



University Transportation Research Center - Region 2

Final Report



Building a Sense of Place in an Information Era: Accessibility, Connectivity and Travel

Performing Organization: Rochester Institute of Technology



May 2016



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The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation's economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is "Planning and Managing Regional Transportation Systems in a Changing World." Presently, under the direction of Dr. Camille Kamga, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC's three main goals are:

Research

The research program objectives are (1) to develop a theme based transportation research program that is responsive to the needs of regional transportation organizations and stakeholders, and (2) to conduct that program in cooperation with the partners. The program includes both studies that are identified with research partners of projects targeted to the theme, and targeted, short-term projects. The program develops competitive proposals, which are evaluated to insure the most responsive UTRC team conducts the work. The research program is responsive to the UTRC theme: "Planning and Managing Regional Transportation Systems in a Changing World." The complex transportation system of transit and infrastructure, and the rapidly changing environment impacts the nation's largest city and metropolitan area. The New York/New Jersey Metropolitan has over 19 million people, 600,000 businesses and 9 million workers. The Region's intermodal and multimodal systems must serve all customers and stakeholders within the region and globally. Under the current grant, the new research projects and the ongoing research projects concentrate the program efforts on the categories of Transportation Systems Performance and Information Infrastructure to provide needed services to the New Jersey Department of Transportation, New York City Department of Transportation, New York Metropolitan Transportation Council, New York State Department of Transportation, and the New York State Energy and Research Development Authority and others, all while enhancing the center's theme.

Education and Workforce Development

The modern professional must combine the technical skills of engineering and planning with knowledge of economics, environmental science, management, finance, and law as well as negotiation skills, psychology and sociology. And, she/he must be computer literate, wired to the web, and knowledgeable about advances in information technology. UTRC's education and training efforts provide a multidisciplinary program of course work and experiential learning to train students and provide advanced training or retraining of practitioners to plan and manage regional transportation systems. UTRC must meet the need to educate the undergraduate and graduate student with a foundation of transportation fundamentals that allows for solving complex problems in a world much more dynamic than even a decade ago. Simultaneously, the demand for continuing education is growing – either because of professional license requirements or because the workplace demands it – and provides the opportunity to combine State of Practice education with tailored ways of delivering content.

Technology Transfer

UTRC's Technology Transfer Program goes beyond what might be considered "traditional" technology transfer activities. Its main objectives are (1) to increase the awareness and level of information concerning transportation issues facing Region 2; (2) to improve the knowledge base and approach to problem solving of the region's transportation workforce, from those operating the systems to those at the most senior level of managing the system; and by doing so, to improve the overall professional capability of the transportation workforce; (3) to stimulate discussion and debate concerning the integration of new technologies into our culture, our work and our transportation systems; (4) to provide the more traditional but extremely important job of disseminating research and project reports, studies, analysis and use of tools to the education, research and practicing community both nationally and internationally; and (5) to provide unbiased information and testimony to decision-makers concerning regional transportation issues consistent with the UTRC theme.

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Abstract

This research work examines the relationships among: (i) Sense of Place (SOP); (ii) non-motorized sustainable travel choices and accessibility; and (iii) adoption and use of information and communication technologies (ICT). A guiding principle in designing the built environment for sustainability and livability is the latent construct of Sense of Place (SOP) which leads visitors to perceive and associate a strong identity or character with a particular location. For SOP, the literature agrees on the following characteristics associated with the place: (i) physical characteristics; (ii) user perceived affects and meanings; (iii) human activities taking place; and (iv) social interactions. Integral to these defining dimensions is the perception of accessibility of the space, which is likely impacted by widespread adoption of mobile ICT, such as smartphones and tablets. In an information era, the ability of ICT to provide ubiquitous information and communication across multiple timeframes and geographies has expanded interaction with the location to include both physical and virtual interactions. Additionally, visitors can engage with the location pre and post-trip through information acquisition. Further contributing to developing a sense of place are the modes of access; non-motorized travel modes that allow more direct exposure to the location may have a more positive influence on sense of place, relative to private modes, such as personal autos. With respect to this context, the research work addresses the following research questions:

- 1) Does access to and use of ICT facilitate Sense of Place, and if so, through which mechanisms do they operate and function?
- 2) Do non-motorized or public travel modes, such as bikes or walking, and perceived accessibility of a setting impact Sense of Place?

To address these research questions a combination of survey instruments and econometric models are developed and estimated. The final findings indicate that while Sense of Place is statistically linked to non-motorized travel and visits, and in general, travel that allows visitors to experience their surroundings, the effects of ICT are less pronounced. Furthermore, sites that have less conformity in design lead to more uniform attitudinal responses, with respect to SOP. In contrast, designs that are more organic, lead to a wider range of SOP attitudinal response, which span both positive and negative perceptions.

Keywords: Sense of Place, Non-motorized Travel, Built Environment and Online Data Mining, Latent Variables, Attitudinal Studies.

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Chapter 1: Introduction and Motivation

In this work we examine the relationships among: (i) *Sense of Place* (SOP); (ii) non-motorized sustainable travel choices and accessibility; and (iii) the use of information and communication technologies (ICT) for gaining location information. A guiding principle in designing the built environment for sustainability and livability is a *Sense of Place* which characterizes visitors' perception and association through strong identity or character with a particular location. For SOP, the literature agrees on the importance of following dimensions associated with the place: (i) physical characteristics; (ii) user perceived affects and meanings; (iii) human activities taking place; and (iv) social interactions. Integral to these defining dimensions is the perception of accessibility to the space or setting, which is likely impacted by widespread adoption of static and mobile ICT, such as smartphones and tablets. In an information era, the ability of mobile ICT to provide ubiquitous information and communication across multiple timeframes and geographies has expanded interaction with the location to include both physical and virtual interactions. Additionally, visitors can engage virtually with the location pre and post-trip through information acquisition. Further potentially contributing to developing a *Sense of Place* are the travel access modes; non-motorized travel modes that allow more direct exposure to the location may have a positive influence on sense of place, relative to private modes, such as personal autos. With respect to this context, the proposed work addresses the following research questions:

- 1) Does visitor access of information about a location through ICT facilitate *Sense of Place*, and if so, through which mechanisms do they operate and function?
- 2) Do non-motorized or public travel modes, such as bikes or walking, and perceived accessibility of a setting impact perceived *Sense of Place*?

To address these research questions, the following main outputs are provided by this research work:

- a) A survey instrument to evaluate and measure users' *Sense of Place* perception with respect to several dimensions, including travel behaviors, ICT adoption and use, attitudinal indicators and physical characteristics of the built environment;
- b) An econometric model relating observed travel mode choices with attitudinal responses and indicators, through a collection of latent constructs that characterize *Sense of Place*.
- c) An architecture studio exercise and potential studio course module for architecture students that engages students on designing for a *Sense of Place* and its evaluation through user or visitor evaluation and feedback.
- d) Additionally, online reviews of locations within a specific neighborhoods were data mined using topic analysis to identify the potential of leveraging these for assessing SOP. For

example, if we are interested in the SOP of the East End neighborhood, we may infer perceptions of SOP from datamining reviews left by visitors for a restaurant on Trip Advisor and Yelp, which comment on other aspects of the experience at the location.

This completed work extends the existing body of work on Sense of Place (SOP) by: (1) broadening previous dimensions considered to include travel mode access and ICT adoption; (2) developing a framework for measuring Sense of Place and quantifying its relationship to other dimensions; and (3) identifying the most salient factors as perceived by users or visitors.

1.1 Salient Findings

With respect to the research questions put forth, we determined several findings related to SOP and travel to a particular site. Three different sites, which are all neighborhoods in Rochester, NY, were considered in this study: (i) Rochester Public Market; (ii) East End; and (iii) The concept of SOP was examined through three different lenses: (i) ICT and online information; (ii) built environment and design; and (iii) attitudinal and behavioral characteristics of travelers. The salient findings with respect to these three perspectives are described next.

ICT and Online Information: To characterize the association between online information about a place and Sense of Place, we data-mined reviews for locations within each of the three neighborhoods considered in this study. For example, the East End neighborhood is comprised of Eastman Music School and theater, and a mix use of food establishments, residential and commercial buildings. Visitors to several of these locations leave reviews on their experiences websites such as Yelp, commenting on the parking and access, in addition to overall experience at the location. The premise of this section of the study is that reviews, while specific to an establishment within the neighborhood, can also provide insight into access and SOP within the neighborhood. We data-mined two popular sites with respect to the three neighborhoods of interest: (a) Yelp and (b) TripAdvisor. The following findings were obtained:

This study examined Sense of Place (SOP) through the lens of text-mining. Specifically, topic modeling approaches, TF-IDF and LDA, are applied to online text reviews to identify the main topics of concern to visitors. These identified topics are compared with the key dimensions of SOP found through the literature and implemented in intercept surveys used to infer the degree of SOP associated with a location.

- A) As a standalone analysis, text-mining, including topic modeling, requires additional domain expertise to interpret the outcomes appropriately. For a sentiment analysis, interpreting favorable versus unfavorable reviews is relatively easy. In the context of interpreting the SOP dimensions additional domain expertise is necessary to properly associate the output from text mining which require contextual knowledge.

- B) Seasonality and timing of activities across a wide range of timeframes are particularly important to visitors, having filtered up in both the TF-IDF and LDA. Additionally, attributes found in the literature such as “food” or “amenities” as a means of characterizing the attractiveness of a place inadequately captures SOP dimensions, previously assumed in intercept surveys.

