentum for change in the fundamental transportation conditions. The Asheville City bicycle comprehensive plan, accepted by city council in February 2008, the Asheville Transit Authority's 'Bike on Bus' program, and the Strive Not To Drive campaign, among many other forward thinking initiatives are the beginning to create an efficient transportation structure with a strong presence of buses and bicycles.

For understanding the potential livelihood of bicycle and bus networks in the community, the research turns to the ecological niche theory. In regards to ecological communities a potential invader must use unconsumed resources to survive, grow, and reproduce (Tilman 2004). While in time an invader can out-compete for a larger portion of resources, in the beginning the invader must work hard to establish its presence with more constraints. In urban community structure, the established vehicle mode consumes a vast amount of resources. Bicycle and bus networks can be viewed as the 'invaders' that have limited means to strengthen their presence. To thrive the networks must depict that they can compete and interact in the transportation structure, meaning that everyday middle class workers use the system, in addition to devout bicyclists, fitness conscious citizens, and low budget students and households.

The ecological niche theory will be used to show a parallel between the natural and built environments in order to create a framework for understanding the processes that construct species and modal habitats. Groningen, Netherlands will be analyzed using this framework to depict a city with a realized bus and bicycle network. Then, the research will detail interactions that the invader, bus and bicycle networks, must develop to become a prominent functioning community member in the Asheville transportation system. The precise reasons for successful niche habitation are hard to grasp qualitatively or quantitatively, so instead of a single policy, culture, or governance solution, this research will provide a foundation for understanding transportation structure and how to realize an interdisciplinary web that can support modal diversity.

Table of Contents

Chapters:

I. Introduction	.....	p. 3
II. Theoretical Framework	.....	p. 8
III. Methodology	.....	p. 22
IV. Analysis and Findings	.....	p. 26
V. Discussion and Conclusion	.....	p. 44

Figures:

Figure 1: Motivational Web	.....	p. 4
Figure 2: Conceptual Diagram	.....	p. 21
Figure 3: Methodological Triangulation	.....	p. 24

Appendices:

A: Soft System Analysis	.....	p. 50
B: Stated Preference Method	.....	p. 52
C: Planning Support System	.....	p. 53
D: Interview Questions	.....	p. 55
E: Interviewed Citizens	.....	p. 57
F: Interviewed Planners	.....	p. 59
G: Supplementary Transportation Information	.....	p. 60
H: Sample of United States Multi-Modal Programs	.....	p. 61
I: Asheville Information	.....	p. 62

Chapter I

1.1 Introduction

“The bicycle has more advantages for human mobility in cities than any vehicle yet devised. Not only is it the most energy efficient machine for moving people, it can move ten times the volume of traffic under city conditions than automobiles with a single occupant in less time, and requires about one-twentieth the storage space of a car. Trees and people on bicycles complement each other, the one providing shade, scale, and lane separation, and the other providing safe, rapid movement with clean air to enhance tree growth.”

-Henry Arnold (*Trees in Urban Design*)

Mobility impacts every aspect of life: where one works, what one eats, who one sees, where one shops, and how one entertains oneself. Sustaining accessibility and mobility in urban environments in a socially, economically, and environmentally friendly manner is a constant challenge.

In response to mobility concerns, the discipline of transportation planning has blossomed, theories have evolved, research has been undertaken, and models have been developed. However, “the realization is striking that four decades of quantitative models have still left cities with congestion and a constant search to improve methods to predict trip behavior and transportation habits” (Cuculis 2005, p. 1354). The reverberating message is clear that despite the certain theoretical attempts, there is still a gap to bridge between theory and reality. Considering this gap, it is logical to question whether or not planning, a “unique experiment in place, time, and context,” has improved, decreased, or had no effect on the situation (Cuculis 2005). Given the dynamic context of the world, it is impossible to truly answer if planning does matter, so instead Cuculis (2005, p. 1361) poses advice, “The answer thus is not to hide from future uncertainty but to tame it by recognizing that, however unexpected, the future is born out of the present and the past, involving many predetermined as well as unforeseeable elements.” Thus, planning cannot claim, nor should it attempt to, to project an infallible design. Rather, planning forges onward in an inter-disciplinary fashion embracing the uncertainty as it tries to bridge the theory-reality gap. The terms “coherent, concerted, holistic, joined-up, inter-, network, and cross-cutting” appear frequently in literature, but an actual process of “cooperation, coordination, and integrated policy making” is less common (Stead, 2007). Therefore, it is not a relevant debate about whether planning matters, but what is applicable is for words to become actions.

Words are one-dimensional, while action is multi-dimensional. For action to occur there is a need for ‘tailor-made’ solutions to transport issues that consider social and environmental criteria alongside traditional spatial planning (Ritsema 2005). The cut and paste method for policies, infrastructure networks, and land-use design from one place to another is not sufficient. Ideas can be used from other places, but adapting to the context is critical. This research aims to examine the quest to build tailor-made bridges to connect theories in words and practices in action to improve mobility for all citizens.

Mobility in Groningen, Netherlands will be used as an example of words turned into actions. Asheville, North Carolina, United States will be studied for how

words can transition to actions to create tailor-made mobility. The applicable lessons to other cities will be how to analyze their own transportation structure, extract ideas from other cities, and to create a tailor-made mobility blueprint.

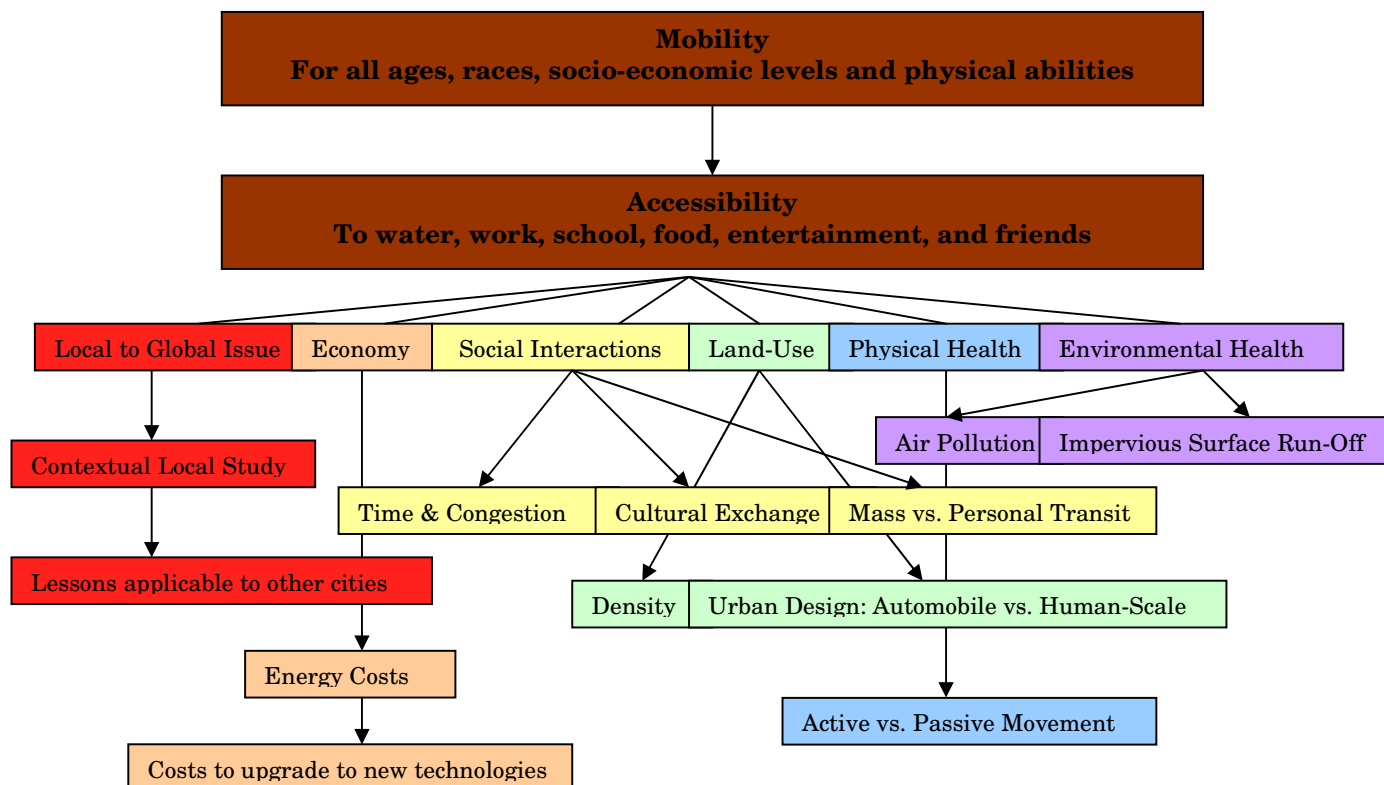
1.2 Motivation

“In the long run, resolving our energy crisis will entail dismantling an American society designed around and dependent on, suburbia, shopping malls, interstate highways, housing developments, and single-use neighborhoods. It will mean building a new America where housing, businesses, jobs, and schools are integrated, and within walking (or cycling) distance from each other. ... But the alternative of doing nothing, waiting for our gasoline based economy to collapse, and then somehow trying to manage the social chaos that will surely follow is a much dimmer prospect that should not be part of any American’s dream for the future of their country.”

-Dr. Frank Kalinowski, “A Policy that Combats America’s Oil Addiction,” *Asheville Citizen Times*, 6 July 2008

Mobility is a local to global issue. Directly associated with mobility are economics, social interactions, land-use, physical health, and environmental health. The motivational web below serves to depict that by addressing mobility concerns many other issues are concurrently focused upon.

Figure 1: Motivational Web



The motivational web could be extended further in each of these categories, but the basic diagram shows the domino effect of mobility. Improving mobility is critical because instead of providing short-term solutions that just put a patch over problems, addressing mobility gets to the root of many issues.

The cost of oil has continued to rise as worldwide supplies decrease. Basic supply and demand predicts this trend to continue, as demand is far outgrowing the declining supplies. In referring to the increasing costs of gasoline in the United States, Lee Schipper, a visiting scholar at the transportation center of the University of California, Berkeley, said, "This is the wake-up call ... We actually have a lot of choices, based on what car we drive, where we live, how much time we choose to drive, and where we choose to go. But you have built in a very strong car dependency. And when the price hits the fan, people have a hard time coping" (Mouawad, 2008). Schipper accurately states that there are many choices available. However, as prices increase more rapidly than people are able to shift habits, such as purchasing fuel-efficient cars, or quicker than urban design can retro-fit to human-scale, in contrast to the current automobile-scale development, then the built-in limitations of the infrastructure system produce frustration with a lack of affordable mobility.

Additionally, environmental awareness about the effects of run-off from impervious surfaces and vehicle emissions accumulating in the atmosphere push for infrastructure changes to reduce the number of road lanes and polluting tailpipes. Albeit this is a different angle than economics, it has similar aspirations to design a more efficient system. Another angle that wants to improve urban design comes from social discussions on the isolating nature of single-occupancy vehicles and its associated development patterns of low-density residential areas. The social side has goals to increase interactions through using modes that push people to share space and live in higher density development. Furthermore, awareness of declining physical health in citizens has resulted in campaigns for more activity in daily life. Human-scale instead of automobile-scale development is highlighted as a means to foster a more fit populous.

The global context is too broad to formulate design solutions that get to the root of mobility in all locales, so the focus for the research is on two local contexts: Groningen and Asheville. The local contexts differ though because Groningen has an extensive multi-modal system, while Asheville does not. Thus, Groningen is used as an example to analyze actual filled transportation niches, while Asheville is the focus for a detailed examination of how to fulfill transportation niches.

Asheville is the primary case study for constructing niches because it is an eclectic city with a collage of local movements. The collage consists of developers capitalizing on the growth of the area, environmentalists with a vested interest in maintaining the mountain ecology, bicycle advocates for utilitarian cycle culture, entrepreneurs in small technology firms, public health officials campaigning against obesity (especially in children), farmers preserving their land, and citizens supporting local production based on less transportation, among others movements. The diversity of this mountain city makes it ripe with potential for a beautiful collage, but it also makes it susceptible to be mismatched and unattractive. The collage pieces must be brought together to match the array of colors, shapes, and

sizes in a functional manner that improves quality of life and the natural and built environments.

1.3 Background

“Because when it comes down to it, the bicycle is a cheap, healthy, and environmentally friendly means of transport. However, governments, interest groups, and experts often undervalue the bicycles’ contribution to well-being and prosperity. Meanwhile, they rightly concern themselves around the world with problems related to the environment, poverty, sustainability, health, and the quality of life, all problems for which the bicycle could be the solution they are looking for.”

-Roelof Wittink, *The Economic Significance of Cycling*

Niches can have a simplistic meaning of just filling a need, but the ecological niche theory delves further into the term and the way species utilize their habitat. Niche can be defined as ‘the concept of [the] ultimate distributional unit, within which each species is held by its structural and instinctive limitations’ (Vandermeer 1972). The distributional unit on the base level points to physical geography. However, as Tilman brings to light ‘resource competition, invasion, and community assembly’ (2004) are all interconnected into shaping the distributional unit. In recognizing the variation in niche identification from the basic physical surroundings perspective to the complex web of interactions aspect, Vandermeer (1972) then outlines the fundamental niche as the ‘set of elements in the environment’ that would be occupied by a particular species if there were not feedback effects ‘inter or intraspecifically;’ and he continues to outline the realized niche as the ‘set of elements in the environment’ which will be occupied by a species when it is in equilibrium with other species in the community. The realized niche must incorporate the fundamental niche definition because equilibrium with other species is based upon their physical surroundings. But, these definitions remain distinct because their contrast provides more understanding. The fundamental niche is more easy to grasp and can be used for a simple understanding of why a species can inhabit an area. The realized niche is a challenge to grasp, but the complexity must be examined when looking at the physical conditions is not enough to determine such aspects as abundance, habitat patterns, and birth-death rates of a species.

The concept of niche began with species in nature, henceforth these ideas must first be explained in natural terms, but then can be applied to the built environment. Thus, like the natural environment, the built environment has “species” with niches. The “species” in the built environment are the different land-uses, for example—housing, businesses, industries, parks, and transportation networks. The interactions of these “species” maintain the community assembly. While it would be beneficial to study all “species” in the built environment, it is not feasible in one coherent paper. Thus, the focus of this research is on transportation modes, each mode being a distinct species because each has a different role in the community assembly. For example, vehicles offer speed and personal convenience; bicycles offer a personal mode of transportation that does not pollute and its small size can easily adapt to rural or urban settings; buses offer mass transit that can

overcome long distances and topographical challenges, while utilizing road space more efficiently than individuals in their own vehicle.

The distinctness of each mode means that each could potentially have a place in the built environment. At the fundamental level, roads and basic mobility infrastructure is in place in cities. However, even when the physical conditions are appropriate, the complexities of interactions, geography, and overall community stability result in open realized modal niches

In Asheville there are open modal niches that provide accessibility to work, school, markets, and community in an economically viable manner. The fundamental conditions are appropriate for bicycle and bus networks, but the realized interactions continue to support the status quo of vehicle dominance rather than filling the open niches. Diversity in modal species has the potential to meet the needs of all citizens and to increase the effectiveness of the entire transportation system.

To address transportation niches, the first step is to understand niches in nature then this knowledge can be adapted to the built environment context. Chapter 2 explores the ecological niche theory to grasp the process used in the natural sciences to identify, comprehend, and construct niches in the natural environment. Chapter 3 delves into the methodology that was used to gather the primary data for the case study cities of Groningen and Asheville. From there, Chapter 4 details how the data was analyzed and the findings. The results are based upon the framework of the ecological niche theory applied to understanding niches in Groningen, Netherlands, a built environment where diversity in transportation modes has been filled. Then the ecological niche theory is applied to Asheville, a built environment that is in the process of identifying open niches and constructing them. The paper culminates in chapter 5 with a discussion comparing the findings, and then concluding with thoughts on how future resource cycles begin and perpetuate. Lastly, suggestions for future research are posed to offer solutions to fill transportation niches to meet mobility needs in other cities.