Built Environment and Design: The earliest studies on Sense of Place (SOP) were rooted in both the social science perspective of connectedness and identity with the environment, and the perception of built environment design. To assess this, a design characterization of these three neighborhood was conducted by architecture students as part of an architecture studio. The schematic drawings and studio outputs from these are provided in Appendix B of this report. Additionally, a panel comprised of architects and other design community members reviewed these outputs and subjectively scored them based on dimensions of SOP used within the design realm, such as “imaginability” and “visual enclosure.” The following findings were obtained:

- A) *Typology:* All three sites have similar relatively flat topographic conditions without significant natural features, such as water feature or forest. Compared to Rochester Public Market (RPM) and College Town (CT), the design in East End (EE) shows greater diversity in sidewalk design, building typologies, building height, building mass, and open spaces. EE also has more large trees along the sidewalks. CT contains a variety of open spaces, but the typology and overall building height and building mass remain homogenous and lack of diversity. RPM contains only one type of open space, but the building typology differs widely since most buildings are existing buildings and been converted to commercial use from their original industry or residential functions, including architectural character.
- B) *Architectural Context and Character:* RPM was built in 1905 and the present day RPM retains most of its existing buildings from its industrial past, reusing them for modern functions. The arch structure at one of its entrances has a distinguishing character and uses local materials; the arch was built particularly for open space markets. The ground pavement also uses local materials. The majority buildings in the EE were built between 1920 and 1980; new buildings built after 2000 account for 2% (City of Rochester Property Information). The EE has three historical landmark buildings that are nationally registered: (i) Little Theater; (ii) Sibley Triangle Building and (iii) the National Company Building. These buildings carry unique architectural details representing the regional and local identity of Rochester. For CT, all the buildings were built between 2012 and 2014 by a single developer (City of Rochester Property Information).The uniform architectural character of CT provides consistency in appearance; the lack of diversity may elicit a more homogenous reaction from visitors. The buildings in CT do not represent any unique local architectural style or character. The use of conventional façade materials and construction types instead of local materials isolates CT from the neighboring University of Rochester main campus from a design perspective.

- C) *Streetscape*: The streetscape of a space related directly to the human scale. Of the three sites, EE is more pedestrian orientated compare to CT and RPM. EE provides a larger outdoor seating area and weather protection (i.e. awnings). Lighting from street lamps provide safety for pedestrian and may encourage public interaction and activities, which contribute towards interaction with a place. East End also has a higher density of bus stops and connected streets compare to CT and RPM. RPM's fenced wall and gateway provide safety for all activities within the Public Market boundary, but isolates public market from the adjacent neighborhood areas. While CT and RPM provide bike racks for parking, both are inaccessible for bicyclists. There are no designated, marked and protected bike lane/trails leading to those two sites. Finally, the tree density along the sidewalks is higher for EE relative to the other two sites.

Attitudinal and Behavior Characteristics: The final perspective used to characterize SOP in this study was drawn largely from the social science and transportation planning/geography fields. A visitor survey was developed to elicit responses to attitudinal statements used in past studies on SOP, in addition to other travel and household characteristics of the visitor. The survey was conducted on site with actual visitors to each of the three neighborhoods used in this study. The actual survey used is provided in Appendix A of this report. Furthermore, an integrated latent variable and discrete choice model was estimated using survey responses. The following findings were obtained:

- A) *Latent Variable SOP*: With respect to the latent variable SOP, many observed responses were found to be positively and statistically explained through SOP. The latent variable estimation for both visit and bike frequency models were similar. For both models, the latent variable SOP was found to explain responses to statements on identity, dependence and attachment. SOP also explained Social and Satisfaction dimensions. However, fewer of the attitudinal statements from the two dimensions were statistically significant. Aesthetics had no statements which were explained by SOP in a statistically significant manner, suggesting a low association between SOP and Aesthetics. This is consistent with past social science literature on SOP which has characterized it as mainly as a connection with the environment. The dimensions of social, satisfaction and aesthetics were additional dimensions found later by other researchers. Respondents from RPM were found to perceive a higher SOP in general, relative to other sites.
- B) *Walk/Bike Frequency*: With respect to the choice model for bike/walk frequency, the estimation results indicate that the latent variable Sense of Place (SOP) has a positive impact that is statistically significant, such that locations with a higher SOP see higher stated walk/bike frequencies. Additionally, respondents that have lived in Rochester a longer number of years showed a higher stated walk/bike frequency relative to those less

than one year of residency. Additionally, with respect to specific locations, respondents from RPM state lower frequencies. This low frequency may be explained by either the poor bike/walk access, which is affected by several factors, such as (i) safety of the neighborhood; (ii) infrastructure such as dedicated bike lanes; and (iii) operationally, the market is open Tuesdays, Thursdays and Saturdays, while the restaurants are open daily.

- C) *Visit Frequency*: The choice model for visit frequency is similar to that for walk/bike frequency and indicates that the latent variable Sense of Place (SOP) has a positive impact that is statistically significant, such that locations with a higher SOP see higher stated visit frequencies. Additionally, respondents with longer residence in the Rochester area showed a higher stated visit frequency relative to those less than one year of residency, possibly also due to the higher perceived SOP. With respect to specific locations, respondents from RPM state lower visit frequencies, relative to College Town, while the East End respondents stated higher visit frequencies. However, the lower frequencies for RPM may be attributable to the limited hours the market is open. While the shops around the market are open most days of the week, the actual market is only open Tuesdays, Thursdays and Saturdays weekly.

1.2 Report Structure

This research report documents the output and products of this research project. The remainder of this report is structured as follows:

- ii. Chapter 2 presents a literature review of Sense of Place (SOP) from all three perspectives considered in this study, including the built environment design perspective. This literature review examines both conceptual descriptions of Sense of Place (SOP) and the methodological issues associated with its characterization.
- iii. Chapter 3 describes the survey sample characteristics, including its collection and logistics. The motivation behind types of questions asked is also discussed.
- iv. Chapter 4 presents a factor analysis of survey responses to obtain latent factors that characterize SOP. Latent variables discovered through a factor analysis are used to guide model development in the following chapter.
- v. Chapter 5 presents the survey results and modeling of visitor responses. The framework for the integrated latent variable discrete choice model is described and the estimation results presented.

- vi. Chapter 6 presents results from the data-mining of online reviews for the ICT and online information portion of this study. Online reviews from Yelp and TripAdvisor were scrubbed from the internet and a text and topic analysis was used to identify how well online reviews overall address SOP dimensions.
- vii. Chapter 7 discusses the design evaluation completed in the field of these three neighborhoods. This chapter documents the work from a module for an architecture studio.
- viii. Chapter 8 concludes this report with a synthesis of findings from previous chapters and directions for future research.

Chapter 2: Background and Literature Review

This chapter presents background and literature review relevant to the study. While reviews of literature are typically organic and occur continuously throughout the research period, this specific chapter brings together different perspectives on SOP and serves as a starting point. We consider this chapter as the start of a continuous dialogue on the literature which occurs throughout this report. This review covers three broad topics related to Sense of Place (SOP), Travel and Information and Communication Technologies (ICT). The first topic covers the concept of SOP in other fields, such as geography and urban planning. The second topic covers literature related to the modeling and estimation of SOP in past research. Due to its latency, past research uses a range of tools to measure and characterize this latent construct.

Sense of Place (SOP) continues to play an important role in urban redevelopment and community focused built environment design. From the perspective of engineers and designers identifying the main factors driving sense of place is essential for designing built environments and transportation infrastructures that promotes sustainability and livability. The majority of the literature consists of a collection of insights based on introspective, observational and theoretical writings not specific to a single location, and reveals no single accepted definition (Ryden 1993; Seamon 1990; Biedler 2007). However, while theories and definitions are diverse, the literature shows consensus on three attributes: (i) the physical setting; (ii) activity within the setting and (iii) meaning associated with the setting, all of which are intertwined. Social interactions taking can be considered a sub-category of (ii) human activity (Stedman 2003). The literature offers no consensus on the mechanisms or process through which they operate on SOP.

2.1 Sense of Place: Definitions and Concepts

Increasingly urban planners are focusing on building livable communities that benefit community well-being along several dimensions. Livable communities critically require Sense of Place (SOP), which characterizes how humans interact with their natural and built environments, and each other, collectively. Locations with a strong SOP can facilitate lasting connections between visitors and the location. Additionally, SOP has gradually entered several organizational decision-making levels, from local municipalities and neighborhoods (Soni et al. 2012, Tester et al. 2011) to international discussions on ecology, the environment and sustainability (Newman and Jennings 2012). SOP has also gained momentum in other research fields, ranging from anthropology to environmental psychology. Applications include the planning and design of urban spaces (Billig 2005, Deutsch et al. 2013) and natural resource management (Brown and Raymond 2007). Furthermore, the United Nations Environmental Program (UNEP) has identified SOP as an essential feature of sustainable environments, including aspects of the surrounding ecosystem (Newman and Jennings 2012).

SOP has both human and physical dimensions (Stedman 2003). The human dimensions have been researched extensively and often considered core to SOP (Deutsch et al. 2013, Stedman 2003, Tapsuwan et al 2011). These human dimensions find their basis in attitude theory which defines three distinct factors: affective, cognitive and conative. Subsequently, researchers have characterized SOP along these three dimensions (Jorgensen and Stedman 2001). Place Attachment, the affective component, is defined as the positive bond developed between a person and their environment (Low and Altman 1992). Place dependence measures the perceived strength of association between a person and a place (Stokols and Shumaker 1982). Place identity, represents the individual's identity in relation to the physical environment (Proshansky 1983, Proshansky 1978). Other studies have identified additional influential aspects, such as place satisfaction, social and architectural/aesthetic settings. Place satisfaction is the summary judgment of the perceived quality of a place/environment (Mesch and Manor 1982). The social and aesthetics settings are more loosely defined. Aesthetics includes views on architecture, the beauty of the place, the balance of decorative and functional attributes, artistic value, peaceful and relaxing atmosphere. Social includes the topics such as social atmosphere, the level of crowdedness, amount of activity, safety, the level of friendliness to people (generally), kids and family and safety of walking around (Deutsch et al. 2013, Deutsch and Goulias 2010, Deutsch and Goulias 2011).

First, while each dimension is important from the visitor perspective, the design practice and literature provides little guidance on which dimension should be emphasized for developing sense of place, with some work advocating the physical environment over activities or associated meaning (Jackson 1994). The literature also disagrees on the role of time on the role of time in creating sense of place (Tuan 1981). While some long-term association with a place or setting is necessary, some researchers argue that time erodes the acute awareness experienced, leading to increasing insensitivity towards the setting.

Second, with respect to the link between travel and SOP, much of the literature has investigated complete streets design that focuses on accommodating multi-modal and non-motorized travel (Burden and Litman 2011; Rue et al. 2011). Missing from this body of work are system or network level dimensions, such as connectivity or accessibility of the location which may also play important roles, especially for visitors not residing in or near the setting. The relationship with information and communication technology (ICT) adoption and use is virtually non-existent in the literature.

Finally, with respect to evaluation methods, the predominant approach has been qualitative methods which investigate the meaning of experiences from the study participants (Hammersley 1992; Taylor and Bogdan 1998). Studies on complete streets design have taken similar approaches. The use of data driven analysis, especially from the user or visitor perspective, has been limited in studying sense of place (Pretty et al. 2003). One notable study is Stedman (2003) who develops a 'direct-effects' model under which affective dimensions of sense of place could be understood as a function of the setting, but rejects this model based on poor fit with collected data. Data on respondent attitudinal and preference responses have long been used in travel behavior studies to

investigate perceptions of latent constructs, such as comfort or reliability of travel modes, through quantitative modeling. The guiding vision of this work is that similar methods can also inform models of Sense of Place.

The next section reviews the literature on methodological approaches to assessing SOP. Methods ranging from econometric approaches to text-mining approaches are reviewed.

2.2 Methodology Approaches for Assessing Sense of Place (SOP)

From an implementation and practitioner standpoint, urban design and natural resource management contexts have shown the strongest interest in SOP. Within urban design, SOP is considered a guiding principle for designing public spaces and built environments, to shape social contexts and foster social connections. From the perspective of the natural environment, SOP can also provide a framework for encouraging or strengthening commitment and environmental stewardship towards a given place, such as national parks, which is necessary for growth and maintenance (Williams and Stewart 1998).

Given that SOP explores the perceptual and psychological relationships between people and places, researchers are beginning to explore the applicability of SOP in travel behavior. First, SOP advances behavior models by adding a psychological element to choice process which is usually modeled based on economic realism. Researchers have explored the influence of some or all aspects of SOP as an explanatory variable for travel choice modeling. Zandvliet et al. (2006) studied place identity and its relation to destination choices in Netherlands. A series of research papers from University of California, Santa Barbara explore many travel behavior facets of visitors (arrival time, mode, frequency, sequence of activities, companionship, and long distance travel) and SOP of two malls in Santa Barbara (Deutsch et al. 2013, Deutsch and Goulias 2010, Deutsch and Goulias 2011).

Quantitative approaches towards Sense of Place (SOP) measurement are typically multidimensional and examine the strength that each SOP dimension associates with a particular location. Intercept surveys containing Likert scale attitudinal statements are typically used to measure these dimensions (Stedman 2003). Responses can estimate and measure the strength of each statement response towards each dimension. Factor analysis and structural equation modeling are common methodological approaches for relating SOP with other observed exogenous variables, such as trip frequency (Deutsch et al. 2013, Tapsuwan et al. 2011, Jorgensen and Stedman 2001, Lee et al. 2015). Researchers have also used qualitative methods to evaluate SOP, such as visitor interviews and engaging community members with face-to-face conversation and photos of the location (Kyle and Chick 2007, Stedman et al. 2004). Despite its applicability in many areas, few guidelines or codes exist for designing SOP and evaluating its strength or presence. Approaches that provide more systematic evaluations about a location that also relate to

the attitudes and behavior of people visiting a place may be helpful for both practitioners and researchers.

2.2.1 Econometric Approaches

One methodology considered in this study consists of two main components: (i) a survey tool for collecting behavioral response and attitudinal information related to sense of place and (ii) an integrated model relating latent constructs that collectively indicate sense of place with observed travel mode choices. Attributes pertaining to the decision-maker, the location or setting, trip-making, the travel modes available and ICT adoption will also be included in the estimation and final model to the extent possible. In this study, Sense of Place is considered one of these latent constructs. The integrated model is a joining of factor analysis which models latent constructs from observed response data (Walker 2001) and discrete choice modeling under a random utility maximization (RUM) estimation framework (Ben-Akiva and Lerman 1984).

These latent constructs are estimated from attitudinal and perceptive responses obtained through the survey tool. Example of potential latent constructs for sense of place include: (a) rootedness; (b) community; or (c) place attachment. In the integrated model these latent constructs are linked to the utility of travel mode choice alternatives. This modeling approach integrates latent constructs with choice models in an attempt to explicitly analyze psychological factors and their effects on behavior which cannot be determined through revealed preferences alone. The entire model system is shown below in Figure 2.1. Utility, latent variables and indicators all have measurement and other errors indicated as ε , η and v respectively. Model estimation is accomplished through simulated maximum likelihood estimation (Walker and Ben-Akiva 2002). The estimated model parameters of the model provide the best fit for both the choice utilities and latent variable indicators that collectively describe sense of place and travel mode choices.

In the transportation literature, similar approaches have been used to investigate constructs of (a) perceived benefit from telecommuting (Bernardino 1996), (b) satisfaction with traffic information systems (Polydoropoulou 1997) and (c) comfort on transit modes, typically linking latent constructs with observed choice behaviors (Morikawa et al. 2002).

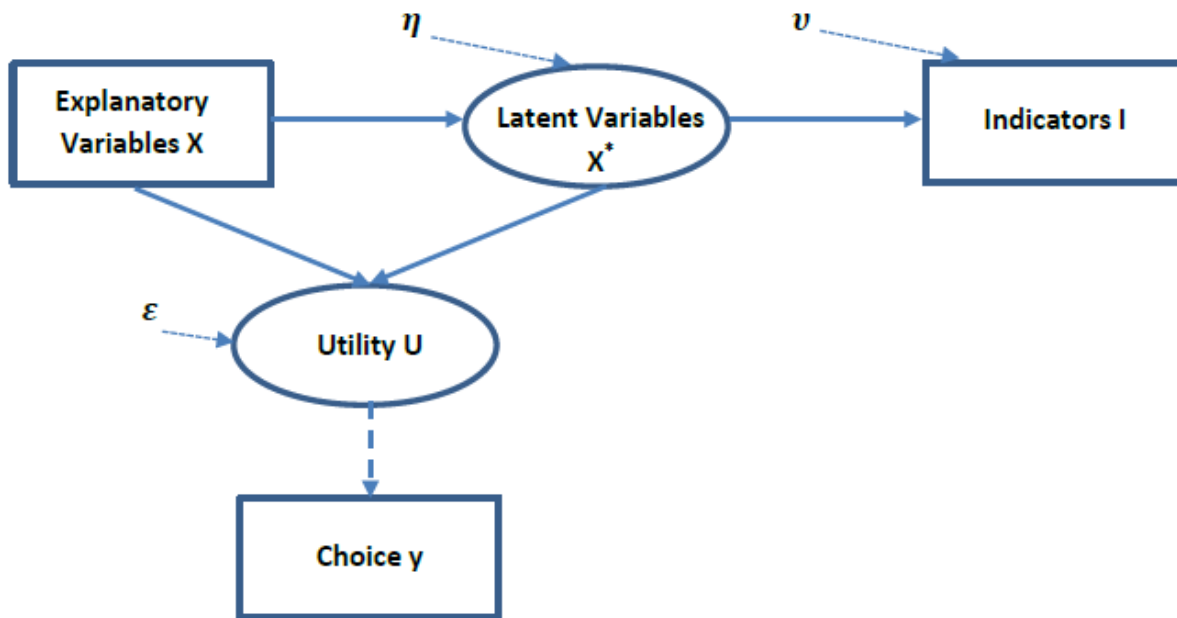


Figure 2.1: Framework of Integrated Latent Factor and Discrete Choice Models

Other behavioral and social science fields have investigated similar latent constructs in consumer/marketing, sociological and psychological studies (Jarvis et al. 2003). In the proposed work, the latent constructs are measured through (i) rating responses towards important sense of place dimensions indicated by the literature and (ii) observed attributes of the respondent, which includes ICT adoption and use, setting or site attributes, which include indicators of network accessibility and connectivity, and travel mode choice alternatives. The discrete choice model portion of the integrated model is estimated given observed attributes of the respondent, setting/site and latent constructs. The main components of the modelling framework in Figure 2.1 are as follows:

Explanatory Variables (X): These include observed attributes of the decision-maker, travel choice alternatives, the setting/site and ICT adoption decisions. These are all observed or collected through the survey developed and distributed, or through the site visits.

Latent Variables (X) or Constructs (including Utility U)*: These collectively describe sense of place, typically perceptions, attitudes or preferences. Perceptions indicate how respondents view the setting/site. Example of potential latent constructs for sense of place include: (a) environmental friendliness or (b) community. Attitudes are latent constructs that reflect individuals' needs, values tastes and capabilities, such as the importance of community. For example, attitudes of about toothpaste include importance of health benefits, cosmetic benefits and price. Individual's preferences are also assumed to be latent variables that represent the desirability or utility of alternative choices.

Attitudinal and Perceptual Indicators (I): These consist of ratings towards statements regarding the dimensions of sense of place that are latent and psychological. The literature review in Task 1 will help inform and refine the final set of indicators and statements. The marketing field has long developed scales that evaluate latent consumer perceptions (Bearden and Netemeyer 1999). This proposed work adopts a similar approach, aiming to develop scales and indicators for sense of place. For example, respondent were asked to rate from 1 (very poor) to 5 (very good) the following *three indicators for transit ride comfort and convenience* (Walker et al. 2002):

- i) Relaxation During the Trip
- ii) Safety During the Trip
- iii) Ease of Traveling with Children and/or Heavy Baggage

Observed Travel Choices (Y): Observed travel choice of the respondents surveyed. These include both revealed modes from the observed trip/visit to the site and mode choices from scenarios in the online survey, and other stated choices.