Chapter II

2.1 Theories

Niche is derived from the French word *nicher*, meaning ‘to nest.’

The quest to understand the world has led to scientific theories in biology, chemistry, and physics. As laws governing the biotic and abiotic environments were discovered, tested, and validated into general acceptance, then the next stage was to comprehend the social and mental levels occurring. Ecology, derived from the Greek words meaning ‘household’ and ‘knowledge,’ was coined by a German zoologist, Ernst Haeckel, to “describe the ‘economies’ of ‘living forms’ ” by “the construction of models of the living systems with their environment” (Stanford 2008). Understanding social behavior and interactions began with the examination of other species. From this intrigue the desire to analyze and classify human behavior grew, albeit under different academic titles—such as sociology and psychology, but retaining the same principle curiosity to understand the interactions with each other and the environment.

Human behavior has a direct correlation with urban design because daily decisions affect the flow within the built environment. Transportation is a facet of urban design that seems to be dictated by physical infrastructure, but in reality its effectiveness is determined in conjunction with daily individual decisions of mode, route, and location choice. Essentially the built environment is the human ‘household’ and there is a quest to acquire ‘knowledge’ of how the household functions. The examination of nature, the household of all species, is used for guidance on how the built environment functions.

The theoretical framework draws a parallel between ecological niche theory and transportation. In each of the preceding sections the development in niche theory is first explained, then the correlation to transportation is discussed.

Before proceeding it is important to clarify what is meant by species and how the term will be used. A species is a group of organisms that can interbreed and produce fertile offspring. In this research, the corresponding parallel in the urban environment is a mode of transportation as a species. For example, buses can be viewed as a distinct ‘species’ because different models—varying in style and energy sources, can ‘interbreed’ and produce buses adapted to evolving urban needs and conditions.

Individuals, populations, or entire species can serve as the basis of examination. However, an individual, or correspondingly one bicycle or bus, is too microscopic for this research, which aims for a more broad scope. A population, a sector of a species, usually inhabiting one area in space at a particular time, or correspondingly, one fleet of buses or bicycles, will be used in the case studies for contextual examples. Since a species, or correspondingly buses or bicycles, can occupy many habitats or cities, the lessons from the specific population studies, in this case the populations in Groningen and Asheville, will be used to identify transferable lessons, which are able to transcend space and time relations.

With the concept of the population of a species clarified, then it is possible to analyze the niche of the species. A species niche is not a simple definition of its place, food, and shelter. The fundamental physical niche is the foundation and the realized interactive niche determines the long-term longevity. Furthermore, the

factors that shape the physical and interactive niches are in constant flux, so a species is continually constructing its dynamic niche.

2.21 Fundamental Niche

“The facts of geographic distribution, accumulating in very great and increasing amount, demonstrate beyond reasonable doubt that diversity of environments, otherwise habitats, has been essential to the evolution of everyone of the many diverse types of vertebrate animals.”

-Joseph Grinnell

In 1924 Grinnell defined niche as a measure of the distributional behavior occupied by one species (Love, 1977). In essence, the distributional area is where the conditions, in theory, are appropriate for a species to inhabit. The biologist Hutchinson worked to refine this definition, suggesting, “niche might be viewed as the total range of conditions under which the individual or population lives and replaces itself” (Love, p. 28, 1977). The distributional area implied where the species lived, but Hutchinson added the conditional twist of ‘replacing itself.’ Physical habitat is relevant to survival of that individual, but the ability to reproduce and nurture young requires the recognition of interactions. In recognition of this complexity, he further broke the definition down into the fundamental and realized niches. He described the fundamental niche as the “set of elements in the environment which would be occupied” by a particular species if no other species were present; thus, the fundamental has “no density dependent feedback effects” (Vandermeer 1972). For the realized niche Hutchinson characterized it as “occupied and at equilibrium with the community” (Vandermeer 1972). The fundamental and realized niches together create a broad descriptive picture, but first the individual pieces, the fundamental and realized aspects, must be discussed separately.

The fundamental niche is considered to be pre-interactive since it encompasses the physical and climatic barriers, but neglects the impacts of food supply and competition. The fundamental niche of a mode of transportation is the physical infrastructure and climate that enables it to function. It is logical then that transportation planning began in the engineering field with the construction of roads, bridges, and sturdy structures to reduce the influence of nature and to provide mobility routes.

Infrastructure building and planning has occurred since the settling of cities, but the professional field of planning, still in practice today, did not significantly emerge until the 20th century. The increasing population, specifically in cities, required more projecting to meet the growing spatial and resource demands. To determine how to meet the demands, transportation planning looked to the natural sciences for guidance. The planners’ “faith in science” was depicted by their use of the gravity model from physics for trip distribution modeling (Kane 2003, p. 115). This “faith” was in-line with the period of hope and belief in the physical sciences to explain the world. Planners did not use science to explain transportation patterns, but they relied upon the natural science equations to predict the pre-interactive infrastructure needs. The supposed pre-interactive infrastructure needs were derived from population numbers and predicted mode use, without consideration of the web of interactions that occurs when the system exists in reality.

2.22 Realized Niche

“Studies designed to link specific genes to behavior have failed to find anything larger than very small associations. It’s now clear that one gene almost never leads to one trait. Instead, a specific trait may be the result of the interplay of hundreds of different genes interacting with an infinitude of environmental factors”

-David Brooks, “The Luxurious Growth,” *New York Times*, 15 July 2008

Computer modeling in line with a reductionism manner worked, to a degree, to model physical environmental conditions because of the elimination of interactions. However, physical scientists realized the model results were similar to observations, but still did not precisely explain reality. Equation modeling has continued to play a role in foundational understanding, but observations of the intricacies of nature in reality also began to be documented. Accordingly, explanations of ecological niches shifted from the basic ‘distributional unit’ focused definition to the realized post-interactive niche definition. This definition takes into account the effect of resources and the food chain on species’ livelihood (Vandermeer, 1972). The term ‘post-interactive’ is used because of the intraspecific, referring to contact between individuals of a population, and interspecific, contact between different kinds of species, interactions occurring. The recognition of the web of interactions pushed the idea that the environment does not function on a one-to-one cause and effect basis.

In transportation awareness that not everything functions on a one-to-one relation results in the questioning of the traditional four-step travel forecast model, based on the divisions of trip demand, trip distribution, modal split, and traffic assignment, to accurately plan. In cautioning users of the classic model to be aware of the error margins, Linden writes that the model is “based on numerous assumptions and simplifications” (2004, p. 200). The “assumptions and simplifications” enable the model to generate a base picture, but the reductions limits its capability to project reality. In reference to the four-step model, Loo (2002, p. 211) writes, “Based on this generalized model, attention is put on the four aspects of the absolute number of trips (trip generation), the origin and destination of each trip (trip distribution), the mode of travel (modal split), and the route of travel (traffic assignment) ... The primary focus is on the quantity of trips ... the attention of transportation planners cannot be so narrowly focused. Apart from the absolute number of trips, attention has to be placed on the quality or nature of these trips as well.” Loo gets to the issue that quantity of trips based on numbers neglects the quality aspect. Ecological interactions are not just based on the number of interactions, but the quality of what occurs has a significant impact; similarly in transportation quantity and quality of modal networks must be recognized as contributing factors.

The realized niche in transportation planning must incorporate the aspect of the niche that recognizes the web of social, cultural, political, and economic interactions that largely determines a mode’s survival and reproduction. In writing about grassroots planning Couclelis (2005, pg. 1357) notes that “because no community is an island, ‘bottom-up, decentralized activity,’ for all its worth, is by

itself not enough. Grassroots planning is admirable but it can only grow grass; someone of something needs to grow the fruit trees and the oaks of the future.” While this comment is specific to grassroots planning, it is pertinent to planning in general. Couclelis highlights two important aspects: grass alone is not sufficient and it is about growth together. A large quantity of grass, in this case community input, neglects the grand picture of the entire forest. A forest thrives on quantity and quality. Transportation planning benefits from community input, but it is the collaboration across social, cultural, and political divisions that produce a realized niche.

2.23 Niche Construction

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are needed to see this picture.

IKEA one of the biggest box retails and synonym for urban sprawl is now starting a new concept at their Danish stores. It has invented bikes that will pull trailers so that customers can ride home with the new purchases.
-European Platform on Mobility Management

It has been established that the fundamental niche outlines the appropriate conditions and the realized niche encompasses the necessary interactions for species livelihood, but it is still pertinent to discuss how a species constructs and maintains this niche. First and foremost a species must ensure and retain a distinct aspect to its niche. According to Gause’s competitive exclusion principle—no two species can coexist if they have the same ecological niche (Vandermeer 1972). Even if two species are closely related or appear to compete for the same resources, the subtle differences are what enable them to prosper in the same vicinity harmoniously.

The amount of niche overlap, the degree of similarity tolerated, is determined to understand how the species survives. The amount of overlap then relates to the niche breadth, the flexibility of a species to handle spatial heterogeneity, competitive displacement, commensalisms, predation, and specialization (Love 1977). A species capability to adapt to differences in space, changes in other species, and invasions into its territory affects how a species constructs its niche.

However, “no investigator can possibly analyze the total range of conditions tolerated by a given organism” (Love 1977, p.28). The inability to analyze the full range of conditions returns to the reasoning behind the distinction and use of both the fundamental and realized niches. The complexity of the realized niche is too much, but the simplicity of the fundamental niche is too little to generate a comprehensible, yet coherent picture. The overlap and breadth within both aspects of the niche must be analyzed since neither alone is sufficient.

In transportation, the modes frequently overlap, but each also serves a distinct purpose—be it personal health, convenience, speed, or space maximization, among others. The modes vary by their nature, for example size, capacity, and

energy usage. In determining the overlap and breadth the strengths and differences emerge. The challenge is to welcome overlap to provide options for the same location, but for each mode to retain a unique enticement. Then, by capitalizing on the differences, a network based on modal complementation rather than just competition can develop. By mutually benefiting each other, competition for resources will not be 'either-or,' but rather a 'both-and' situation.

A further element of complexity is added though because a species niche is constantly changing, which means the amount of overlap and range in breadth shifts as well. Thus, constructing a distinct niche adapted to the physical conditions and networked into the environmental interactions is not straightforward. Niche construction is defined as "the process whereby organisms, through their metabolism, their activities, and their choices, modify their own and/or each other's niches (Okasha 2005, pg. 2). These daily processes means that niche construction is a constant process to find stability within a dynamic environment.

Since niche construction is a constant process, it occurs both when a species remains in a steady location and when it migrates to a new habitat. Remaining in its current habitat requires continual maintenance and adaptation of its niche. A shift in habitat means an introduction into new interactions and environmental cycles, which means crafting a new fundamental and realized niche. At the most fundamental level, an invading species represents competition over scarce resources (Love 1977). Acquiring resources is entangled in the processes of exploitation, mutualism, symbiosis, commensalisms, parasitism, and predation. Each process has different opportunities and consequences associated with it. Exploitation is when an organism appears to be partaking in a mutual relationship, but in fact provides no benefit to the other organism. Mutualism occurs when both organisms benefit from the interaction. Similar to mutualism, symbiosis results in increased fitness to both organisms, but it implies a longer-term relationship than mutualism. While commensalisms is a relationships where one benefits, but the other is not harmed or helped. Contrastingly, parasitism is when two species, usually in a long-term relationship, results in the host species being harmed. Predation is when one organism preys upon another organism for its own survival. These interactions overlap, but yet biologists have separated them because the process of each relationship ends in different results. Furthermore, each of these interactions is continually changing as the needs of each of the species shifts, which thus links back to the constant niche construction process.

Stability amidst these dynamics is a paradox to a degree. A level of constancy is possible through feedback mechanisms. In an article entitled 'Evolutionary Theory: Personal Effects,' Jones (2005, pg. 14) writes about the shaping forces of feedback, "The emerging view in biology stresses that organisms not only adapt to their environments, but also in part create them. The conventional view of evolution sees natural selection as shaping organisms to fit their environment. Niche construction, by contrast, accords the organism a much stronger role in generating a fit by recognizing the innumerable ways in which living things alter their world to suit their needs. From this perspective, the road between organism and environment is very much a two-way street." The two-way street of an organism and its environment shaping each other means that a species does not passively succumb to the process. Instead a species is reactive, adapting to an environmental change, and then places its own modification back onto the

environment. This cycle of organism and environment constructing each other perpetuates the evolving natural.

Moreover, this feedback cycle is comprehensible for one species, but the accumulation of the countless two-way streets between each species and its immediate environment creates a complex web of confusion to comprehend. Fortunately, it is possible to examine intersections of the two-way streets, moments of adaptation between multiple species and the environment. Sultan, a botanist at Wesleyan University in Connecticut, “defines niche according to the way an organism experiences the world—its niche is the sum of its experiences, rather than its immediate physical surroundings” (Jones 2005). The intersecting experiences then shape each species and the environment. Thus, the suitable physical conditions change moment by moment; observations in one moment are washed quickly away by reality. Examining the process of these moments, how the intersections are handled, is how niche construction begins to be understood.

Researching these processes in nature is intriguing because the pieces of the process are assembled to hypothesize how the species survives. The species itself relies upon trial and error for survival in its constructed niche. A species does not have the luxury to study indefinitely its niche before occupying it; in transportation planning there is a desire to fully understand the niche before the real trial and error experiments. Transportation planning has the ability to perform numerous studies before forging into a niche, but extended dwelling in the study phase is not practical because just like in nature the suitable conditions will continue to change.

Thus, constructing modal niches relies upon acknowledgement of the two-way street in transportation planning of transport modes and land-use shaping each other. Transportation planners acquire information about infrastructure capacity, traffic counts, trip distribution and couple it with land-use data about business, industry, residential, and cultural uses. The data is supposed to provide insight to the relationships that will emerge. Although the biological terms are not commonly used in urban transportation the modal relationships are also based upon the ecological concepts of exploitation, predation, mutualism, symbiosis, commensalisms, and parasitism. How the modes benefit or hamper one another depends on their interactions derived from physical infrastructure design and human behavior.

Modal niche construction, of physical infrastructure and human habits, faces the challenge that data collected on transportation and land-use is out-of-date as soon as it is gathered. Voogdt (2004, p. 235) comments on this dilemma, “Patton (1998, p. 228) provides arguments: findings have a very short half-life; they deteriorate quickly because the world changes quickly, and specific findings often have small windows of relevance, so what remains after evaluation is the process.” Modes and land-use constantly modify each other due to changing accessibility, economics, and social capital. The intersections of the two-way streets in transportation planning are multiple modes and land-use crafting each other. The moments of experiences of modes working in conjunction with each other or with a type of land-use slowly accumulate in acquired experiences. So researching the process of how modes and land-use worked in conjunction becomes just as valuable as the infrastructure capacity data. The process of modes and land-use molding each other reveals how niches can be constructed.

While species may not communicate with other habitats across the globe, fortunately, transportation observations from other cities can be used as part of its

sum of experiences. However, “culture itself can be seen as a niche that we inhabit, and just as we shape our culture, our culture shapes us” (Jones 2005). Culture and people crafting each other is an example of a two-way street on another level. This example of another dimension of a two-way street once again depicts simplicity and complexity. From the simplistic view, lessons from the two-way streets of modes and land-uses shaping each other in different cities are relevant. From the complex view, the added cultural-people dimension in various cities means that the contexts differ and synthesizing the dimensions would create more confusion than clarity for the purpose of transport planning. Thus, the overall point remains that lessons can be taken from other cities on appropriate overlap, possible modal breadths, and how the moments of intersections are dealt with, but with recognition that unexpected twists will evolve in separate cultural contexts.

2.24 Invasion Dynamics

“People are the same at the core, all just want to get by, feed family and live life.”

-Jim Ellis, former Asheville City Council member

A species constructing a niche in new territory represents an invasion. An invasion has a negative connotation, but in this sense it is neither positive nor negative, but simply a change in dynamics. When and where the processes are altered by a new presence is studied because it indicates potential environmental shifts and hints at the likelihood of survival success.

In his article entitled, “The Invasion Paradox: Reconciling Pattern and Process in Species Invasions” Fridley analyzes the ecological paradoxes that make it challenging to accurately predict invasions. In particular he highlights the conflict between experimental and observational studies and the difference between fine and broad-scale findings. “That experimental and observational studies often ask different questions and employ different methods suggests that their synthesis may increase our understanding of invasions rather than leading to a paradox,” thus in synthesizing his own findings Fridley (2007, pg. 5) questions “one theory fits all or a plea for pluralism?” Experiment and observation have both contributed to the understanding of competition, exploitation, predation, mutualism, symbiosis, and commensalisms, but through different means. Experiments serve to isolate factors and focus on one term at a time. Observation contributes to the broad picture from focus on the interaction of all terms simultaneously. Conflicts in outcomes should not be disputed, but rather the studies should be merged in accordance to their various aims to compile a more detailed picture of when and where invasions can, will, or should occur.

The ‘plea for pluralism’ to understand invasions also requires merging of the broad and fine scale studies. Broad-grain observational studies have produced positive relationships between diversity and invasions, meaning that the more natives, then the more exotics. While at fine spatial scales a negative relationship has been determined, meaning that the fewer natives, then the more invasions (Fridley 2007). In speculation Fridley writes “The panoply of processes that may be relevant to local coexistence, resident species richness, and the ability of residents to resist invasion surely contributes to the inconsistent pattern of NERRs (native-

exotic richness relationships) in natural ecosystems. Ideally, a synthesis of the relative importance of these processes (niche partitioning and local competitive exclusion; neutral processes of stochastic mortality and immigration; top-down control; disturbance and non-equilibrium conditions; climate tolerances and physiological trade-offs) in different habitats would allow predictions of which areas are under greatest threat from species invasions. Such a synthesis does not appear to be forthcoming” (2007, pg. 8). Instead of dismissing the findings, Fridley, pessimistically or realistically, acknowledges that the diversity-invasion relationships differ at scales, but the threshold of the scale shift or the reasoning behind it remain elusive because of the ‘panoply of processes.’ He provides a lengthy list of processes to show that on their own each process has been termed and recognized, but together comprehension is a challenge. The length of the list depicts this because even in reading it, the mind is challenged to keep pace with the processes.

Thus, the invasion paradox enlightens and complicates. It provides enlightenment to focus upon invasion efforts by recognizing the interplay of biotic and abiotic at different scales, which facilitate or hamper invasions (2007). There is complication because the conclusion from studying the paradox is awareness, not a simple relationship: “Whether a true invasion paradox exists or not for a particular system, the separation of negative vs. positive native-exotic richness relationships for different scales and research methods gives two complementary recommendations” which are 1) awareness that diverse native communities are highly susceptible to invasions and 2) “native species richness can contribute to invasion resistance by means of neighborhood interactions” (2007, pg. 14). Instead of dwelling over the complexity though, Fridley uses the heightened awareness to focus on how to resist invasions. To reduce species invasions resistance efforts should target corridors, ports, active habitats, resource rich areas, and disturbed sites. Furthermore, neighborhood interaction and attention to the highly local scales, in relation to seasonal and annual fluctuations, pose the most potential for the invested energy.

For transportation the focus is not to resist invasion, but to reverse this concept to foster invasions by other modes. The first recommendation is to be aware ‘that diverse native communities are highly susceptible to invasions’ rings with validity because cities with a current vehicle dominated transport structure are tough to invade. The lack of diversity tends to perpetuate a homogenous structure. However, cities with multi-modal structures being utilized tend to attract other modes, thus, these areas are more susceptible to invasions. The modes compete for usage, exploit each other’s weaknesses in time or convenience, but they also can mutually facilitate a structure of diversity through commensalisms.

If diverse native communities are highly susceptible, then planning must first and foremost focus on creating a multi-modal community. From there the cycle of invasions will begin to perpetuate itself. Implementing a system that attracts invasions returns to the broad and fine scale ecological relations. The broad ecological scale noted a positive relationship between natives and exotics, but negative at the fine scale. Since the broad scale is ultimately composed of overlapping fine scales, transportation planning must proceed first at the fine neighborhood scale, and then it can stitch the neighborhoods together to create the vast urban area.

The second recommendation that ‘native species richness can contribute to invasion resistance by means of neighborhood interactions’ relates to the notion of quantity and quality focus. Neighborhood interactions can be interpreted on two levels: 1) interactions of species (modes) within the neighborhood 2) interactions between the fine scale neighborhoods. Within a fine scale neighborhood that is not growing rapidly and has an array of options, it can focus on quality development rather than expansion. A fine scale that is growing means it is shifting to a broad scope and will be attracting more options in accompaniment with the increasing people and resources, and thus shifting to a positive relationship between exotics and natives. Interactions between neighborhoods to resist invasions in ecology can be seen in transportation as the fine scale focuses on quality, but the stitching together of the fine scales then increases the broad scale diversity.

Resisting ecological invasions means focusing on vulnerable areas, so in opposite implementing a rich native transportation network relies on targeting the areas open for change. Taming ecological exotic takeovers requires an understanding of the seasonal and annual fluctuations of the species life cycle. In transportation, a network must account for seasonal and annual fluctuations in climate that will change human habits.

This web of fine scales merging to compose the broad scales makes the entire planning, or ecological combating of species, still extremely complicated. Knowledge of what would always enable a successful invasion remains elusive, but what can be termed comprehensible uncertainty does provide a foundational insight.

2.3 Uncertainty

“ ‘In fact,’ says urban-planning consultant Sam Schwartz, a former New York traffic commissioner who helped the city prepare for the 1980 transit strike, ‘in the case of true gridlock, the streets are actually 60% empty. All of the crowding is at the intersections, with nothing getting to midblock.’ In the arts as well, simplicity and complexity may masquerade as each other.”

-Jeffrey Kluger, ‘The Art of Simplexity,’ *Time Magazine*, June 2008

‘Comprehensible uncertainty’ stems from the fact that there is certainty of habitats, physical infrastructure, and the existence of competition and cooperation, but uncertainty of how they will function in context. Nature has worked itself out for billions of years through trial and error. Despite the studies of nature and laws of science there remains an element of mystery and unpredictability. This lesson must be heeded for transportation planning: while studies can bring a level of certainty, the mystery of reality will always remain. In writing about transportation planning, de Roo (2000) comments, “One extreme of the continuum represents a high level of predictability in terms of the outcome, whereas in the other extreme there is no longer any certainty. Instead there are a large number of possibilities that can be created during the planning process. In other words, there is a bridge between functional rationality and its opponent, communicative rationality. That bridge, then, is complexity.” The bridge of complexity is built through development of interdisciplinary thinking to harness more certainty and share the risks of uncertainty.

2.31 Ecological Interdisciplinary Theories

In recent years articles on ecological niche theory have expanded to combine theories to share knowledge and the inherent uncertainty in explaining natural phenomena. The combination of these theories is highlighted to depict how the ecological field is evolving in its methods and findings. In his article entitled 'Niche Tradeoffs, Neutrality, and Community Structure: A Stochastic Theory of Resource Competition, Invasion, and Community Assembly,' Tilman (2004) breaks down trade-off theory and the neutral theory to arrive at the stochastic theory. Trade-off theory describes the co-existence of species through exchanges of opportunities and constraints, but the theory does not account for species abundance or a possible limit to diversity in the community assembly. On the other hand neutral theory claims that species are equivalent in response to constraints and that there are not interspecific tradeoffs. This theory falls short of mentioning a relation between species abundance and traits, which must be accounted for if all species are equal, but not equally represented. Stochastic niche theory, deriving from the concept of the elasticity of niches in the environment, incorporates both previous theories in an attempt to explain diversity, composition, abundance patterns, and invasion dynamics in one theory. The theory incorporates the concept that species, especially invaders, must 'survive, grow, and reproduce' on resources unconsumed by other species, but their arrival impacts the demographics, and thus the available tradeoffs. The effect also works the other direction because the tradeoffs in conjunction with competition and environmental stochasticity impose limits on recruitment of invaders and growth of species. In essence in this interdisciplinary research Tilman does not discredit either theory, but challenges what the theories have overlooked in order to make a more robust unified theory.

In another apt theoretical example in 'Integrating the Effects of Area, Isolation, and Habitat Heterogeneity on Species Diversity' Kadmon writes that Island Biogeography Theory and Niche Theory must be combined in order to synthesize their basic elements of "area, isolation, habitat heterogeneity, and niche differentiation" (Kadmon, 2007). Niche theory is based on an 'equilibrium view' and constant species composition, and island biogeography on a 'nonequilibrium view,' with a changing species composition. Through synthesizing the two Kadmon concludes that habitat heterogeneity does not just have a 'monotonic positive effect' on species richness, but negative or null effects result under variations of area, dispersal, reproduction, and immigration patterns. Similar to Tilman, Kadmon does not dispute either theory, but takes them to a higher level of understanding. For example habitat heterogeneity and species richness is not always a positive relation, but yet his results in varying circumstances provides clarity for the deviation in observations. Sharing of knowledge and aspects does not necessarily produce a simple answer, but it fosters cooperation, rather than competition between the different schools of thought. In both instances cooperation is more effective than debating correct or incorrect.

This combining of theories is relevant to transportation planning at two levels: 1) the results of these expanded ecological concepts are relevant to transportation structures and 2) the notion to merge theories has carried over into transport theories.

Firstly, Tilman's synthesis of neutral and tradeoff theories into stochastic

niche theory resonates with transportation because each mode affects the others. A transportation mode's role in the built environment is elastic, stretching and contracting in relation to the other modes present, human habits, and infrastructure resources.

Synthesizing island biogeography and niche theory is akin to transportation because diversity of infrastructure does not necessarily produce a positive correlation with mode richness. Wealth in infrastructure can have a negative or null effect if it is not dispersed appropriately or it is not accompanied by corresponding awareness in mode use.

Secondly, in an article titled 'Rethinking the Role of Integrated Land-use Models in Spatial Planning' Couclelis highlights why transport theories and advances must work together. "As de Jouvenel (1972), the French founder of the 'Futurbiles' movement wrote, 'For [Wo]Man, as a thinking subject, the future is uncertain, whereas for the active subject, the future is opportunity and power.' Today's modelers seem very uncomfortable with the uncertainty, which they try hard to quantify and excise, whereas the planners do not sufficiently appreciate the indeterminacy that alone leaves room for shaping the future. Both sides need to be bolder. Planners would do well to remember Issermans's (1985) injunction: "Dare to plan!" For modelers, the word should be: "Dare to build the right kinds of models for planning!" (2005, p. 1369). Couclelis gets to the point that uncertainty is uncomfortable if examined with the mentality of fear, but the realization that crafting reality instead can be seen as 'opportunity and power' to create something better. 'Shaping the future' revolves around using the certain status quo, while 'daring' to forge into the unknown. Thus, the apt lesson from her comments is the emphasis on collaboration between planners and modelers. Modelers cling to numbers for security and planners cling to the norm for security, but both have to forego the comfort zone at times to progress. While most are keen to claim success, few are as excited to claim mistakes in forecasting or planning. A solution to reduce the risk of blame is to share the uncertainty, to work across fields and between hierarchical levels. If each field dares to go forward in open communication, then interdisciplinary work has potential.

2.32 Transportation Interdisciplinary Theories

Transport theories have plowed forward to combine the traditional four step model of trip generation, distribution, mode choice, and route with various micro-simulation models for more detailed travel behavior, generating methods referred to as 'soft systems' (Kane 2005), 'stated preference method' (Loo 2002), and 'planning support systems' (Couclelis 2005). The 'soft system', in contrast to the hard system of engineering, incorporates a logical, reality based, cultural analysis. Kane (2005, p. 120) describes the reasoning behind the soft systems methodology, "It provides 'thinking tools' to assist in the exploration and interpretation of the complex human or socio-political situations commonly found in transport planning institutions and programmes." The method recommends working in conjunction with the rational planning base and technology, but also to create a matrix addressing such questions as "Who are the actors involved in the transport planning process?, What is the worldview/paradigm set of those involved? What is the political system – type of power that exists, how is it obtained?" (Kane 2005, p. 122) (Appendix A: Soft System Analysis Matrix Sample). A case study example was completed in Cape Town,

where the soft system provided themes of concern to accompany the hard system facts, figures, and physical infrastructure. In Cape Town the concerns were consistency in funding, lack of trust between officials and councilors, low level of creativity, and apathy expected from the public. Thus, the planning progress proceeded with certainty on how to construct the needed capacity, while reaching out to address the uncertain human behavior aspects.

The ‘stated preference method’ is based on combining hard data of “traffic counts and surveys” with soft data of “attribute valuations, perception studies, and collection of attitudinal data” (Loo 2002, p. 212). In an attempt not to isolate any aspect of transport planning, to be highly specific to the local context, and to provide relevant feedback information, Loo expands the questions addressed in the traditional 4-step model (Appendix B: Stated Preference Method: Expanding the Four-Step Model). A primary goal with the additional data collection is to combine environmental and economic valuations. “Stated preference methods are particularly useful here because they allow us ‘to establish values for those environmental goods which, because they are not directly traded in conventional markets, do not have immediately available monetary value to form the basis of inputs to financial, cost-benefit and similar forms of policy appraisal’ (Pearman 1994) either in the traditional four-stage transportation planning model or the cost-benefit analysis in evaluating transportation infrastructure projects.” Instead of converting all data to monetary values, the synthesis of preferences permits environmental considerations in their own contextual terms.

The ‘planning support system’ is based on “open-ended questions, just like planning itself” (Couclelis, pg. 1355, 2005). Planning support systems uses three steps of open-ended questions: scenario writing (what may be?), visioning (what should be?), and storytelling (what could be?) to gather foundational information and then recommends models to “contribute to scenarios, backcasting, and attractive-visual narratives” (Appendix C: Scenario, Visioning, and Storytelling). The questions are meant to involve an array of people for diversity of opinions, and the technology emerges for clarification and guidance. Couclelis (2005) writes “Planning Support Systems” translates models into meaningful stories to shake out complacency (visualization); [and to] find turning points that distinguish different outcomes.” Models are not used to estimate end certainties, but as tools to inspire people to react and to be involved in the visualizing and storytelling. Overall, the details of each of these evolving transport methods differ, but the general purpose is the same—each is working to provide information from both sides—hard and soft infrastructure.