A more detailed presentation of the methodological approach taken in this study will be presented in later chapter.

2.2.2 Machine Learning and Datamining Approaches

The recent explosion in mobile information and communication technologies (ICT) allows place/site visitors to share experiences and online text feedback or reviews over a more granular temporal and geographic scale that can inform SOP (Humphreys and Liao 2013, Dias et al. 2013, Schwartz 2015). An opportunity exists to examine SOP through the lens of data mining, i.e., extracting information and data online and forming digital narratives of place. In particular, text-mining, which falls under the umbrella of data mining, is promising from the standpoint of systematically analyzing text based on the usage and association or “clustering” of words, and subsequent interpretation.

Text mining uncovers strong trends and/or topics within textual data, such as online consumer text reviews. With respect to assessing a location’s SOP, their application towards collected online reviews is virtually non-existent in the research and practitioner literature. Several applications of qualitative approaches exist, such as face-to-face interviews, followed by case specific interpretation by analysts. Dias et al. (2013) analyzed online reviews of vacation rentals in Portugal through a qualitative approach and identified broad themes that described the surrounding landscape and leisure activities affiliated with a place and recommendations for rental owners and future visitors (Dias et al. 2013). In another study, Oz and Temizel (2012) qualitatively analyzed FourSquare reviews from Turkey to identify parts of speech indicating place attachment. A qualitative approach is infeasible in the age of mobile ICT where millions of visitors share massive quantities of text reviews on place experiences. Text-mining serves as a feasible approach for

analyzing this large volume of online text data, potentially revealing topics of concern related to SOP. Intercept surveys conventionally used for SOP studies, require resources of money and time to survey visitors at sites of interest. Text-mining can passively collect and analyze reviews across many geographic levels. Additionally, text-mining may reveal issues or topics related to the attractiveness of locations that are missed in these intercept surveys that are location specific. For example, a text-mining of reviews for a neighborhood may reveal a strong attractiveness with respect to the local food served at food establishments, but a conventional SOP intercept survey that broadly addresses SOP may miss this issue.

Within the field of computer science, approaches that uncover topics within a text are termed topic models. Topic models can potentially elicit themes, which in the case of this study will be SOP dimensions (i.e. attachment, satisfaction, etc.), from online text reviews left by visitors. Successful application of topic models in other fields includes inferring topics from academic journal websites and Wikipedia and finding patterns in genetic data (Blei 2012). An output from topic models is a list of words or terms representing a “topic”. The list of words is formed based on the frequency of reoccurrence in the corpus. A corpus is a collection of documents, which in this study is a collection of online text reviews. The analyst needs to make a qualitative judgment on the meaning of the topics identified in the topic models. For example, Blei (2012) implemented a topic model on 17,000 articles from the academic journal Science. One of the popular topics identified was “Computer” based on the following list of words outputted from the model: *computer, models, information, data, computers, system, network, systems, model, parallel*.

Unlike topic models for academic journals and news articles, which has seen successful applications (Zhao et al. 2011, Wang and Blei 2011), interpreting SOP topics from online reviews is challenging. Online reviews contain informal language; identifying SOP dimension from a list of words requires a deeper understanding of the words and their context. For example, an identified topic related to "food" can contain the words: food, wings, love, beer, chicken. However, relating this topic to a SOP dimension is not straightforward and requires additional context. For example, this topic could be associated with satisfaction, in terms of food options available, but this association is not easily determined based solely on the identified topic.

2.3 Built Environment Design Perspectives on Sense of Place (SOP)

The literature on Sense of Place (SOP) agrees on its multidimensional latent constructs that embody a set of tangible and nontangible qualities regarding a particular location. From a design perspective, “place” is different from “space;” place is a unique collection of qualities and characteristics (McMahon 2006). Similar to the social science perspective, the design perspective acknowledges that a set of key indicators define SOP: physical, visual, social and economic (Cross 2001). According to Gieryn (2001), “place is, at once, the buildings, streets, monuments, and open spaces assembled at a certain geographic spot and actors’ interpretations representations, and

identifications.” In contrast to space which is meaningless, places are built or manipulated; they are interpreted, narrated, perceived and felt. Tuan (1977) makes a clear distinction between space and place: “Place means primarily two things: one’s position in society and spatial location. The study of status belongs to sociology whereas the study of location belongs to geography.... only human beings can have a sense of place”

Many similar fields, such as sociology, geography, environmental psychology and architecture and urban planning have long theorized an emotional connection between people and places. In order to make a place meaningful, the space creators, such as architects and planners ensure the space carries certain distinguishing characteristics to create a Sense of Place (SOP). A guiding principle in designing the built environment for sustainability and livability is a Sense of Place. The physical environment plays an important role in perceptions about place, which constantly change due to the shifts in time and context that may “unmake” a place. Architects primarily use the physical environment in crafting SOP, but leveraging visitor perceptions of place may yield benefits. The Gallup and Knight Foundations (2010) teamed up and conducted a three-year study called “Soul of the Community.” The study answers questions such as: “What makes residents love where they live?” or “What attracts people to a place and keeps them there?” This study found that the most important factors that create links between people and their community were not jobs and economy, but rather “physical beauty, opportunities for socializing and a city’s openness to all people.”

Urban planners and architects have various methods to measure SOP that are mostly qualitative. Powell (2010) uses mapping as a multisensory research method to understand SOP. Jackson (1994) characterizes Sense of Place (SOP) through recurring events, indicating “something that we ourselves create in the course of time... Sense of Place is reinforced by what might be called a sense of recurring events.” Norberg-Shulz (1979) believed that SOP is best described through three-dimensional spatial organization: “Space denotes the three-dimensional organization of the elements which make up a place, and character denotes the general atmosphere which is the most comprehensive property of any place.” Lynch (1960; 1981) develop a qualitative framework to measure the sense of place which contain several key indicators and establish the potential relation between physical forms and people’s perception. According to Lynch (1960; 1981): “Sense is the interaction between person and place...[and]...depends on spatial form and quality, culture, temperament, status, experience and current purpose of the observer”. Table 2.1 list previous published works regarding SOP from collateral fields.

Title	Author	Field	Year	Approach
A Space for Place in Sociology	Gieryn	Sociology	2000	Qualitative
Space and Place: The Perspective of Experience	Duan	Geography	1977	Qualitative
Place and the Promise of Conservation Psychology	Bott et al.	Ecology	2003	Qualitative
Towards a Phenomenology of Architecture	Norberg-Schulz	Architecture	1979	Qualitative
A Sense of Place, a Sense of Time	Jackson	Landscape	1994	Qualitative
The Image of the City	Lynch	Architecture and Urban Design	1960	Qualitative
A Theory of Good City Form	Lynch	Architecture and Urban Design	1981	Qualitative

Table 2.1: Literature on Design and SOP from Collateral Fields

Quantify the relation between physical environment and human's emotional attachment is challenging. Although motivated to create a space that stimulated positive connections with visitors, most current design guidelines take a prescriptive approach without providing transparent reasons behind certain requirements. For instance, the City of Los Angeles's downtown design guide requires that each sidewalk provide a minimum of 6 feet of continuous path of travel, and an 18 to 24 inch wide access zone next to the curb. This requirement lacks transparency with respect to setting the prescriptive requirement and how the consensus was reached on those design measurements. The lack of transparency may result in three types of mismatch: 1) Unclear requirements; whether the physical spaces and dimensions from guidelines are necessary for practical reasons, such as car parking size, car turning radius, etc, or physiological comfort of pedestrian is unclear; 2) Lack of scientific or robust analytical support; most guidelines emerge from the designers' field experience and observations that have been proved to be effective in certain condition; however, there is virtually no agreed upon research results supporting a universal design guideline and its suitable for different urban context. 3) Uncertainty of the effectiveness: there is really no confirmed feedback about the effectiveness of those design guides.

Visitors who experienced downtown Los Angeles, a 6 foot long continuous travel path certainly is not the key component in creating a sense of place or vibrant urban environment. There is rich history of discussion and theory developed over the last century by researchers from geography and sociology filed exploring the connection between physical environment and users' perception. However, in the architecture literature there exists few pieces that takes integrated quantitative and qualitative approach to Sense of Place (SOP).

Chapter 3: Sample Collection and Description

This chapter presents a characterization and initial analysis of responses from an on-site visitor survey conducted at the three sites in Rochester, NY. First, we present the survey design and underlying motivations, including logistics for data collection and conducting the onsite survey. The second section of this chapter characterizes the sample of survey responses for subsequent model estimation, including attitudinal responses and participant attributes. Results from this chapter indicate a strong relationship among: (i) destination visit frequency; (ii) internet use; (iii) frequency of biking and walking; and (iv) latent constructs for Sense of Place based on attitudinal statements.

3.1 Survey Design and Response Collection

A guiding principle in designing the built environment for sustainability and livability is a Sense of Place (SOP), which leads users and visitors to perceive and associate a strong identity or character with a particular location. Methodologically, past studies conceptualize SOP as a latent construct related to the following characteristics of the built environment: (i) physical characteristics; (ii) user perceived affects and meanings; (iii) human activities occurring; and (iv) social interactions. However, this study hypothesizes that the recent growth in mobile ICT adoption warrants considering online information access for locations. By providing ubiquitous information and communication across multiple timeframes and geographies, mobile ICT have expanded interactions with the location to include both the physical and virtual. This study further hypothesizes that a second contributing factor to a Sense of Place (SOP) is the visitor's travel access modes. Non-motorized travel modes, such as biking and walking, allow for more direct exposure to the location and may have a positive influence on SOP, relative to other modes, such as personal autos. Public transit, where riders can focus on the passing environment, may also share a similar effect with non-motorized modes.