The mission is no longer to adapt strict models or matrix questions to each context, but for the process of planning to evolve on location. “The fallacy of adaptive planning is that it underestimates the inertia of institutions, infrastructures, and social practices: it is like trying to steer a supertanker through an unknown obstacle course. By the time the future reveals itself it is often too late to do anything about it. The answer thus is not to hide from future uncertainty but to tame it by recognizing that, however unexpected, the future is born out of the present and the past, involving many predetermined as well as unforeseeable elements” (Couclelis 2005, pp. 1361). Knowledge, theory, and curiosity of the past and present propel humans into the future. But steering the supertanker is delicate: lack of forethought and the supertanker plunges blindly around each corner with mere hope for the best; on an absolute pre-determined path the supertanker is

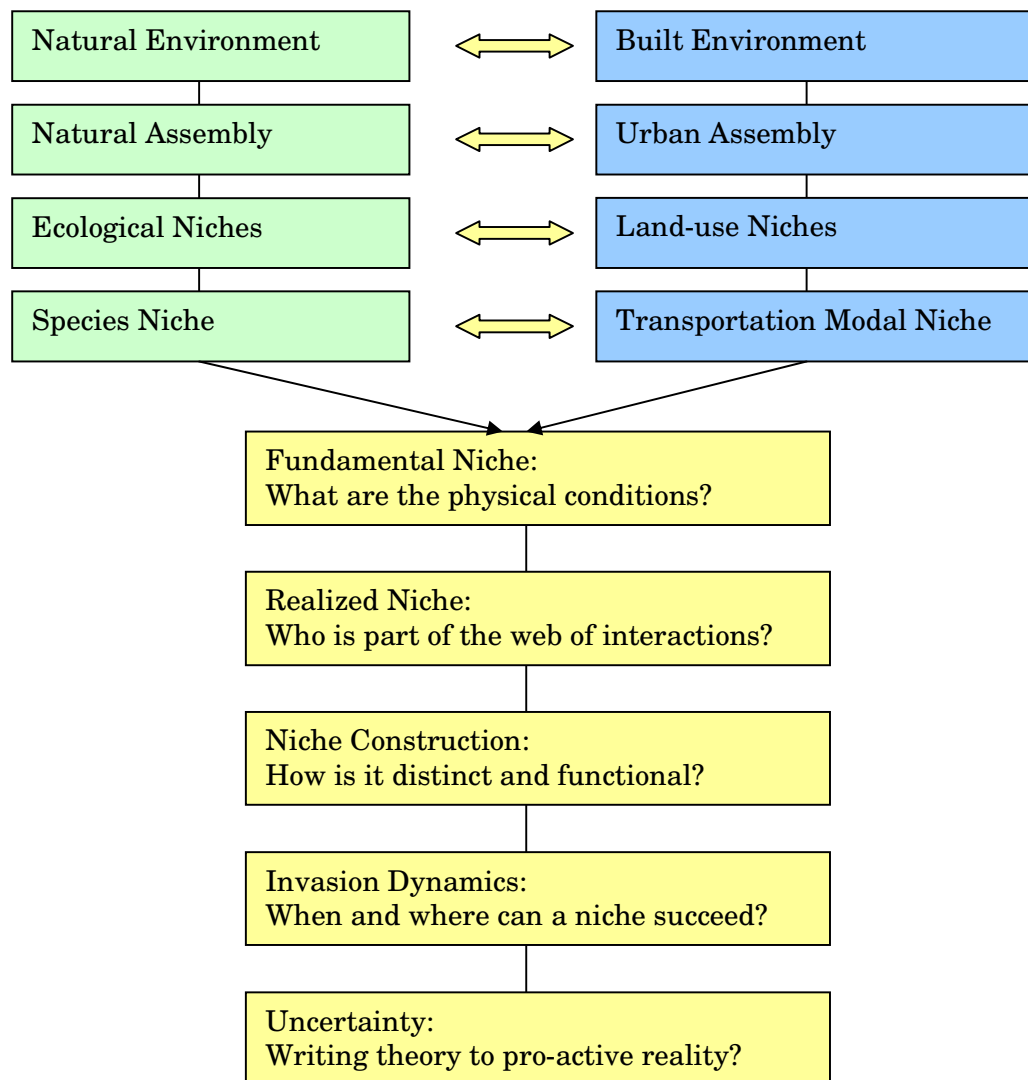
too vulnerable to chance occurrences; a lack of contextual knowledge and the supertanker has no bearings for where it came or where it is going. The steering wheel needs a set of hands to actually make a decision and turn the wheel, but those hands require guidance from the collation of populace thoughts. Nothing is certain about the future, but each field works to reduce uncertainty, so the purpose of this research is to acquire information from people themselves, people with different fields of interest.

2.4 Conceptual Framework

“The new machine was like a revelation, everyone wondered how something so simple could have remained unknown for so long, why it had taken so long to discover it.”

-Stijn Streuvels, describing the bicycle

The overall framework for this research is a parallel between the ecological and built environment systems. While the ecological research focuses on natural habitats with less human manipulation, urban planning focuses on areas based on human manipulation. The parallel between the functioning of species, habitats, and interactions enables lessons from ecology to be applied to urban environments. The theories section analyzed the ecological niche theory by dividing it into the sections of fundamental niche, realized niche, niche construction, invasion dynamics, and uncertainty and the findings on the built environment in this paper will also adhere to those divisions.

Figure 2: Conceptual Diagram

First the research questions and process of obtaining the findings is elaborated. Then the results on the built environment are revealed, paralleling the ecological niche theory divisions. The findings section utilizes the first four divisions (fundamental, realized, construction, and invasion), and the discussion section parallels with the concept of uncertainty.

Furthermore, the concept of this thesis is to explore the developed parallel between ecological niche theory and the primary data. Inclusion of other transportation case studies could be used for further support, but is outside the scope of this paper. Thus, supplementary transportation information sources can be found in Appendix D.

Chapter III

3.1 Research Questions

“This month (June), however, Washington is rolling out America’s first high-tech bike-sharing program. The so-called SmartBikes come with key-card locking systems and tracking devices to prevent theft. And officials are hoping the only problem this time around will be having enough supply to meet demand.”

-Kristina Dell, ‘Bike-Sharing Gets Smart,’ *Life Magazine*, June 2008

The research questions were based upon drawing a parallel between nature and the built environment. The questions were formulated with the intention to induce and deduce how nature could be used as a guide in transportation planning.

A. What are the fundamental and realized niches of a transportation network?

Defining the physical conditions and interactions for each mode in context is the foundation. From the definitions, an inventory of what exists, what is needed, and what is absent can be determined.

B. How are the fundamental and realized niches filled in transportation?

After an infrastructure and interaction inventory, the process is to determine how to construct a distinct modal niche so that a transport mode can function as an effective community member.

C. How do bicycle and bus transportation networks successfully become a part of the Asheville, North Carolina transportation community?

To invade into a constructed niche, knowledge of the invasion dynamics and relations that must be cultivated for the modes to succeed must be explored.

D. How is uncertainty of fulfilling the modal niches handled?

The focus is shifted from dwelling on uncertainty to how to have open dialogue to recognize concerns and issues.

E. What can other cities learn about analyzing and addressing open niches in the built environment?

The way to address open modal niches will not be by copying and pasting potential solutions from Asheville, but the guidance will be on how to generate a similar process to use ecological niche theory as the foundation for the built environment assembly in other cities.

3.2 Methodology

“The people we have heard the least from in this epic campaign season have been the voters – ordinary Americans. We get plenty of polling data and alleged trends, but we don’t hear the voices of real people”

-Bob Herbert, “Letters From Vermont,” *New York Times*, 14 June 2008

The purpose of the data collection is to provide insight into current transportation planning practices, the reality of daily transit, and potential commonalities between reality, planning, and culture that can improve community mobility. The research inquiries are transportation specific but the themes of the interview questions were cultural, economic, social and political structures. (Appendix E: Interview Questions). The reasoning behind the broad scope of questions relates to the interconnectedness of mobility as outlined in the motivation section. The questions were descriptive, structural, and thoughtful in nature. Descriptive questions were used to gather information on personal experiences and accounts that shaped their opinion. Structural questions were used to explore the cultural and government systems that exist. And thoughtful inquiries were used to draw links between personal experiences and the system structure that shapes and maintains the cultural mentality.

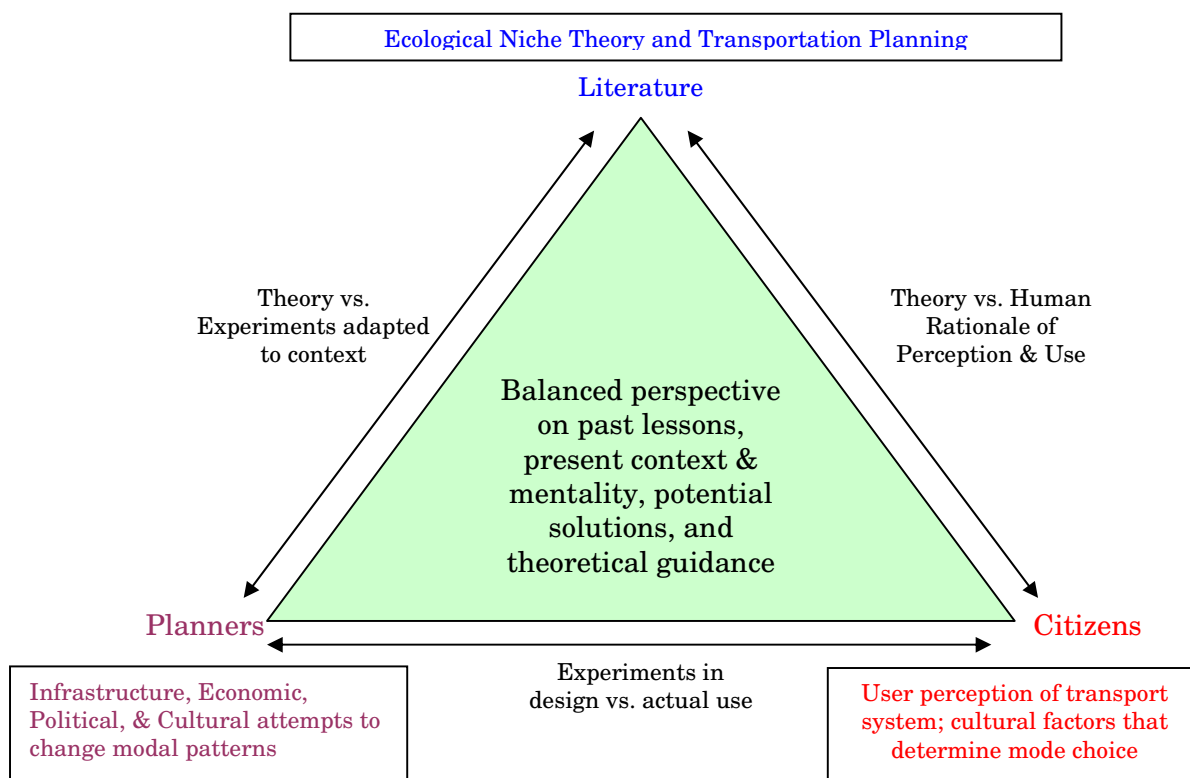
The qualitative data was gathered from interviews with a handpicked non-random small sample in Asheville and Groningen. Interviews were chosen because of their semi-structured style that couples formal questions with dialogue. In *Methods in Human Geography*, Flowerdew (2005, p. 111) writes, “The advantage of this approach is that it is sensitive and people-oriented, allowing interviewees to construct their own accounts of their experiences ... one of the additional strengths of this approach is that it allows respondents to raise issues that the interviewer may not have anticipated (Silverman 1993).” The process of an interview creates rich data because of the ability to explore the unexpected and to gain depth on issues.

Interviews with Asheville citizens and planners were the main focus of this research. On the other hand, Groningen is the present home of the researcher, so face to face interviews with planners in the Netherlands was used to gain a more in-depth understanding of a multi-modal transportation system that functions in reality. In order to achieve credibility in the data collection, the method of triangulation was used. The triangulation used in this study of transportation infrastructure was composed of literature, planners, and citizens. The literature provided the theoretical basis; the citizens explained their perceived reality of the system; and the planners detailed the attempts to link theory and reality.

Every person, be it the writer of literature, a planner, or a citizen, is biased. A person understands reality from their daily experiences, which are individual and cannot be replicated. When trying to capture these accounts in an interview bias can occur on the side of the interviewer and the interviewee, but “ ‘Interviewers are not losing their ‘objectivity,’ becoming partial or imposing a particular world view on the respondent, rather they are using the interview as an opportunity to explore the subjective values, beliefs, and thoughts of the individual respondent’ ” (Flowerdew 2005, p. 112). The gaze is shifted from looking at innate bias as a negative, to using it as an opportunity, a chance to dive into a different perspective. These subjective views represent the ‘push’ in the triangle. Each point believes its opinion to be the

‘truth’ because it reflects their observations and participation in the network. Being a part of the system an individual is unable to objectively witness the whole. The collation of perspectives then serves to reduce bias by each point pulling the others to understand their opinion. Thus, the ‘push and pull’ of the three points balances the perceptions to form an equilateral triangle as outlined in figure 3.

Figure 3: Methodological Triangulation



Since triangulation is not a traditional statistical quantitative method of obtaining valid information the process will remain transparent and any possible subjectivity will be explained. The first point to maintain transparency is to explain the selection of the points. The literature, as discussed in the theoretical section, was chosen to gain a broad perspective on natural and built environment assembly. In order to grasp the broad picture, literature on the ecological niche theory was utilized because of the emphasis on interconnecting systems. The natural world is the foundation for the built environment, so research on the interactions at the base can be applied to the next level—the manmade level. The citizens were selected by the snowball technique. This method uses one contact to recruit another. With many initial contact points, it ultimately is a method to build an extended layered web (Flowerdew 2005). Indeed, the snowball technique is nonrandom, but the strength of this method is to build trust and to be able to seek out particular experiences or backgrounds. A web fosters trust through accountability, which is facilitated by a relationship. Contacts are recommended because people find them

reliable and capable to follow through in an honest manner. Through the initial contact points, from the university, schools, advocacy organizations, and private business, the researcher sought individuals with particular knowledge of transportation, urban design, cities abroad, and city government. Since it is a small sample, the researcher had clear aims to obtain quality responses. The snowball technique, then does assume a level of trust with the researcher's initial contact points to select citizens with a detailed to broad perspective on culture, economics, and politics. (Appendix F: Interviewed Citizens).

The planners were selected by their professional positions (Appendix G: Interviewed Planners). Their professional backgrounds were all rooted in urban planning, but the individual experiences varied from private, city, provincial-regional, and university contexts. The diversity of backgrounds provides information about different planning techniques, spatial extents, and funding resources.

The process of a literature review was a straightforward reading of articles, but the interview process was dictated by accessibility in time and space. The Groningen planners were interviewed in-person at their respective offices. The majority of Asheville planners and citizens were interviewed through the computer program skype utilizing microphone and camera. The interviews were done in this respect because it was not possible for the researcher to travel to Asheville during this period. The interviewees utilized skype from their home, office, or through the computer of an initial contact point, and the home computer of the researcher. The interviewee responses were hand-written by the researcher during each interview. All interviewees accepted this method and agreed to be quoted in this research. 'Email dialogue' was utilized for one of the interviewees due to constraints to use skype. This method consisted of the researcher emailing a set of questions, similar to those asked in the skype interviews, then after reviewing the response, sending follow-up questions to expound upon particular points.

Chapter IV

4.1 Data Analysis

“A Species ... is a ‘kind of animal or plant which has run the gauntlet of the ages and has persisted.’ A species in nature, I would emphasize, is not any sort of a variant strain, even one of the more striking mutants, until such variant has been subjected to the drastic processes of trial for existence under natural conditions, and has ‘stood.’ ”

-Joseph Grinnell

The ecological niche theory, detailed in the theory section, is the foundation for the analysis. The raw data collected from the interviews was first separated by relevance to Groningen, Asheville, and other cities. From there the data was sorted by the themes developed in the theoretical framework—fundamental conditions, realized interactions, niche construction, and invasion dynamics.

The thematic divisions make the data manageable for analysis to extrapolate meaning, develop interpretations, and formulate conclusions within each sub-group. The analysis within each section was based on word choice, concepts, linguistic devices, and non-verbal cues. Word choice and concepts were examined for repetition throughout an interview and across the interviewee spectrum. For example, the repetition of the word ‘community’ and the concept of convenience emerged as a dominant strand for individuals of many backgrounds. Additionally, the linguistic devices used in the manner of expression and the associated non-verbal cues employed were used to associate the response with a personal narrative, social-historical discourse, reference to daily occurrences, or grounded in theory (Flowerdew 2005). For example, Joe Minicozzi, an Asheville planner, used numerous metaphors to illustrate his social-historical points. His use of metaphors indicated his frustration with the daily talk of these issues, and his desire to approach the topics in a different manner—to use everyday comparisons to illustrate problems to solutions. The manner in which a concept was told was used to determine the interviewee’s relation to the subject matter. For example, personal narratives by citizens tend to represent informal sectors that need to be incorporated into modal development, while planners referencing the compact city theory have relevance to the formal fundamental infrastructure.

In the process of extrapolating meaning from the remarks, interpretations were developed based on a cycle of deductive and inductive reasoning. Deduction entailed ‘uncovering’ the similarities and differences in transportation perspectives and cultural mentality between the interviewees. Induction was then based upon discovering how the similarities could unite different backgrounds and how the differences could be overcome. This cycled back to deduction where the topics of difference had to be delved into beyond the surface answer to obtain underlying reasons and motivations. Then, inductive reasoning was used to derive common strands between the underlying reasons and motivations.

The first findings section is on Groningen, where bus and bicycle niches are realized. The data was analyzed to see how the actual built environment assembly paralleled with the natural assembly used as the foundation in this research. While Groningen serves as an example of a functioning realized niche, due to cultural, political, and topographical differences it is not appropriate to adapt its structure to

Asheville. Thus, the findings are correlated with the ecological niche theory, and ideas that could be melded into the Asheville structure appear in the discussion section.

The second section coagulates the Asheville data to determine the existing and needed infrastructure, the shaping forces of a realized interactive web to provide resources, how to make the open niches habitable for the long-term, and when and where to support bus and bicycle invasions. The result is not a transportation plan or map, instead it is a synthesized concrete guide of ideas and processes that ordinary citizens and planners support. The foundation of the guide remains the ‘natural assembly’ with the second layer being the ideas from other cities, transportation literature, planners, and citizens.

Furthermore, relevant to the findings are bus and bicycle programs being implemented in other cities. As the interviewees were from Groningen and Asheville, it was not possible to obtain primary data on the array of movements to construct bicycle and bus habitat elsewhere. But for additional information Appendix H: Sample of United States Programs to Promote Multi-Modal Systems has been provided.

Following the findings, the discussion section addresses overcoming uncertainty in interdisciplinary transportation planning. The culminating conclusion section moves beyond the synthesized interpretations to address how to keep pace with evolution.

4.2 Groningen Findings

Groningen was selected as an apt case to harness lessons from because of the depth and usage of its transportation network. The statistics speak for this depth: 58% of journeys are by bicycle and 4% by bus within the city; furthermore, to and from the city, 10% of journeys are by bicycle and 16% by bus (Stoker). The fundamental and realized niche of bicycle and bus networks is a reality. The findings demonstrate that Groningen indeed mirrors the concept of ecological niches within the built environment.

4.21 Fundamental Conditions

“The bicycle is a low-cost means of transport, both for the cyclist and for the society as a whole. Moreover, cycling is healthy. Motorised transport, apart from making a positive contribution to the economy, results in high external costs related to the environmental pollution, energy consumption, use of space and road casualties. For car traffic, these external costs are highest per car per kilometer on short journeys in built-up areas. And this is exactly where the bicycle can take over a significant share of the journeys in many cases at least 50% thereby increasing the benefits of cycle traffic even more”

-Roelof Wittink, The Economic Significance of Cycling

In Groningen the bicycle and bus networks are just as natural as the habitat for the personal vehicle. Nature regulates itself, but the built environment is dictated by human choices. The infrastructure aspects, the ‘pre-interactive distributional areas’, are more straightforward than the interactive niche facets, but

there still remains a creative scientific art to developing a physical habitat. First and foremost Groningen has focused on quantity of habitats throughout the city, and after a connected foundation, quality has been emphasized.

In 1977 Groningen drastically changed its traffic circulation plan. It removed vehicle traffic, except buses and taxis, from the center city to a ring road around the city. Eric van Huissteden, senior transportation planner for the City of Groningen, describes the plan, “grid for people, ring for cars and parking.” This did not mean a complete separation of cars, people, and bicycles, but a degree of delineation of habitats so that each could function. Due to the indirect nature of rings they are not convenient modal habitats. The personal vehicle prospers in large part because of its speed, so for more equal quantity of ‘fertile’ habitat space, this change was made for more direct paths for the slower modes and indirect for the faster modes.

These transportation habitats were fostered by the implementation of the compact city theory. The theory has been debated as to whether compact development is appropriate due to the resulting close proximity of environmentally sensitive areas to more intrusive functions, but despite this Van Huissteden comments that the compact city mentality continues in reality. The hospital, of vital importance and the largest employer, was kept in the city, while strip malls have been limited to the outside area near the ring road. The hospital represents more vitality so it is kept in the compact zone, while strip malls based upon vehicle traffic are relegated to the non-compact area. Furthermore parking garages have been built along the ring, with higher pricing being directly correlated to the proximity to the city center. Thus, economics are utilized to support vehicle habitat on the outside and bicycle and bus habitats in the compact zone.

The grid within and ring around plan in conjunction with the accompanying land-use regulations have ensured quantity for each modal habitat. With sufficient quantity in place, the city now focuses on quality. For buses the quality of the habitat is improved by road maintenance, covered bus stops, clear timetables at all stops, connectivity to other modes, and direct routes to main destinations. Cor van der Klaauw, senior transportation planner in Assen, Netherlands and formally for the City of Groningen, comments on the subtle aspects of improving bicycle habitat: designating red as the bicycle color—used for lanes & signs, bicycle priority at roundabouts, red boxes at stoplights for bicyclists to pull forward and to be out of the pollution path of tailpipes, and temporary parking to complement the permanent parking during market days and special events. Furthermore, both habitats function due to the signage. The bus stops, in and outside the city, have maps, which can also be used by cyclists for street orientation. To avoid signage overload in the dense center, the distance signs begin on the periphery of the city. The edges and countryside have a plethora of signs for cyclists to navigate from small towns to cities. Habitat connectivity is not broken by the lack of signs in the city. On the contrary, the city is strengthened by the ‘less is more’ approach because the city is still navigable due to the bus maps, while the coherence of the city is not lost with information overload. Furthermore, the vehicle niche on the outskirts means that abounding automobile signs in the center are not even an issue. Instead of concentrating on vehicle quality in and outside the city, the efforts are focused on widening of the ring road, tunnels, and double-layer intersections on the periphery. On the whole, the city perpetuates each mode through infrastructural quantity for each, rather than an overload of quantity for one mode, and by quality design of informing, but not overwhelming users.

According to Wybe Naube, the City Architect of Assen, Netherlands, the main driver of effective quantity and quality implementation of plans is safety. In nature, safety is not ensured, and neither is it in the built environment. However, species settle into a habitat because of a level of security, and modes are utilized because of a perception of safety from daily observational use. When asked how the effectiveness of the transport system is measured Naube replied “safety.” Statistics are gathered and released, citizens are active to report dangerous intersections or paths, and parents are highlight areas unsafe for children. The feedback on safety links right back to improving quantity and quality so that future accident rates decline and citizens comment on the positive change. While these fundamental conditions applied to flat topography and the Dutch culture is context-specific, the lessons of quantity and quality with safety at the helm mirror species in nature seeking secure refuge.

4.22 Realized Interactions

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

“Whether you're a professional designer who can submit a detailed plan or you are someone who uses buses every day and has one great idea that would make your journey better, we want to hear from you.”

-Mayor of London, on the New Bus for London Competition

Physical quantity and quality, the pre-interactive aspect, is the simple assessment of infrastructure that enables modes to survive, but the post-interactive web of interactions is the complex feature that results in ultimate livelihood or not. To accompany its vast infrastructure, Groningen is remarkable, in contrast to many cities, in the success of its web to perpetuate and improve the modal structure.

The most relevant detail to the success is who is participating. The government is a significant contributor in terms of legislation and funding. Erwin Stoker, transportation planner for the provinces of Groningen and Drenthe, remarked that perpetuating the system is ‘beyond market numbers.’ One hundred percent cost-effectiveness is not likely and the government, nor the citizens, should expect it to be. Groningen-Drenthe’s public transport is 60% cost-effective, while Amsterdam, which has more modes, is 25% cost-effective. But the market numbers represent only monetary valuations and neglect the mobility, accessibility, quality of life, tourism, and atmosphere that in the long-term can override that one market number. Thus, the government’s role becomes one not of making ‘go, no-go’ decisions for modal niches based on market numbers, but for creatively looking for partnerships and improving capacity and safety so that citizens want their tax

dollars to fund transport ‘habitat’. Everyone uses the transportation system, but who is willing to provide direct support is the challenge. The creativity for partnerships emerges when determining who uses which facet of the structure and being able to weave funds together. Businesses, industries, service sectors, schools, and community events rely on accessibility, so as Klaauw details the key is to target a specific need and create a public-private partnerships around that aspect. The elected officials and planners must take responsibility for carrying out the government tasks. The elected officials must pass legislation that delineates the regulations of public-private partnerships that will be in the collective interest. The provincial and municipal public planners remain the weavers of the patchwork process for support and funding of modal habitats.

Citizen input becomes vital in the web of interactions because they are the backbone, as the users and ultimate financial backers of the system. While larger entities, such as businesses and industries, are the ones requested for infrastructure partnerships, it is still citizens who significantly pay for the system, albeit indirectly through tax dollars. Direct consumer payment of the total costs discourages use and undermines the purpose of collective transport to provide flow for the entire community (Klaauw). Instead, public money is collected through taxes and distributed from the national, to the provincial, who allocate it to their regional transport services and then to municipalities. So citizen input does not directly accompany each portion of funds, but as the users their input is vital. And once again planners emerge as the weavers that must connect citizen input with their use of the system and their tax dollars.

In receiving citizen opinions, planners must find a way to balance technical and citizen information. In the bicycle plans for Assen, Klaauw commented that he does not model modal splits or microsimulate behavior, but instead uses simple traffic counts and public testimonials to determine what to prioritize for capacity or quality improvements. Citizen use and direct comments remain the foundation for his decisions. Huissteden uses models for air pollution, noise, and microsimulation in Groningen, but says that they are “tools to help thinking about planning.” They are ‘tools’ because the web of people remains the basis of his decisions. Moreover, to maintain the citizen strand of the web, the thread must be weaved into interactions with others. Examples of involvement include public workshops, guided by civil servants or private firms, and followed up with feedback from the municipality within a defined period; legal proceedings for citizen complaints, free of charge at the initial level; and the media, printing special transportation update sections in the local newspaper.

Detailing each strand of the Groningen web could continue to infinity. However, each thread is most relevant in context with the most important aspect being the understanding that the interactions to foster a realized multi-modal network are a web, not a linear ladder. And like a spider web, the web is continuously rewoven keeping basic patterns, but adding and removing strands of actors.

4.23 Distinct Niche Construction

“The company had learned that there were several keys to success: allowing subscriptions, so people get the sense that the bikes are free once

they have paid their up-front fee; making sure the bike stations are ubiquitous and keeping the system ‘user-friendly.’ ”

-Maia de la Baume, ‘A New Fashion Catches on in Paris,’ *New York Times*, 13 July 2008, discussing Velib - Paris’ Bicycle Share program

Groningen has the fundamental infrastructure and the realized interactions in place that support the modal niches, but each mode, like a species, only inhabits and persists due to its uniqueness. Transportation by any mode has the same purpose of moving from point A to point B, and the primary factors repeatedly mentioned in determining how to go from point to point are time, convenience, and money. Species in nature must carve out their own distinct function, while in the built environment humans must do the crafting of the uniqueness of each mode.

The modal overlaps and breadths are taken into account in the distinct carving process for time, convenience, and economic benefits. At first glance, the personal vehicle has the greatest breadth as it can readily adapt to time and convenience preferences of the individual, but the cumulative effect of the entire community using it for its breadth does not enable flow. Groningen restricted vehicles from the city center, and developed the breadth of the buses and bicycles. Buses are unique because of their capability to transport masses, but this ability is only beneficial if fully utilized. Stoker views the way to maximize this capability is to couple bus uses. For example, elderly transit shuttles used to be separate, and the province was supplementing 38 euros for their free rides. Coupling the elderly transit shuttles with the ‘service buses’ going through neighborhoods then increased the passengers on each bus and reduced the province supplement to 3 euros per ride. In the instance of the park & ride buses, which one-third of residents come to the city on, one car of workers rides for 2 euros (Stoker). The 2 euros does not recoup the cost per person, but the buses are full and the city can maximize space in the center for more economically active functions than parking garages. Additionally, the hospital pays for its workers to ride the bus because of the practical economics that the bus is cheaper than buying land to build private parking. The bus becomes more cost-effective when the primary bus works in conjunction with elderly shuttles, schools, businesses, and park & ride lots.

Unlike vehicles and buses, bicycling is cost-effective. The bicycle breadth is short distances (for the majority of people under 5 kilometers) on moderate to flat topography. Bicycle breadth is increased by links to other modes to extend its scope, but by its nature it retains its personal flexibility. The flexibility is enhanced by the variety of sizes and styles sold in the Netherlands, so its breadth includes commuting, touring, utilitarian, or transporting children. Furthermore, the government broadened its breadth by allowing folding bicycles to travel free on all forms of public transport. A cultural aspect that increased its scope is the common Dutch practice to park a 2nd bicycle at the public transport destination. A sign of a developed and utilized breadth is that the bicycle is not just shaped by land-use, but has a role in its shaping. Land-use determines where the bicycle needs to go, while accessibility by bicycle becomes a vital characteristic for homes, offices, and restaurants.

The modal niches will always have some overlap in Groningen. For example, car, bus, and bicycle all provide mobility to the train station, but each is unique in cost (gas, parking, fares), time (distance and traffic dependent), and convenience (schedule, weather, baggage). So each mode retains its own charm in how it carries

passengers to the train. Just as each mode maintains a unique identity, Groningen, as a functioning urban ecological system, also retains a distinctive feel due to this structure. While many cities are struggling to carve niches, Groningen is fortunate to be beyond this stage. Each modal niche is assured time, energy, and money each year, but the city must still maintain pace with evolution in technology, citizen desires, and infrastructure updates. Niche construction is an on-going process.

4.24 Invasion Dynamics

“Not choice, but habit rules the unreflecting herd.”

-William Wordsworth

The invasion of modes into the transport structure is not a present issue for Groningen, but when and where campaigns to rejuvenate or expand modal habitat take place is relevant. The vehicle can be seen as a predator that has successfully preyed on the other modes' weaknesses. Predation was successful as long as there was space for all the individual cars to exist simultaneously. However, as discussed earlier, Groningen halted this rate of predation by limiting vehicles because the 'intra-species' vehicle interactions were not conducive to a vibrant city center. To counter the predation cycle, new cycles of mutualism were established.

Klaauw gives an overview of the idea of mutualism in the built environment, describing that investment is not up for debate, but the how to is tied to combining issues, such as emissions, spatial structure, and economics. An example of mutualism is the park and ride lots where buses and vehicles function together. In interviewing Huissteden he indicated on the city maps where new residential areas were being built and then his subsequent point was the location of the new park and ride lot to service the neighborhood. His following sentence shifted gears to the connecting bicycle path to the city center. Mutualism thrives off of success from each angle, so inclusion of all modes, not exclusion is the objective. Moreover, inclusion in the initial construction phase is critical for residents to have options upon moving in.

Similarly, inclusion of modal education when children are young instills understanding of the system. Dutch primary schools instruct children on bicycle laws and practice how to handle intersections and roundabouts, which culminates in an exam. Knowledge enables proper usage and development of appreciation of the network.

Upon listening to citizens, the issue arose that there was a lack of knowledge of how to use the bus. Just as children beginning to use the bicycle network need education, first time bus users want a basic familiarity before boarding. To rejuvenate the bus, a successful campaign was the '1 euro, 1 uur, 1 kaartje,' translates to '1 euro, 1 hour, 1 ticket.' Signs were placed on all the buses to provide awareness. A poster in the window provided the needed information for a ticket – the monetary amount and the time limit. The 25% increase in bus ridership demonstrated the value of knowledge (Stoker).

Awareness does work in both directions – for the planners and the users. Just as the users yearn for familiarity before starting, planners must be aware of what is yearned for. Citizens themselves provide information on where modes need to be improved, but Naube commented on the benefits of the Fiesterbond lobby group. The group is able to draw attention to bicycle issues at all scales. Consistent

monitoring of the modal networks greatly assists in perpetuating them. Thus, the when and the where to rejuvenate modes flows from the users.

In essence the modal richness in Groningen is part of its identity. Maintaining the species richness is part of the culture. The real success of invasions shows in the modal persistence through time and the mentality and will of the people to ensure the modal longevity.

4.3 Asheville Findings:

Asheville has the threads to weave bus and bicycle networks into the transportation system, but the current weaving is slow and patchy. There is not a single reason why the vehicle thread dominates, and there is not a single solution to how to weave in other modes. The findings reveal that the components of comprehensive plans, citizen desires, and planning knowledge exist and Asheville's built environment can mirror natural assembly, but cooperation and mutual benefits must be established. (As the findings section is focused on primary data, additional secondary data sources can be found in Appendix I: City of Asheville Information.)