To investigate the relationships among (i) visitor attributes; (ii) travel mode access; and (iii) ICT use, we design and conduct an on-site visitor survey at three sites in Rochester, NY. This survey instrument collects data for assessing visitors' SOP with respect to several dimensions, including travel behaviors, ICT adoption and use, attitudinal indicators and physical characteristics of the built environment. Additionally, we collected respondent attributes such as socio-economic information. From the standpoint of analysis for relating SOP with observed travel choices, the survey provides empirical data required for estimating a collection of latent constructs that drive SOP and relate to travel choices. We use the finished survey design to collect the following types of information and data: (i) respondent personal and household attributes; (ii) travel characteristics; (iii) ICT use; and (iv) responses to attitudinal statements relating to Sense of Place (SOP).

3.1.1 Site Selection and Characteristics

For this study, we select three neighborhoods in Rochester, NY that serve as our three study sites that varied in their design elements. We based our selection on architectural relevance to Rochester and high daily visitor rates. All three sites were mixed-use developments where there is a blend of residential and commercial. Even in the case of Rochester Public Market (RPM) which is located in the residential neighborhood of Marketview Heights, RPM is blend of the market space and commercial space for restaurants. The chosen neighborhoods were East End (EE), College Town (CT) and Rochester Public Market (RPM), and are described as follows:

East End (EE): The East End neighborhood lies between East Ave, Alexander and Main Streets.

Rochester Public Market (RPM): RPM is located at 280 N. Union Street. The Market is open on Tuesdays, Thursdays and Saturdays year round.

College Town (CT): CT is a mixed-use development/sub-neighborhood in Upper Mount Hope. The location is adjacent the University of Rochester Medical Campus.

These three sites differed with respect the centralized versus decentralized planning effort. College Town was planned centrally and deliberately such that the development follows a strict strategic guideline for development. RPM in contrast experienced decentralized planning and had not strategic guidance over time in terms of design and development. East End lies between RPM and CT, with some portions well planned, such as the Eastman Music School campus and some portions more organic like RPM. Finally, all three sites differed in their urban fabric, which depends on the building massing, architecture style, and streetscape; it can also be characterized by the relationship between built and void objects.

3.1.2 Collection and On-site Intercept Logistics

The research team conducted all intercept onsite surveys during the months of September, October and November 2015. We selected these months due to the high visitation rates to all three sites in the fall relative to other seasons. During the winter months, bicycle and walking access to all three sites severely drops. The sites experience lower visitation rates during summer months due to summer break for education institutions in Rochester.

Rochester Public Market (RPM): For RPM, the team conducted all surveys on Saturdays (10/10/2015 and 10/24/2015) between 9AM and 2PM and on Thursday (10/8/2015) between 9AM and 11AM. Each respondent received a \$5 food token for completing the survey. At the RPM, a dedicated tent was available for locating student assistants conducting the survey. The market administrators made a public announcement every hour at RPM.

East End (EE): For East End, the team conducted all surveys between 4PM and 7PM on a Tuesday (10/27/2015; 11/3/2015), Thursday (10/29/2015; 11/5/2015) or Friday (10/30/2015). These dates coincide with “Taco” and “Trivia” nights at the Temple Bar and Grille. Each respondent received

a \$4 food token for completing the survey. At the EE, since the neighborhood was unsafe in some parts, the team conducted the survey at Temple Bar and Grille, and neighborhood food and drink establishment. The owner of Temple Bar and Grille was the president of the East End neighborhood business association; the team decided a good representation of visitors to and community members of the East End visited his establishment.

College Town (CT): For CT, survey intercepts occurred in the afternoons on Monday (10/19/2015), Wednesday (10/21/2015) and Friday (10/23/2015) between 1PM and 5PM, and on Saturday (10/31/2015) morning between 9AM and 12PM. At CT, due to administrative difficulties, the team conducted the survey at Saxby's coffee shop and at the Barnes and Noble Bookstore, which serves university bookstore for University of Rochester. Each respondent received a \$3 gift card to Saxby's for completing the survey.

The research team conducted the intercept survey, with each student research assistant working one or more three hour shifts on the weekdays and weekends. We implemented the survey in Survey Monkey, an online service for implementing and administering surveys. Additionally, each team member conducting the survey had a tablet for accessing the survey online at the time of visitor intercept. Survey Monkey allowed research assistants to conduct and record visitor responses quickly, storing the final collection of responses online for later download. Access to final responses were limited to the PI only, including informed consent agreements. Each student engaged with visitors using a pre-written script; student research assistants presented and obtained informed consent information orally. All student research assistants handling the data completed Human Subject Assurance Training. The critical administrators and establishment owners at each site gave advance permissions to conduct the survey during pre-specified times.

Interested readers can find additional survey logistic details, in addition to IRB documentation, in Appendix A.

3.1.3 Survey Structure and Information Collected

The survey instrument designed for this study allows collection three broad types of information from respondents or actual visitors to the sites. First, respondents faced a series of attitudinal statements related to SOP, and disagreed or agreed with the statement based on a seven point Likert scale. Second, we collected data on ICT use, specifically visitor habits regarding accessing online information about locations and leaving reviews or feedback. Finally, we collected personal and household attributes to help identify specific market segments. These three information types are described as follows:

Attitudinal Statements: With respect to measuring SOP, the literature agrees on conceptualizing SOP as a latent construct characterized by responses to a series of attitudinal statements that serve as measurements for SOP (Deutsch et al. 2013; Deutsch and Goulias 2010, 2011). The dominant

approach asks visitors to rate a series of Likert scale attitudinal statements relating to SOP. For this survey, we relied on statements used by other studies on SOP (Deutsch et al. 2013; Deutsch and Goulias 2010, 2011).

Information and Communication Technology (ICT) Use: One main hypothesis put forth in this study assumes the recent increase in mobile ICT adoption has reshaped the factors underlying SOP. To assess visitor ICT use, the survey had question regarding information search about sites online and leaving reviews or feedback. The literature agrees that information and experience with a site shapes visitor SOP, through physical experience or social interactions. ICT accesses of site information may serve to either strengthen or weaken visitor SOP.

Travel and Site Visit Characteristics: Information collected through the survey also indicate visitors' travel and visit characteristics. A second main hypothesis of this study suggests that non-motorized travel access to sites can strengthen SOP development relative to personal auto, due to the direct exposure to the environment. Transit modes may show a similar effect since riders can sit and observe the passing environment, as opposed to driving which requires focus on vehicle operations and wayfinding.

Respondent Personal and Household Attributes: Finally, we collect information on personal and household attributes were obtained through the intercept survey. These help disaggregate distinct segments that may differ in effects of non-motorized travel and ICT on SOP.

3.2 Sample Characteristics

This section presents descriptive statistics on survey responses segmented by location. A total of 283 responses were collected across all three sites with 78 from College Town (CT), 71 from East End (EE) and 134 from Rochester Public Market (RPM). The majority of respondents finished the survey within 15 to 20 minutes. Only visitors 18 years or older took the survey. The previous section provided details on the survey intercept logistics. Table 2.1 below presents a tabulation of survey responses across all three sites for non-attitudinal questions.

Gender: Of the sample surveyed, visitors at College Town (CT) and Rochester Public Market (RPM) had more females responding relative to males, with 56% and 61% female respondents respectively. In East End (EE) the sample was predominantly male at 66%.

Age: The respondent sample age distribution also differed across the three sites. Respondents 18 to 24 years and 25 to 34 years, not surprisingly, comprised the largest percentage of the sample from College Town which is adjacent to the University of Rochester. The East End neighborhood sample had a similar age distribution, but with more respondents 25 to 34 years relative to 18 to 24 years. Interestingly, for RPM, three age groups with the highest percentages were 25 to 34 years, followed by 45 to 54 years and 55 to 64 years, respectively. This difference may indicate

the limited mobility of students who are aged 18 to 24 years. While RPM is a mixed-use type land use with restaurants, other food establishments in addition to a farmers' market set within a residential area, access is severely limited to personal auto and transit routes are limited.

Household Income and Member Employment: The household income distribution for the three sites reflect a similar reasoning. College Town which is predominantly visited by students have a higher percentage of respondents within the \$0 to \$24,999 annual income bracket, relative to the other two sites. The modes of the distribution for EE and RPM were both \$50,000 to \$74,999 annually. For all three sites, a significant percent of respondents refused to disclose their income. This was not surprising given the sensitivity of the information. With respect to the number of full-time employees, visitors to EE had the highest percentage of one and two full-time employee households. CT and RPM has a higher percentage of zero full-time employee households. However, much like household income, this information is sensitive and may bias responses from survey participants.

Number of Years Living in Rochester: With respect to years living in Rochester, both EE and RPM had a high percentage of respondents living more than 10 years, at 59% and 69% respectively. Not surprisingly CT had a high percentage of respondents living in Rochester less than one year and one to five years. These distributions suggest that while visitors to both EE and RPM maybe from outside of Rochester, they are predominantly visited by long time residences. CT in contrast is comprised of more visitors new to Rochester.

Household Membership Attributes: Interestingly with respect to household member composition, most respondents indicated they lived with immediate families. For College Town, the second largest category was living with friends, followed by living alone. Given the proximity to the University of Rochester, this is not surprising. For both EE and RPM, a higher percentage of respondents were living alone relative to living with friends. Across all three sites, household sizes were predominantly between 2 and 3 members. The sample at EE showed a higher percentage of single individuals relative to the other two sites. Predominantly, respondent households across all three sites had no children.

Number of Vehicles in Household Fleet: The distribution of households' transportation resources indicates that most households have two vehicles and subsequently two or more drivers. Not surprisingly, the percentage of zero motor vehicle households was higher at CT, given its high student population.