4.31 Fundamental Niche

“Culture and patterns get created by surroundings, which is infrastructure and funding, which currently happens to be cheap cars and gas.”

-Yuri Koslen, Transportation Planner, Asheville

The physical conditions are the base layer for survival. Asheville has a quantity of roads, namely for vehicles, and extensive development within the city, but the habitat for buses and bicycles is lacking. Jay Bonner, Asheville resident and Associate Head Master at Asheville School, accurately stated that “we must decrease asphaltting, develop what we have, and max out our capacity first.” Immediately, he gets to the heart of the matter that renovation, not new construction is the issue at hand within the city. Yuri Koslen, transportation planner at University of North Carolina – Asheville (UNCA), commented that bicyclists “drive for a half hour to get out” in order to ride. Thus, the synthesis of these two observations is that inside and outside the city center, the asphalt exists, but it is the utilization that needs focus.

“It is not anger, but disappointment in the system” is how Carol Barely characterized the transportation habitats. Anger does not radiate because there is paving, building, and repairing to keep the system functioning, but it is a disappointment because the cycle continues to dote on vehicle habitat. Parking, the stationary aspect, ironically receives a significant amount of attention, especially in the dense areas. The founder of Asheville on Bikes, Michael Sule, highlighted that local businesses lobby for parking garages because that is how they envision daily consumerism. In addition to consumer parking, employee parking is a spatial drain. The fact that the need for parking continues to grow depicts that citizens are willing to pay, but as Koslen observes, “the price of parking is right by market standards, but the challenge is that employees are paying.” So consumers are apparently willing to pay for short-term parking, and long-term parking is not an issue because employees do not pay the cost, at least not directly. To meet the needs for

automobile resting spots, parking garages have emerged as effective public-private partnerships. The government and businesses are both willing to contribute to vehicle parking because it is viewed as an economic necessity. When employers cannot find or fund enough space they are purchasing vacant land parcels for park & ride lots. This is an example of disjointed land-use. Short-term solutions, rather than a grand land-use plan, dominate to avoid a breakdown of the mobility system. Vehicle habitat maintains the known system of mobility and it is logical for the public and private sector to try to protect the flow of the system. But, on the whole this results in increased automobile traffic and neglect to other modes and the larger land-use picture.

As a parent of 3 children, Irene Russell also notices how the single emphasis on vehicle habitat extends to children. School bus routes are combined and lengthened in budget cuts, and as a result parents take to the habit of driving their children to school. On the city bus level, Kitti Reynolds, a professor at UNCA, described her personal experience with the poor bus habitat. The bus takes her directly to the campus in the morning, but then there is no direct option home in the afternoon. There was a change in the bus schedule recently, which reversed the problem so that in the morning there was no direct option, but in the afternoon she was able to get home in a timely manner. She patched together a solution of combing carpooling and bus riding, but noted that these inconveniences foster vehicle use and bus neglect. Arnold Wengrow, a retired Drama Professor and now a freelance journalist, detailed his habits of walking based on the premise that waiting for the bus and then riding in a long zigzag loop took longer than to use his feet, even for journeys over 3 miles. He also commented that the bus stops do not have clear timetables that detail what time the bus arrives at that exact stop. Furthermore, he believes that the bus stops too frequently for any manner of timeliness. These narratives reveal the subtle disgruntlement with the lack of appropriate developed habitat for buses.

However, while buses need a degree of focus, they only represent one component of land-use. Just as vehicles receive too much focus in reality, too much emphasis on buses, even if just in writing, would be an injustice to the larger land-use system. Components of land-use represent simplicity, while the overall picture represents complexity. In Koslen's opinion, LEED (Leadership in Energy and Environmental Design) certification of buildings is a higher priority than overall land-use schemes. It is difficult to prove the exact validity of this statement, but the point is that just a single component of land-use is focused upon. Jim Ellis, a former city council member, hints at the paradox of this because the way to reduce the complexity in planning is through infrastructure simplicity. He advocates for infill because it uses existing basic infrastructure, noting it is common sense to use what is present first. Thus, the reconciliation of these views is that the complex picture of land-use must be acknowledged, but the initial way to tackle it is not through disjointed component solutions, but through re-use of the present structure.

Tied with land-use, and affecting modal habitats, are the current hot topics of zoning and steep slope development. Once again the issues are discussed in isolation rather than through their interrelation to each other and the broad land-use picture. Irene Russell, an environmental science professor at UNCA, would like to see more strict zoning that enforces, among other things, limitations on steep slope development. Interestingly, Russell does not point fingers at someone for the lack of changes in existing patterns and regulations, instead she comments on the

lack of familiarity. As a transplant to Asheville, Russell says she grew up with zoning in the Northeast. She has a familiarity with it, but here where zoning has not been prominent, especially at the county level, there is a lack of familiarity, which scares people away from it. Zoning gets broken down to an either-or issue, and the knowledge of how zoning can benefit overall community land-use is lost. As long as single topics are focused upon, the larger picture of land-use and modal habitat complementing and shaping each other will suffer.

The findings show that a quantity of infrastructure does exist, but it is too focused on vehicle habitat. Quantity of all modal habitats is necessary; and which is possible due to potential infill in land-use. Joe Minicozzi, an urban designer for a private firm, says that quality design of connectivity must be in the initial phase, not an afterthought. Thus, he is pushing Asheville not only to realize quantity, but a level of quality at the same time. For examples, he highlights the Blue Ridge Parkway and the Appalachian Trail as two examples of phenomenal planning and execution of mobility habitat in the mountains that mesh with the larger setting. Both are based on the need for mobility through scenic areas. And both have been successful because they provide a thoroughfare that considers preservation of nature, an environmental benefit, and connections to small towns, an economic benefit. These two projects are of a larger scale, but Asheville has the potential for a similar magnitude of effect by implementing quantity and quality modal habitat throughout the city that strengthens the entire land-use picture.

4.32 Realized Niche

“Velib is a hybrid name, a mix of ‘velo,’ which means bicycle and ‘liberte,’ which means freedom, in French.”

-Mary Schmich, “Easy to Ride; Tougher to Rent,” *Chicago Tribune*, 15 May 2008

The discussion of quantity and quality of multi-modal habitat is foundational, but additionally who collaborates to achieve the transforming feat must be addressed. The people who identify themselves as southerners, Appalachians, bluegrass folk, county citizens, businessmen, artists, native Americans, hippies, African Americans, metropolitans, retirees, bible belt believers, Latinos, Confederate ancestors, farmer, outdoorsman, or an ‘Ashevillian’ are the people weaving and re-weaving the web of interactions to realize the multi-modal niche (Minicozzi). Eclectic and diverse consistently emerge to describe Asheville, as it is a Mountain melting pot of looks, styles, economic status, and beliefs. “It is in conflict that one usually finds creativity. It is the heat of friction of these cultural collisions” (Minicozzi) that must be channeled beyond words to spin a web of proactive people.

Citizens: The series of interviews depicts that the citizens, however they identify themselves, have ideas to utilize. Jim and Jeannie Webb, a retired forest serviceman and teacher who moved frequently, offered the most pertinent advice to the situation of creating change: moving was not an isolating experience because everywhere they moved they were “constantly involved” because “approach and attitude” are the key ingredients. Their approach was not to harass “higher-up officials” or get frustrated with writing letters to the editor that did not get published; instead they started at the bottom level wherever they could get involved. Most notably in politics they began as formal campaign volunteers, but gradually

moved to a social, informal level where their ideas were being discussed in daily conversation. Their story might not be strikingly original, but it coincides with Minicozzi's point – 'the friction' occurs through interaction, interaction occurs through involvement, involvement occurs through the attitude.

How to constructively foster a proactive attitude in more citizens can be a challenge. The greatest strength, and weakness actually, is that mobility is connected to everything. The topics of property taxes and the housing market might seem off topic from transportation, but they were reoccurring themes throughout the interviews. So the frustration with a high property tax base and an unaffordable housing market is a trigger for many to be involved in the wider spheres of land-use and mobility. Bonner notes that individual property rights dominate, rather than regulations vested in the interest of the collective. Russell mentioned the dilemma of second home residents who have money to buy in prime locations, but which pushes permanent residents into secondary locations and beyond. Carol Barley, psychology manager at Memorial Mission Hospital, also believes the greatest weakness of the Asheville economy is the housing market. Thus, her primary interest is to be involved in the community through the Mountain Housing Organization, a nonprofit that builds affordable homes. The angles vary, but the topic draws people in. The variations on the most important details will likely cause 'friction', but in the process of getting to the heart of each issue is where ideas can radiate, and ultimately overlap into transportation development.

The housing market is just one example of channeling interests to break down issues and build up solutions. Another example highlighted by interviewees, Barley, hailing from the South, and Russell, from New England, was the entrepreneurial spirit in Asheville. The mentality to forge into business for oneself is not common in New England, but in Asheville Russell sees it as a viable option that generates creativity in the competition to survive in the marketplace. The entrepreneurs want to be involved in shaping the community and providing access to their business, so requesting and channeling their input is necessary. Furthermore, Jeannie and Jim Webb mentioned different aspects of environmental groups that have a vested interest to be involved—groups concerned with preserving ridge tops, water quality, steep slopes, and land conservancy. Also, the Webbs, who have grandchildren in the surrounding universities, suggested tapping into the energy at the academic institutions, specifically Appalachian State, Warren Wilson, UNCA, Western Carolina, Brevard, AB-Technical, and the community colleges. In the dialogue with Michael Sule the involvement of minorities and low-income, who have historically been less active in voicing their opinion, arose because they are predominant users of the alternative modal habitats. While these are just a selection of groups, the point is the process of how to build a strong web of people.

Amidst the notion of stirring ideas together from different groups, Sule mentioned the value of diversity in backgrounds. One example of diversity in backgrounds is heritage of place. As a transplant from the Northeast he notices subtle differences in customs, but appreciates the coupling of ideas as he joins in the identity of Asheville. New additions do mean a re-making of the identity as groups meet and merge. For this, Sule emphasized the term "cross-pollination," which can be applied to the notion of transplants and the above-mentioned groups intermingling. The 'cross-pollination' is a way to describe the weaving, and re-weaving, of the web.

Government: However, “cross-pollination” does not necessarily result in fertility, just like weaving strands together does not necessarily produce a strong web. In referring to differences in city and county opinions, Ellis remarked, “liberals and conservatives talk past each other, creating a gap in the dialogue.” His comment emphasizes that the groups are merged, like strands being interwoven, but the conversation diverges rather than converges. The observation is also relevant in Ellis’ focuses on politicians. The political realm, being in a position of authority, has the ability to foster convergence, rather than divergence, in dialogue.

Elected officials are an important thread to weave throughout the web because effective combining of government and citizen strands has the potential to create vast strength, but indeed also heightens the complexity of the web. The local, state, and federal level all have a place in the facilitation of the interweaving. Minicozzi comments that localities sometimes lack the experience of time in contrast to the state and federal levels. Thus, the upper level politicians tend to bring experience and a vision of how each locality fits into an even larger picture. While the local level officials immersed in context have foundational knowledge of where to begin dialogue to converge groups.

Within the local realm, city council is the prime actor. As primary actors of weaving the web, the election process is critical. Ellis believes that campaign finance reform, shifting to public financing in a limited amount, would be the most beneficial for the election process. If everyone has the same economic footing, then that provides the most transparent process for electing the most capable citizens to bring the community to convergence on issues.

City council maintains the role as the primary local decision-maker, but in addition to citizen input, as discussed above, planner recommendations must be woven in. Koslen clarified a portion of the role of city planners to: orchestrate public participation, take ridership counts and user testimonials, and be part of transportation listserves that exchange ideas with outside contexts. The concept being that civil servants actively seeking ideas from a wealth of contacts will put forth substantiated recommendations.

Media: Finally, how the work and ideas from government, politicians, citizens, planners, and others is presented to the wider populace is a critical strand. The media influences the public by inundating them with statistics, opinions, and daily happenings. Mark Boyd highlighted the need for the media to focus on constructive, positive dialogue. When the bicycle comprehensive plan was up for city council vote, he was honked at and treated disrespectfully by drivers more than normal. He believes people who did not normally behave in a rude manner suddenly felt that it was acceptable because the media highlighted that a negative culture of behavior existed and others felt justified to follow in those footsteps. Thus, the media becomes an actor with a challenge to reinforce strength and unity in the web, not to break it down.

The web of interactions emerges as an intermixing of communications from different perspectives, with direct and indirect interest in transportation. Furthermore, there are more strands, than can be accounted for here, to discuss their roles to strengthen the web. Thus, these findings serve as an initial framework of contacts, while emphasizing the most important point of diversity of people and backgrounds.

4.33 Distinct Niche Construction

“In cases where bicycle use is low, this can often be explained by cultural barriers and the lack of proper provision. Climate and geographical location are also important factors but they are seldom the main reason, let alone the only one, for people not using the bicycle.”

-Roelof Wittink, *Economic Significance of Cycling*

The infrastructural shortcomings and diversity of people that need to communicate emerged in the responses, but how these forces collide to form unique niches remains elusive. Unlike the established niches in Groningen, Asheville must carve a distinct niche for bus and bicycle networks to survive.

Like the realized interactive web of eclectic people, Koslen’s apt advice to make niche construction a reality is “to seek diversification in everything.” Sule commented on mode shifts that if it is just economics then it is “dredgery and penny pinching,” but if there is a “quality of life component, then it can stick to culture.” Although in different terms, Sule is echoing Koslen in the seeking of diversification. He acknowledges the role of economics to contribute, but notes that it cannot be the sole factor. From there he highlights quality of life, which by its nature encompasses diversity because it is different for each individual. Thus, the key to modal diversity emerges in emphasizing the modal breadths and connecting those to enhancement of quality of life.

Cultural Distinction: Economics pushes people to an extreme before changing habits, but quality of life is a positive enticement to shift patterns. Wengrow connects culture to the economic mentality of people saying that driving is engrained and the thought process is not to save on transportation, but only when one cannot afford to eat, have shelter, and drive a vehicle is household economics questioned. So if economics requires a push to the breaking point, then options to embed multi-modal transportation in culture must be developed. Wengrow highlights how slogans become a part of everyday lingo. For example, in other cities everyday vocabulary includes “Take the T” (Boston), “The Tube” (London), or “The L” (Chicago). On the surface this does not appear as a quality of life component, but when it is a part of everyday life, there is an inclusive aspect. Infiltrating populace slang means that it can penetrate to populace culture. As a public transit mode, a bus slogan has the potential to infiltrate the populace slang. This does require the creation of a “simple, short, and sweet” (Wengrow) slogan, but it poses a distinct and inclusive factor for the mode, and the city.

When asked to recall slogans, McCauley replied “Just Do It” (Nike’s legendary campaign) and Sule responded with the frying of an egg for a brain on drugs. “Just Do It” has a verbally indescribable ring to it, and the frying of an egg is a familiar sound that resonates with a sizzle. Repetition and familiarity are dominant factors in retention. Sule maintains that repetition in at least three forms, be it internet, radio, television, newspaper, flyer, or word of mouth, is crucial to mental sticking. The bus breadth grows as it takes on an identity through the repetitive process of instilling itself into daily cultural parlance.

Modes can even overlap in their ability to get to a destination, but distinction in cultural discussions creates motivation to use certain modes over others. In speaking of the hospital's "Lighten Up For Life" campaign, Barley viewed the daily repetition, a newspaper featured profile of a participant, and hospital advertising as keys to success to get the program into daily conversations. The features cascaded to everyday talk because everyone could relate even if not directly involved. The focus was on individual health, but indirectly on modal habitat because of the emphasis on physical benefits of walking (at least from a bus stop) or bicycling in commuting or utilitarian trips. So although modal accessibility had not changed, cultural conversation had shifted and actions followed suit.