Number of Bicycles in Household Fleet: Surprisingly, the majority of households in the sample own bicycles. The sample at RPM has the smallest percentage of zero bicycle households, possibly indicating the type of households that visit RPM. Additionally, RPM had the highest percentage of households owning five or more bicycles across all three sites. This high bicycle ownership for RPM visitors contrasts with the bicycle/walking mode access to RPM both on the survey date and during summer/spring months. The survey respondent distribution shows that the RPM sample

highest percentage of respondents who do not bike/walk to the site, even in summer and spring months when the weather is favorable.

Frequency of Site Visit: In terms of visiting frequency to the locations, the College Town sample showed the most infrequent visitation rate, with almost 20% visiting less than once a month. EE visitors have the higher visit rate, with 77% of respondents visiting at least once a week, compared to 53% and 47% for CT and RPM. While RPM had the least percentage of respondents visiting at least once a week, this may likely results from the market being open only three days a week (Tuesday, Thursday and Saturday) compared to the other two sites.

Travel Mode Access on Survey Date: Across all three sites, the majority of respondents used personal motor vehicle as the travel mode to the site, reflecting the strong car dependency in Rochester. Interestingly, the site with the most visitors accessing by walking on the survey date was EE with 30%, followed by CT at 10% and RPM at 3%. The sample at RPM had the lowest percentage of walkers. With respect to transit mode access on the survey date, had the highest percentage in its sample with 14% taking transit. These travel mode distributions on the survey date reflect the built environment features of the three sites. While visitors to RPM are predominantly bike owners, the market is located within a residential neighborhood difficult to access for visitors living outside of Marketview Heights. The neighborhood of EE lies within close proximity to the Rochester downtown and CBD and is easily accessed by surrounding residential areas. CT, while close to the University of Rochester campus, has a low percentage of visitors walking/biking to the site, possibly reflecting the positioning of CT at the intersection of Elmwood Ave. and Mt. Hope Ave., both of which are high traffic volume arterials.

ICT Information Access: With respect to the ICT use characteristics of samples from all three sites, predominantly show a high rate of accessing online information on the three sites prior to visiting, and in particular reading reviews. However, writing reviews and leaving feedback appears has a significantly lower rate. These distributions indicate that online information on sites matter, with a high percentage of visitors searching for online information in the form of reviews and other logistical information. However, the reciprocal of leaving reviews and other feedback is low, indicating sharing of experience online has less popularity.

Participant/Visitor Response	College Town (n=78)	East End (n=71)	Rochester Public Market (n=134)	Participant/Visitor Response	College Town (n=78)	East End (n=71)	Rochester Public Market (n=134)
Gender of Respondent				Household Member Composition			
Female	56.41%	32.39%	61.19%	I live alone.	19.23%	30.99%	14.18%
Male	43.59%	66.20%	38.81%	I live with friends.	32.05%	23.94%	12.69%
Decline to Answer	0.00%	1.41%	0.00%	I live with immediate family.	44.87%	42.25%	67.91%
Age of Respondent				Household Size			
18 to 24 years	46.15%	22.54%	14.18%	I live with my extended family.	0.00%	0.00%	1.49%
25 to 34 years	25.64%	42.25%	30.60%	I live with other acquaintances.	3.85%	2.82%	3.73%
35 to 44 years	6.41%	9.86%	8.96%	Household Size			
45 to 54 years	7.69%	15.49%	20.15%	1	17.95%	30.99%	14.18%
55 to 64 years	10.26%	7.04%	16.42%	2	26.92%	33.80%	46.27%
65 to 74 years	3.85%	2.82%	7.46%	3	23.08%	16.90%	17.91%
75 year or older	0.00%	0.00%	2.24%	4	15.38%	9.86%	10.45%
Household Income				5 or more members	14.10%	8.45%	11.19%
\$0-\$24,999	21.79%	7.04%	17.16%	Decline to Answer	2.56%	0.00%	0.00%
\$25,000-\$49,999	17.95%	16.90%	17.16%	Number of Children in Household			
\$50,000-\$74,999	15.38%	30.99%	20.15%	0	78.21%	78.87%	79.85%
\$75,000-\$99,999	10.26%	11.27%	11.94%	1	11.54%	11.27%	8.96%
\$100,000-\$124,999	3.85%	16.90%	11.94%	2	3.85%	7.04%	5.22%
\$125,000-\$149,999	1.28%	4.23%	2.99%	3	2.56%	1.41%	4.48%
\$150,000-\$174,999	5.13%	1.41%	3.73%	4 or more children	2.56%	1.41%	0.75%
\$175,000-\$199,999	1.28%	0.00%	0.00%	Decline to Answer	1.28%	0.00%	0.75%
\$200,000 and up	3.85%	4.23%	5.22%	Number Employed Full-Time in Household			
Decline to answer	19.23%	7.04%	9.70%	0	29.49%	8.45%	24.63%
Number of Years Living in Rochester Metropolitan Area				1	23.08%	40.85%	29.10%
Less than one year	20.51%	5.63%	4.48%	2	37.18%	39.44%	35.82%
1 to 5 years	29.49%	21.13%	15.67%	3	5.13%	8.45%	7.46%
6 to 10 years	7.69%	4.23%	4.48%	4	0.00%	2.82%	1.49%
More than 10 years	28.21%	59.15%	69.40%	5 or more members	2.56%	0.00%	0.75%
I am not from this area	12.82%	9.86%	5.22%	Decline to Answer	2.56%	0.00%	0.75%
Decline to answer	1.28%	0.00%	0.75%				

Table 3.1 Respondent Sample Socio-Economic and Household Attributes

Participant/Visitor Response	College Town (n=78)	East End (n=71)	Rochester Public Market (n=134)	Participant/Visitor Response	College Town (n=78)	East End (n=71)	Rochester Public Market (n=134)
Number of Vehicles in Household Fleet				Frequency of Site Visit			
0	14.10%	7.04%	6.72%	Everyday	12.82%	28.17%	0.00%
1	24.36%	30.99%	29.85%	Three or more times a week	14.10%	12.68%	1.49%
2	32.05%	42.25%	41.04%	Twice a week	6.41%	16.90%	2.24%
3	12.82%	8.45%	13.43%	Once a week	20.51%	19.72%	44.03%
4 or more vehicles	11.54%	4.23%	7.46%	Once in two weeks	8.97%	5.63%	12.69%
Decline to Answer	5.13%	7.04%	1.49%	Once in three weeks	3.85%	4.23%	3.73%
Number of Drivers in Household				Bicycle/Walking Frequency to the Site during Summer/Spring			
0	2.56%	2.82%	3.73%	I do not bike/walk (0 times)	51.28%	38.03%	71.64%
1	23.08%	32.39%	19.40%	Less than once a month	6.41%	4.23%	2.99%
2	34.62%	43.66%	51.49%	Once a month	7.69%	7.04%	5.97%
3	15.38%	14.08%	14.93%	Once in three weeks	0.00%	1.41%	2.99%
4 or more drivers	12.82%	4.23%	10.45%	Once in two weeks	6.41%	0.00%	3.73%
Decline to Answer	11.54%	2.82%	0.00%	Once a week	10.26%	8.45%	7.46%
Number of Bicycles in Household Fleet				Travel Access Mode on Survey Date			
0	26.92%	30.99%	20.90%	Bicycle	5.13%	0.00%	7.46%
1	28.21%	25.35%	19.40%	Carpool or Ride-Share (Passenger)	3.85%	9.86%	15.67%
2	20.51%	21.13%	26.87%	Personal Motor Vehicle (Driver)	61.54%	57.75%	69.40%
3	11.54%	12.68%	12.69%	Public Transit	14.10%	2.82%	3.73%
4	3.85%	2.82%	7.46%	Walking	15.38%	29.58%	3.73%
5 or more bicycles	8.97%	7.04%	12.69%	Have you ever written reviews about this place online?			
Did you ever access the online profiles/information for this site prior to today's visit?				Have you ever read reviews about this place online?			
No	39.74%	29.58%	42.54%	No	71.79%	42.25%	70.15%
Yes	60.26%	70.42%	57.46%	Yes	28.21%	57.75%	29.85%
Have you ever written reviews about this place online?				Have you ever read reviews about this place online?			
No	94.87%	84.51%	92.54%	No	71.79%	42.25%	70.15%
Yes	5.13%	15.49%	7.46%	Yes	28.21%	57.75%	29.85%

Table 3.2 Respondent Sample Travel, Site Visit and ICT Use Attributes

3.2.3 Likert Scale Attitudinal Responses for SOP Measurements

Examining the distribution of responses to attitudinal statements related to SOP reveals differences in the range of responses between the three sites, suggesting that the variation in response differs. In this section, we empirically show these distributions for each attitudinal statement in the figures below. The attitudinal statements are categorized into the six latent constructs for SOP: (i) Satisfaction; (ii) Attachment; (iii) Identity; (iv) Dependence; (v) Aesthetics and (vi) Social. The distribution of responses presented below only includes responses from actual visitors of the site on the survey date. In other words, an individuals' responses about locations other than their current survey locations, which were also collected, were not included.

Satisfaction: Satisfaction statements addressed all aspects of the location including, food, amenities entertainment options, and transportation access. Across all three sites, visitors were satisfied with these aspects. However, some aspects received disagreement from visitors on satisfaction. In particular, visitors disagreed on the satisfaction for entertainment at both RPM and EE; CT did not receive any strong disagreement on entertainment. Visitors disagreed on satisfaction for many transportation access aspects, especially motor vehicle parking at RPM and EE, unsurprisingly due to the locations of both sites. RPM resides at the edge of a residential neighborhood with limited street parking. While there is a dedicated parking lot, parking is still an issue. Bicycle parking had a similar distribution. With respect to bike/walk access, visitors from all three sites were mostly satisfied, with very little disagreement. Interestingly, CT had the least disagreement with respect to satisfaction, even for parking which had high dissatisfaction from both RPM and EE.

Attachment: Critical to SOP, visitors should feel an attachment or connection with the place. Visitors rated three attitudinal statements on attachment to the survey location. Overall, CT had strong disagreement on visitors' attachment with about 21% disagreeing on some level that they felt a strong connection with the place. In contrast, visitors to RPM showed the highest levels of attachment. At RPM, 91% of visitors indicated they felt a strong connection, 98% indicated they would be disappointed if RPM did not exist and 100% indicated RPM made them "happy." Relative to RPM and CT, EE visitors had a positive connection, but not as strong as RPM. Interestingly, while CT had fewer disagreements with Satisfaction and visitors at CT felt less connection with the place.

Identity: Similar to Attachment, SOP requires visitors to identify with the location. Visitors were asked to rate three attitudinal statements on Identity with the survey location. With respect to reflecting the visitors and allowing them to be themselves, RPM visitors rated these statements in strong agreement, relative to CT, which had the most disagreement. EE was in between RPM and CT, also seen in response Attachment statements. Similarly, visitors strongly disagreed overall that the locations made them feel too self-conscious. In response to the statement: "It says little about me," overall there was more disagreement than agreement, with RPM visitors disagreeing with the highest rate.

Dependence: The response distributions for attitudinal statements about Dependence were similar to Attachment. Dependence statements concerned visitors' needs for services or products, as opposed to having an Attachment without any real needs. RPM visitors strongly agreed more to statements regarding needs and diversity of items, relative to CT, which had the lower rate of agreement out of the three sites. Once again EE was in between RPM and CT.

Aesthetics: Three attitudinal statements help assess visitors' perceptions of aesthetics at each site. Similar to satisfaction, on average most visitors were favorable towards the aesthetics at all three sites. With respect to the architecture, there is strong disagreement from visitors at CT and RPM. Visitors also had strong disagreement on the artistic value of CT and its "beauty." While CT had relatively fewer disagreement on satisfaction compared the other two sites, CT had stronger disagreement with respect to aesthetics.

Social/Atmosphere: The last latent dimension of Social for SOP was measured using attitudinal statements regarding the social feel of the environment and visitor interactions with others. Attitudes towards safety and culture are reflected in these statements. With respect to friendliness and a social atmosphere, most visitors agreed positively. One exception was East End, which had many visitors disagree on the family-friendly nature of the neighborhood. Interestingly for social atmosphere and family friendly, no site had visitors indicating strong agreement. In terms of the "culture" of Rochester visitors to RPM were agreed at a higher rate than the other three sites. The last two attitudinal statements addressed feelings of safety. For all three locations, visitors felt safe and perceived low risk of unpleasant encounters. The exception is East End, which had more agreement of unpleasant encounters, relative to CT and RPM. This is not surprising since EE is woven into the CBD of Rochester. While RPM is in a generally perceived unsafe neighborhoods, its strong boundaries might help improve safety perceptions, along with hours of operations during the day.