To describe Asheville on Bikes, Sule used the phrase "social events on bicycles." "Social events" on bicycles assumes a plurality of benefits: financial savings, physical health, and the gratifying act of socializing. In its second year of existence the organization is still laying its roots, but Sule has noticed the power of infiltration into daily dialogue. Many organized rides in the first year to destinations around town, encouraging utilitarian cycling, had been attended by 10 to 20 people, but in the "Pumpkin Pedaler" this past October, Sule appeared on his bicycle to a crowd of 70 costume clad pedalers ready for a Halloween bicycle adventure. The bicycle had assumed a unique position for a holiday celebration. The benefits of bicycling were not toted as the reasons to participate, but rather the social aspect was highlighted. Thus, it is through distinct social events that Asheville on Bikes is developing bicycle distinction that can work to expand the bicycle breadth.

As social and cultural happenings put twists on utilizing different modes, then the image of mode users can change. According to Boyd, "citizens think of themselves as motorists" and thus their identity is intertwined with the vehicle. In Barley's observation riding a bus, moped, or bicycle sends the signal that one cannot afford a car. Turning 16 and obtaining a driver's license is "a rite of passage" in present society in Sule's terms. As a mother of 3 children, Russell notices that the childhood to adulthood question is, "what is the norm?" The "cool factor" is associated with the norm. If the adult image begins to shift due to the social distinctions discussed above, then the norm can move away from just the vehicle. Also, a shift in the adult image can cascade to the children's image to begin a generation where 'cool' is associated with any mode.

Furthermore, Russell believes a re-alignment of the image goes in conjunction with a re-adjustment of respect. She thinks that the "forcing to share space and interact with peers" fosters a culture of respect. Through communicating and acknowledging variations respect emerges. As respect makes it socially acceptable to use each mode, then the breadth of each mode expands.

Cultural distinctions increase modal breadth by encouraging those who know how to shift habits, but for further expansion, ways to teach the-know-how have to be developed. An example is the "Great Bus About" that Koslen created for UNCA freshmen. It is a scavenger hunt that involves students using the bus to get to various businesses around town. The purpose is to "get on the bus and to feel safe" while increasing the level of "transit smarts." This way the breadth expands further by bringing in new users.

Furthermore, with the modal image in place and knowledge of how to use modes, then the next step to breadth expansion is "aligning the desires and incentives" (Koslen). UNCA has a partnership with the Asheville Transit

Association (ATA) called the Bulldog Express, which provides students a pass to ride for free. In a similar model, ATA is partnering with businesses for employee pass programs. Aligning the desires and incentives has a strong economic aspect, but it also contains an aspect of encouragement through colleagues.

Built Environment Modification: The more a mode expands its breadth the more it will influence the built environment. After establishing a distinct image, then land-uses within the built environment will desire accessibility by each mode. As each mode grows, then accompanying land-use must be ready to adapt. Planners then can foster these adaptations by recognizing the value of incremental planning. Koslen notes that he has resigned himself to “incremental planning” because of budget limitations. He adds that it is frustrating to plan in advance for things unlikely to come to fruition. Long-term plans are ideal for setting goals to achieve a future vision, but since the transportation emphasis is on the vehicle and not other modes, then planners have to be prepared to adapt to make the most of any funding source at any time. The vehicle infrastructure of roads is intact and maintained, so a basis of habitat for buses and bicycles is there, and has potential to be developed at any time. For example, the notion of a bus shuttle floated around a few years ago, but it was not on the University’s priority funding list. However, a new building was constructed and parking had to be in a park and ride lot, and then suddenly the shuttle idea was a possibility. The bus shuttle was enabled by one event, but developing its route meant it could be used in a multi-functional manner, not just serving the one new building. Thus, Koslen was able to regenerate previous ideas with a twist to adapt to the new circumstances. Long-term ideas are necessary and should be discussed, but real shifts are arising in short-term dynamic planning.

In line with the step-by-step approach Ellis was intrigued by the role of “incremental financing,” the local government invests in infrastructure, and the private sector builds and maintains it with incremental tax breaks. But, this is also hinged upon timing because “at the end of the day, an investor wants predictability, a steady market, and clear goals” (Minicozzi). In the dynamic capitalist market, investors will quickly seize opportunities when they appear financially lucrative. Elected officials must ensure legislation that promotes incremental financing projects that create multi-modal habitat. Planners must keep pace that the incremental developments cohesively come together.

Modal habitat changes, thoughtfully planned or not, will happen and will alter city design. Multi-modal habitat must be fostered not only for the mobility benefits, but also for city identity. In seeing current uncoordinated development, Russell spoke of her desire for the city to “retain its character.” It might seem contradictory to support planning and financing changes for new bus and bicycle habitat in order to preserve character, but new modal habitat has the potential to retain the “cosmopolitan for a small place” feel (Boyd) more than perpetuating vehicle habitat. It is through maintenance of the small modal shifts, rather than large infrastructural accommodations for the vehicle, that the city will subtly shift its character, but still hold to its core identity.

4.34 Invasion Dynamics

“For that (people getting excited about bicycling) to happen, public transportation has to solve its big chicken-and-egg problem. Most people

don't want to use trains, buses, or bikes unless they're really convenient, but most cities aren't willing to spend enough to make these services convenient until enough people start using them."

-Kristina Dell, 'Bike-Sharing Gets Smart,' *Life Magazine*, June 2008, paraphrasing Denver mayor John Hickenlooper

Species migrate in tune with natural forces, while when and where modal niches invade is left to human decisions. Minicozzi offered abstract, yet poignant, advice for planning, "We learn with the community, respect opinions, and do not cave to uninformed opinions."

The When: To 'learn with the community' means challenging the current structure so that the community is pushed to a willingness to learn. Transportation is a "multi-scale thing" involving race, poverty, gender, and class tensions that can arise and when the issues are forced "the wall is hit" and that is the catalyst for the "paradigm shift" (Koslen). The synthesis of these two professional planners pinpoints the biggest hindrance – shying away from issues. The wall must be hit in order to learn together; otherwise, the patterns engrained through other experiences persist.

As a planner who works at a university, with an annual shift in the populace, Koslen realizes that when patterns are created is the most susceptible time for change, the time to ensure the distinct aspects of each mode are embedded in the structure. For Koslen the beginning of each University semester is critical. The first week is when faculty, staff, and students survey their environment and nestle into routines. Koslen addresses this with repetition everywhere of the transport options and programs to participate in. Sule takes a similar approach with Asheville on Bikes, utilizing the shifts in seasons and energy of the holidays for ride ideas, such as to the Saturday spring market, Pumpkin Pedaler, Christmas parade "Bee-lieve in Community" bicycles, and Beating the Bounds (an Irish tradition of visiting the countryside boundaries at the start of the growing season). Ultimately, both Koslen and Sule capitalize on the period when people are willing to try something new.

While the changing of seasons is a time for new habits for stationary residents, another period of change is when people re-locate and are looking to settle into a routine. In paying attention to the type of people attracted to Asheville, Bonner notes, "people come for recreation (including road and mountain bicycling), so couple it with access to work by creating convenience through infrastructure." He believes if people see the infrastructure in place they will try it in their initial trial and error period of their available options. This coincides with Kitti Reynolds, an environmental science professor at UNCA, who believes that there needs to be a more concerted effort to make newcomers aware of the active non-governmental organizations upon arrival. This way when people are looking for new social or volunteer groups they will at least have considered organizations that through social, political, or economic means support multi-modal habitat. Alas, both are focused upon the period of establishing habits in a new location, albeit differently, but both are pertinent outlets.

The when to invade maintains a consistent theme of beginnings. Then, in the process of learning together as a community, Minicozzi's second lesson is apt, "respect opinions." Russell advocates finding a "shared community base" because

she acknowledges that people disagree, at least on the surface, on many topics. However, digging beneath the surface is important to finding commonalities because “learning together” is halted if cooperation stagnates. Sule refers to utilizing the “social capital, the impact of being, and listening to people” as the times to gather ideas. Thus, he always incorporates socializing because it is when people become open and discuss. Discussion, for agreement or not, at least stirs ideas and broadens individual horizons.

Moreover, Minicozzi’s thought to “not cave to uninformed opinions” stems from the dilemma that informal socializing ideas can turn to formal nonsense. An educational foundation laid at a young age is important to prevent accumulation of nonsense through time. Boyd advocates for changes in the formal system, such as primary school exams and raising the fees for driver’s education to ensure children learn in their formative years. The Webbs recommended that “x hours of community service be required to graduate high school.” They have seen their grandchildren, in Maryland, begin as required volunteers and the task blossom into a long-term personal interest. Additionally, as active retirees, the Webbs acknowledge that there must be other outlets to education as well. Linking volunteer groups such as the Rotary Foundation, Kiwanis Club, and Lyons Club, among others to businesses, organizations, and employers where they can sponsor events such as transportation education days is also critical. As Ellis says, “It is not about being smarter, wiser, or well-traveled, it is about being more educated.” This observational advice complements Jones’ theoretical writing, “its niche is the sum of its experiences, rather than its immediate physical surroundings” (2005). A real experience might teach more than a set-up classroom experiment, but an initial lesson must be taught somewhere. The timing of education is just as important as the timing of developing infrastructure. For modal habitat invasions to succeed, the mentality must be altered when the energy is high and susceptible to retention.

The Where: While the occurrence of education is more important than the exact place it occurs, the specific where modal habitat shifts is critical to invasion dynamics. In contrasting modal habitats in Europe to the United States, Boyd comments on the difference in urban-rural transitions saying that in Europe the transitions are short and defined due to general city containment, but in the sprawl development of the United States, there is a lengthy transition zone that is most welcoming to vehicles. In his personal analysis, he targets a prime habitat—the corridors, which also happen to be a vulnerable area in nature. Main corridors become an area of commensalisms as bicycles and buses can use the existing developed habitat for vehicles, as they construct their own niche. The vehicle still retain habitat that is “not significantly harmed or helped,” while buses and bicycles benefit. Additionally, the corridors connect one fine scale to the next fine scale, which ultimately builds the broad network. Thus, the corridors emerge as a significant location that can encourage fine to broad scale multi-modal use.

In a realistic manner the Webbs commented that some of the main corridors and roads in Asheville are a topographical challenge for non-avid cyclists. Their recommendation is to align topographical and transportation maps. Older roads were built to follow the flow of the river. As technology progressed new road construction became possible in more topographically challenging areas. Now the old vehicle habitat becomes prime habitat for buses and bicycles to exploit.

Predation, exploitation, and commensalisms exist to give a species an advantage in certain situations, but mutualism remains the most harmonious. Instead of preying on the weaknesses of the other modes, they can capitalize on the other modes' strengths. Complementation of modal habitats fosters effective transportation development. Thus, where to invade ultimately depends upon where the mode's strengths fit into the topographical, cultural, and land-use picture.

Chapter V

5.1 Discussion

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

“The big problem that urban authorities will have to resolve, sooner than might be thought, is that of traffic management, and in particular the role of the private car in large urban centres ... The lack of an integrated policy approach to town planning and transport is allowing the private car an almost total monopoly.”

-White Paper: European Transport Policy for
2010: Time to Decide

Nature is profound for its simplistic complexity. On the surface view, the beauty of nature lies within the vibrant colors, topography, the rustle of creatures, water cascading, and the sun shining. Standing amidst the system, the viewer appreciates it, but does not comprehend the enormity of what is happening from the microscopic to the macroscopic, from the ground to the sun. Standing at a bus stop, the rider appreciates that the bus has a functional habitat, but the comprehension of the input to create the infrastructural network and the web of interactions to maintain the bus species is too vast to process. Transportation is appreciated for its simplicity to move from point A to point B. The attempted breaking down and connecting of the web of complexity described in the previous findings section is not necessarily profound in ideas, but aims to be inspirationally insightful for seeing opportunities rather than constraints.

The triangle of literature, planners, and citizens does not directly pose how to identify every prospect to develop modal habitats, but rather it indirectly gets to issue of synthesizing opportunities amidst the process of creating a physical, social, and economic network. The challenge of the process becomes to cooperate and combine ideas in the face of uncertainty. Inspired by a strand of dialogue with Mark Boyd the thought that resonates is how citizens approach reality—some people are optimistic, some are pessimistic, some stay, some retreat to isolation, some write literature, some fight violently, some argue peacefully, and some remain passive. The fact that there are unknown aspects and that citizens will react differently are constants. What is not constant is how the contextual approaches are melded together to forge into an uncertain future.

The literature outlined the ecological niche theory as a guide because nature is constant, a common foundation for all built environments. Adopting other cities' ideas can be wise, but copying other cities is duped certainty. The web, specifically the cultural strings, is too different for each context for direct copying. For this reason Groningen and Asheville were both analyzed in terms of the ecological niche theory, not in a comparison and contrast of each other. Groningen depicts a built environment with filled fundamental to realized bicycle and bus niches, but is

constantly in action to maintain these niches. Asheville is developing ways to bridge formal and informal means to fill the fundamental and realized bicycle and bus niches.

Nature has a formal structure of hierarchies related to composition and species size, but it also has informal relations of exploitation, predation, symbolism, and mutualism. Formal structures emerged as opportunities and hurdles for both cities. In Groningen modal habitat is part of a more formalized structure, funding is consistent, citizen participation is arranged with feedback periods, each government layer incorporates each mode into its plans, and coupling of interests is common. The informal lies within the system of the give and take of modes in daily interactions. The formal ensures action, but the daily informal activity is a stimulus for new ideas. Too much formal stifles future evolution, but too much informal makes it hard to accomplish anything.

Currently Asheville has more informal than formal structure in place for multi-modal habitats because the niches are not realized. But the abundance of informal relations, groups, and ideas circulating are what provide the volume of potential. Funding is questionable, government participation is inconsistent, organizational communication is weak, and coupling of interests is not common. Synthesizing a portion of the informal will foster quantity development of infrastructure and pooling resources together can ensure quality.

Another way to enhance quality is to focus on the utilization of energy through closed systems. Energy is neither created nor destroyed, but energy transferred to heat energy and released is lost potential. Groningen generated an extreme amount of frictional energy when it closed the city center to automobile traffic, but the friction was channeled to improve outside vehicle habitat and to listen to what businesses in the city center wanted (aside from vehicle traffic). No doubt in any magnitude event, it is a struggle to collect and not to waste energy, but the lesson is to be equipped to at least manage the abundance of energy. Asheville has not recently had a momentous transportation event that generated great friction. But as gasoline prices rise, rather than a significant overnight infrastructure alteration, the economic friction might be the catalyst for significant change. Or perhaps Asheville does not need one extreme event, but will channel daily friction of congestion, parking dilemmas, physical health, and pollution. In either scenario or the collision of scenarios, planners need to be equipped to utilize the energy to generate modal habitat, not to have the potential energy emitted to the atmosphere through squabbles.

As in the combining of hard and soft theories in transportation planning, planners can build multi-disciplinary matrices now, addressing the who, what, when where, why, and how. Planners can equip for the future with basic ideas, generate spectrums of specifics, but must utilize patience for the proper timing to fill in the details.

Thus, planning is and must be consistently inconsistent. Consistent planning must occur to manage transportation and land-use for growing populations, but if the plans are consistently implemented, then they fail to keep pace with reality. If consistent planning is implemented on an inconsistent basis, not when exactly prescribed, but when circumstances, funding, and citizen desires align, then it incorporates reality. Consistency is stability and inconsistency is uncertainty, thus a mixture of both offers the most potential for fulfilling the fundamental and realized bicycle and bus niches.

5.2 Conclusion

“The present was an egg laid by the past that had the future inside its shell”

-Zora Neale Hurston, *Moses: Man of the Mountain*

The chicken-and-egg dilemma continues in transportation planning. Debating whether the chicken appeared and laid the egg or the egg hatched and a chicken appeared is just discussing how the cycle began. It is irrelevant what is first and what is pertinent is that the cycle began. It is understood how the cycle of chickens and eggs perpetuates, but the beginning is and will remain a mind teaser.

In Groningen, and other cities across the world, multi-modal habitats and cycles perpetuate themselves. The modal habitats are there, the modes are utilized, and the modes are maintained to keep the system flowing. Tracing the evolution of where, why, and how the cycle began is possible to a degree, but it alone does not catalyze a cycle elsewhere.

In technical terms, Asheville has begun the multi-modal cycle, buses and bicycles exist on the roads, but in reality the links of the cycle of consistent funding, formal interactions, and steady government decisions are not there. It is easier to write in theoretical terms about a parallel between ecological niche theory and transportation niches and how the concepts of physical conditions, the interactions, the construction, and the invasion techniques can fill the void than to do it in reality. It is simpler to uncover quantitative statistics or design models to reel off the benefits of public transportation and bicycle niches than to delve into physical construction. It is easier to perpetuate the beating road cycle that builds more roads and brings more cars than to start new modal cycles. Thus, smog can increase, healthcare costs can rise, vehicle lanes can be added, parking lots paved, and mobility limited by individual identity being intertwined with 2000 pounds of steel, and all the while writing, theorizing, and planning can occur separately. Fortunately, the series of interviews in this research have inspired and depicted that the time is right in this evolving global context to start the multi-modal habitat cycle.

To evolve is natural. To gravitate toward familiarity is a natural instinct. However, a degree of familiarity is lost in each step of evolution. Communication of what, why, where, who, and how provides stepping-stones to accept evolution and to be willing to re-familiarize oneself within the changing context of reality. Transparency can re-establish a level of familiarity. Thus, it appears that modal changes are not as much about infrastructure as they are about mentality. Asheville needs concrete infrastructural habitat, which will evolve through maintenance and use, but the strongest factor for interactions and changes in the traditional transportation appears to be a cultural mentality of respect, openness, and adaptation.

5.3 Transferable Lessons

“At the heart of the debate is the question of what the international system is. Is it just a collection of legal nuts and bolts cobbled together by

governments to protect governments? Or is it a living framework of rules intended to make the world a more humane place?"

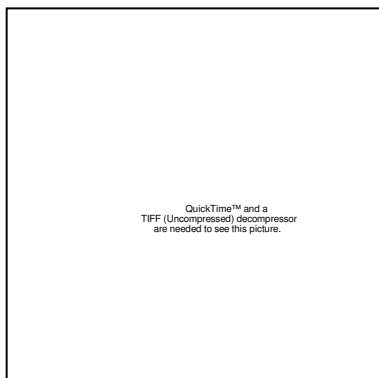
-Madeleine Albright

Nineteen percent of World Bank loans go to improving transport (Wittink 2000, p. 11). Wittink mentions this fact in the 'Economic Significance of Cycling' because of the connection between a functioning economy and a good transport system. Mobility and accessibility dictate personal and business interactions everywhere. Since mobility is a common global problem it is imperative that transportation ideas are shared and circulated.

The most applicable lesson to other cities is for nature to be the first guide, and ideas from other cities used secondarily. The ecological niche theory provided the framework to analyze transportation habitat—fundamental conditions, realized interactions, niche construction, and invasion dynamics. It is recommended that any city examining its transportation structure begin with these four categories in context. The role of planners and modelers becomes the task to inventory the fundamental physical conditions, draw interactive webs, hypothesize on physical and cultural strings to weave, and determine how resources could be obtained. With base contextual information, planners can look to other cities in light of the four categories, and begin the process of incorporating citizen ideas into each section. And similar to the data analysis method in this research the cycle of deductive and inductive reasoning begins. Deducing the similarities and differences in citizen ideas and city approaches, and inductively deriving how to weave these together. Incorporating the ideas back into the four sections then enables the planner to present the findings back to the citizens, keeping the process transparent. The data within the categories will shift, but completed in a transparent matter, the consistent framework provides comprehensible cohesiveness.

Additionally, opening channels for dialogue between citizens and cities is vital. Technology, specifically the internet, enables listserves and internet post boards to flourish. In the professional realm, internet access is common, but among citizens when it is not, a channel must be created to circulate ideas not only from within their context, but from other cities. Experience and 'learning together' must occur across the spectrum of people.

5.4 Further Research



“I thought of that while riding my bike”

-Albert Einstein, on the Theory of Relativity

This research concludes in a paradox itself. The purpose in this writing is a motivation to realized action, for the ideas floating to be connected and channeled into reality. But yet in this process of creating reality, the writer acknowledges that further research into citizen opinions, city communication, and modal habitat design is necessary. In a similar

manner to analyzing Groningen and Asheville, it would be relevant to use the ecological niche theory framework to examine other cities with filled fundamental and realized niches, and cities in the process of modal niche identification and construction. Case studies, in particular the citizen interviews, generate a wealth of ideas to be structured and shared for the improvement of transportation at a local to global scale.

Furthermore, as case studies are completed, a deeper analysis into the parallels of natural assembly and built environment assembly could reveal more about the simple to complex interactions that occur to generate the natural and built environments. Biological theories are constantly finding new interconnections between species and analyzing the interweaving of processes, which can be transferred to transportation.

Ultimately, research based upon a balance of dialogue and structure must continue, but meanwhile the multi-modal habitat cycle must get started. The cycle of multi-modal habitat is like riding a bike. Once a person can ride, one does not forget, but getting the revolutions of the wheels going can take many tumbles and the courage to get up and try again. However, once the wheels are turning, the revolutions are ticking. But a bicycle cannot stagnate and stay standing. So Einstein's statement, "I thought of that while riding my bike," is also an instructive lesson that development occurs in the movement of reality.

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Appendices

Appendix A: Soft System Analysis

A. Logical Analysis

1. Questions answered through the different sources
2. “Root definition” of transport planning system obtained
3. Develop conceptual framework for a transformation to occur
4. Distinguish between logical and actual:
 - Does the logical activity exist in the real situation?
 - How is the real activity done?
 - How is the real activity judged?
5. Iterations of the logical analysis until acceptance of a possible transformation is achieved

	<u>Data Collection</u>	<u>Interviews</u>	<u>Community Meetings</u>	<u>Policy Documents</u>
Who are the customers of the transport planning process?				
Who are the actors involved?				
What transformation takes place?				
What is the worldview/paradigm set of those involved in the process?				
Who are the owners of the situation? Who has the power to stop it?				
What is the political, economic, social environment?				

B. Cultural Analysis

1. Analysis of Intervention:
What are the conflicting values?
2. Analysis of the Social System:
What are the behavior norms?
What values are not discussed?
3. Analysis of the Political System:
What types of power exist?
How are they used?
How are they preserved?
How are they passed on?
How are they relinquished?

C. Combine Hard & Soft Systems

1. Hard System of Engineering reported
2. Soft System of Social Background reported
3. Combine possibilities of hard and soft systems
4. Method of consensus

Appendix B: Stated Preference Method

1. Utilize traditional four-step model for quantitative data
2. Expand four-step model to include social preferences
3. Design 'Stated Preference Surveys'
4. Surveys divided into themes within the 4 model categories
5. Contributions from different actors for what to incorporate in survey
6. Survey results combined with quantitative data

		<u>Users</u>	<u>Operators</u>	<u>Planners</u>	<u>Policymakers</u>
Trip Generation:					
	Trip Chaining				
	Telecommuting Possibilities				
Trip Distribution:					
	Origin-Destinations				
	Residential Location Choice				
	Business/Industry Location Choice				
	Behavior Responses to New Infrastructure				
Modal-Split:					
	Mode Selection Criteria				
	Policy Packages to switch modes				
Route Choice Stage:					
	Costs, speed, transit time reliability				
Additional Factors:					
	Trip Length				

	Safety				
	Influence of Statistics on Behavior				

Appendix C: Planning Support System

A. Scenarios: What may be?

	<u>Scenario 1</u>	<u>Scenario 2</u>	<u>Scenario 3</u>	<u>Scenario 4</u>
Plan A				
Plan B				
Plan C				

1. Planners develop alternative land-use plans
2. Qualitative scenarios are developed based on public and professional input
3. If available, then a land-use model that accepts context developed 'boundary conditions' and qualitative data can be used to generate a layered map depicting the scenario

B. Visioning: What should be?

1. Planners facilitate discussion among stakeholders
2. Planners ensure distinction between future and utopias

	<u>Planners</u>	<u>Citizens</u>	<u>Politicians</u>	<u>Organizations</u>
1. Review of scenario phase				
2. Where are we now?				
3. Where do we want to be?				
4. How do we get there?				

C. Storytelling: What could be?

"As Guhathakurta (2002) notes, people do not connect through common information, but through common interpretations" (Couclelis 2005, p. 1367)

1. Planners develop stories with public participation to combine 'science and rhetoric'
2. Type of story (narrative, comedy, tragedy, parable) based on message that want to explore
3. Planners synthesize stories to ensure each has the story components
4. Share stories with populace
5. Responsibility to citizens to respond about which story or which threads of the story they prefer

Story Components

	Logically Consistent	Empirically Testable	Morally Acceptable	Actionable	Aesthetic
Comedy					
Tragedy					
Parable					
Narrative					
Other					

Appendix D: Supplementary Transportation Information

1. Transport for London Bus System:

www.tfl.gov.uk/sitemap/

The sitemap displays the depth of the modal habitats in London. Of particular note is the “Buses,” “Cycling,” and “Oyster Online” sections.

2. European Union Mobility Management:

www.managenergy.net/indexes/l224.htm

A wealth of mobility case studies throughout Europe.

3. European Platform on Mobility Management:

www.epommweb.org/index.phtml?Main_ID=820

A conglomeration of governments in European Countries working to improve mobility by developing and sharing ideas.

4. Active Living by Design:

www.activelivingbydesign.org/

A program run by the University of North Carolina Chapel Hill that is generating ideas to increase physical activity by community design.

5. International Bicycle Fund:

<http://www.ibike.org/index.htm>

An international non-profit working to develop sustainable transport.

6. Bikes Belong:

<http://www.bikesbelong.org/>

An organization sponsored by the United States bicycle industry whose mission is to get more people on bicycles.

7. Sustrans:

<http://www.sustrans.org.uk/default.asp?sID=1091003006653>

A United Kingdom sustainable transport charity with the purpose of providing transportation that is good for people and the environment.

8. League of American Bicyclists:

<http://www.bikeleague.org/>

A league formed in 1880 with the mission of improving cycling conditions.

9. Pedestrian and Bicycle Information Center:

<http://www.bicyclinginfo.org/>

A site funded by the United States Department of Transportation Federal Highway Administration to provide safety, health, advocacy, education, and other information to citizens.

10. United States Bureau of Transportation Statistics:

<http://www.bts.gov/>

A sector of the United States Department of Transportation that provides research and statistics.

11. Interface for Cycling Expertise:

<http://www.i-ce.info/sitemap.html>

An international non-profit located in the Netherlands pursuing cycle policies in cities across the globe.

Of particular note: 'Cycling Friendly Cities' Video

12. Velo Mondial:

<http://www.velomondial.net/>

Appendix E: Interview Questions

I. Planners:

1. Background information:
 - Age:
 - What city did you grow up in?
 - What is your education level?
 - What is your current professional title?
 - How long have you been in this position?
 - What was your previous work?
2. What are your favorite cities? Why?
3. What are the current trends in transportation and land-use in your opinion? Which should continue? Which should be altered?
4. What are some small changes that have had significant effects on transportation or urban design? Do you know examples from other cities?
5. What is the role of short and long-term plans?
6. What models do you use?
 - If so, how do you select the inputs? How do you determine the values?
 - How are the outputs used?
 - How often do you change or update the models?
7. What is the role of GIS in your work?
8. How do you measure mobility?
9. How does the public participate in the plans?
 - Do you regularly communicate with the public? If so, how?
 - Has this changed during your career?
10. Have you adopted methods or techniques from other cities?
 - Have other cities come to learn about your methods?
11. How do you incorporate new theories into your work?
12. How much of your budget is spent on posters, maps, and publication design?
13. What is the budget breakdown by mode?
14. What is the division of roles between the national, province, and municipality?

Do you think more or less autonomy would be beneficial?

15. What are the most pertinent lessons, successes, or failures from the past?
16. How can buses and bicycles most effectively be used together?
17. What is the cultural mentality of the city?
18. What are your ideas to foster cultural shifts?
19. Dreams make reality, so what is your vision for the future development of the city?

II. Citizens

1. Background information:
 - Age:
 - What city did you grow up in?
 - What is your education level?
 - What is your current professional title?
 - How long have you been in this position?
 - What was your previous work?
2. What are your favorite cities? Why?
3. How would you describe the culture of Asheville?
4. If you want to voice an opinion on a community topic, then what method do/would you use?
 - Do you think citizen opinions are listened to?
5. Are you actively involved in volunteer groups? What is your motivation for being involved?
6. What are your main sources of information about events, politics, etc. in Asheville?
7. How do you view the distribution of power between local, regional, state, and national?
 - Do you think Asheville would benefit from more or less autonomy?
8. What would you like to see your tax dollars spent on?
9. What transportation maps, campaigns, posters have caught your attention?
10. What are the current trends in Asheville's land-use? Transportation?
11. What do you think are the opportunities and constraints of bus and bicycle networks in Asheville?

12. Dreams make reality, what is your future vision for the city?

13. What are your ideas to foster cultural shifts?

Appendix F: Interviewed Asheville Citizens

- a. Jay Bonner, Associate Head Master, Asheville School
- b. Michael Sule, Teacher, Evergreen Charter School; founder, Asheville on Bikes
- c. Carol Barley, Manager Psychology Department, Memorial Mission Hospital
- d. Jim Ellis, retired; former Business Manager of Black Mountain Center for Mentally Disabled
- e. Barbara Reynolds, Environmental Studies Professor, University of North Carolina – Asheville
- f. Cara McCauley, Financial Analysis, Biltmore Farms; professional bicycle racer
- g. Mark Boyd, Computer Science Professor, University of North Carolina - Asheville
- h. Jim Webb, retired, North Carolina Arboretum Board Member
- i. Arnold Wengrow, retired, freelance journalists
- j. Irene Rossell, Environmental Science Professor, University of North Carolina – Asheville
- k. Egbert Hofstra, Environmental and Infrastructure Planning Master's Program, University of Groningen, Netherlands

Appendix G: Interviewed Planners

- I. Groningen, Netherlands
 - a. Erwin Stoker, Transportation Planner, OV-Bureau Groningen-Drenthe Provinces
 - b. Eric van Huissteden, Senior Transportation Planner, City of Groningen
 - c. Cor van der Klaauw, Senior Transportation Planner, City of Assen (Province of Groningen); former Transport Planner, City of Groningen (1994-2007)
 - d. Wybe Naube, City Architect, City of Assen

- II. Asheville, North Carolina, USA
 - a. Yuri Koslen, Transportation Planner, University of North Carolina – Asheville
 - b. Joe Minicozzi, Project Manager, Public Interest Projects

Appendix H: Sample of United States Multi-Modal Programs

1. New Belgium Beer, Fort Collins, Colorado:

The brewery gives a bicycle to everyone who has worked there for at least one year. Additionally, the company hosts the Tour de Fat to celebrate the bicycle as an effective mode of transportation (Mintzer 2008).

2. Pangea Organics, Boulder, Colorado:

The company turned 500 sq. ft. into lockers and showers after employees said that would encourage them to bicycle to work.

3. RideSpring, Santa Cruz, California:

The company sets up secure website note boards for companies so that employees can find ride information for carpooling.

4. Workplace Transportation Audits:

Companies can analyze their transportation demands and ways to reduce it.

5. Zipcar

www.zipcar.com

A car share company that provides citizens with ability to be a member and have access to car parked in a central business location.

6. Bike to Work Days/Weeks:

Businesses can be grouped into size categories and compete for the highest bicycle percentage of workers.

Appendix I: City of Asheville Information

1. <http://www.ashevillenc.gov/#>

On the left-hand side under the 'Projects and Initiatives' is information on the current city plans.

Of particular note: the 'Comprehensive Bicycle Plan' & the 'Downtown Master Plan.'

2. Transportation Engineering Department:

http://www.ashevillenc.gov/departments/trans_engineering/default.aspx?id=542

Of particular note: 'Transit System' and 'Transportation Planning'