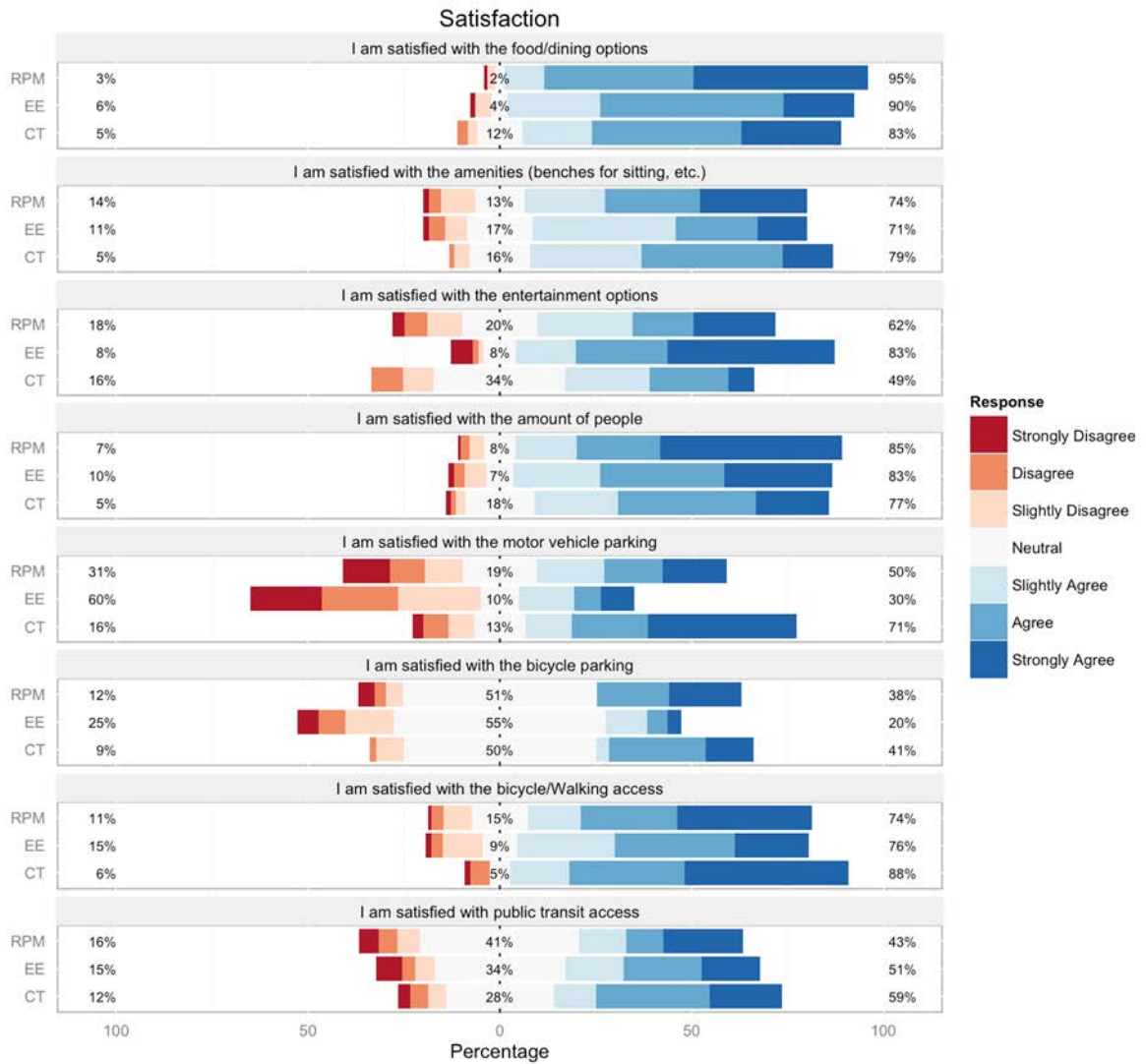


Figure 3.1: Distribution of Likert Scale Response to Satisfaction

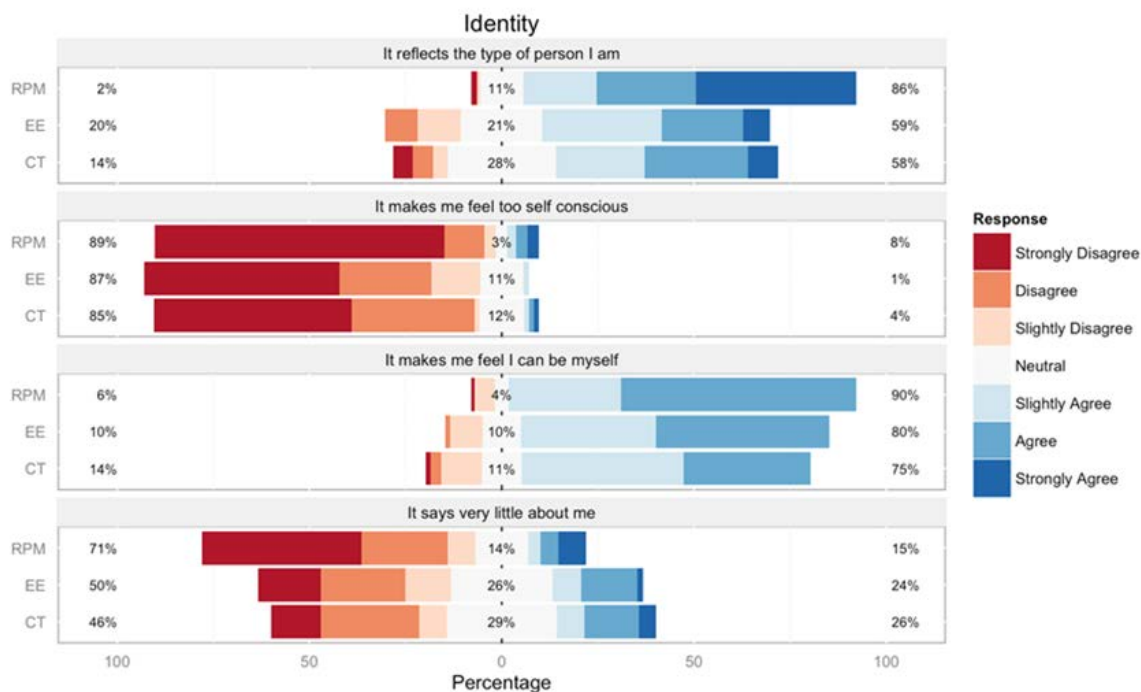


Figure 3.2: Distribution of Likert Scale Response to Attachment

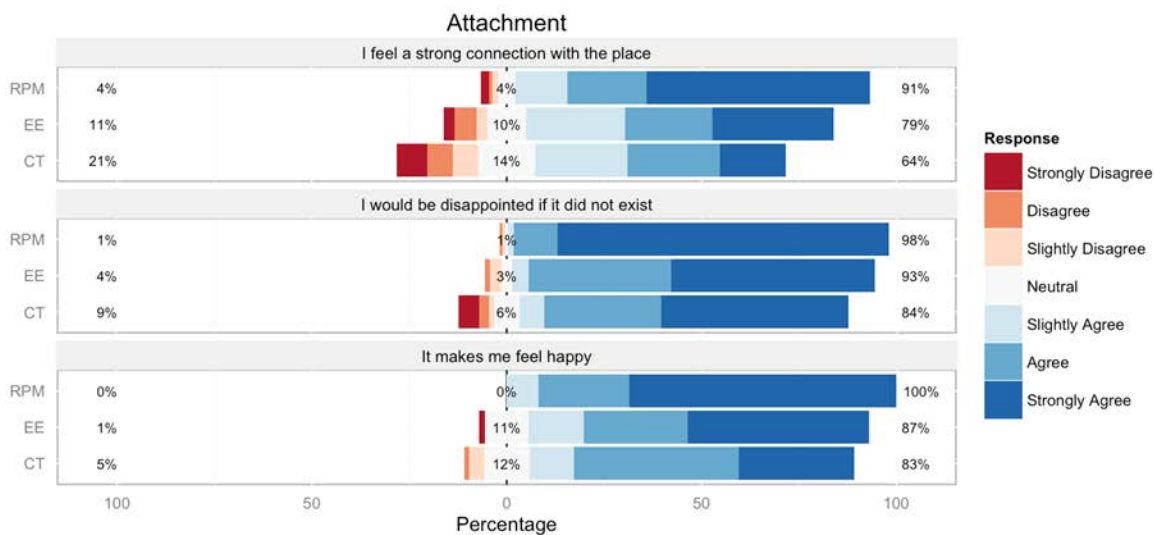


Figure 3.3: Distribution of Likert Scale Response to Identity

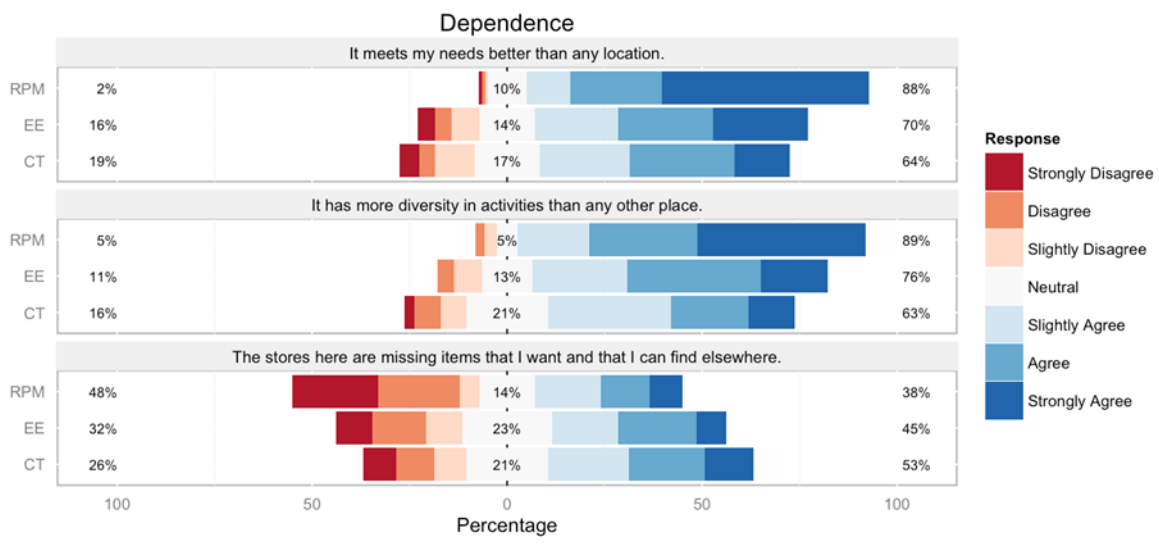


Figure 3.4: Distribution of Likert Scale Response to Dependence

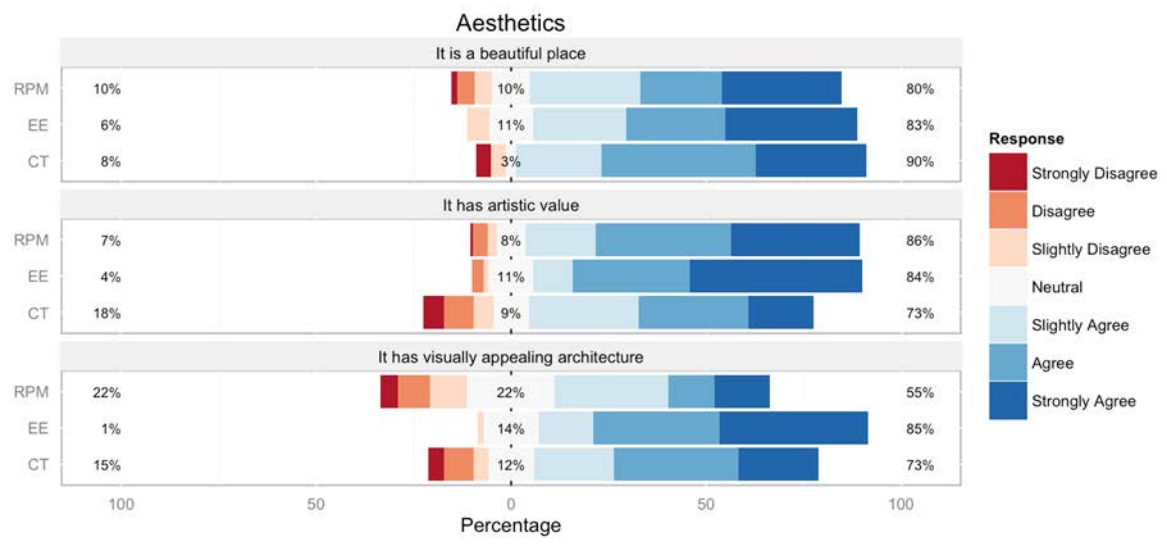


Figure 3.5: Distribution of Likert Scale Responses to Aesthetics

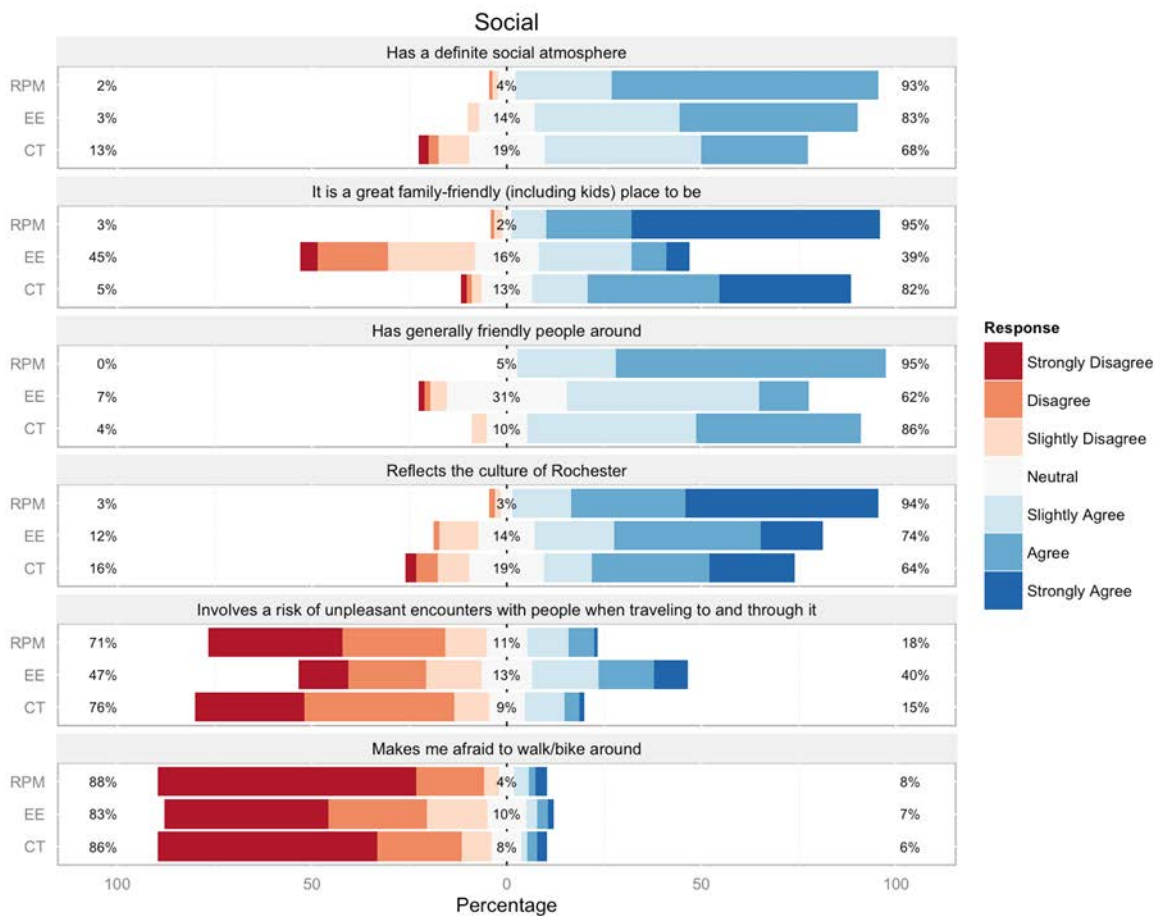


Figure 3.6: Distribution of Likert Scale Response to Social

Chapter 4: Factor Analysis of Attitudinal Statements

4.0 Introduction

This chapter presents a factor analysis of attitudinal responses. The factor analysis will reveal latent factors underlying the response to attitudinal statements. This chapter ends with confirmatory factor analysis (CFA) of attitudinal responses. The CFA serves to uncover underlying latent constructs with respect to attitudinal responses and will serve as an initial exploration of latent constructs for Sense of Place (SOP).

4.1 Correlation Among Attitudinal Statement Responses

Previous literature suggests six behavioral dimensions govern perceptions of Sense of Place (SOP): (i) satisfaction; (ii) Attachment; (iii) Dependence; (iv) Identity; (v) Aesthetics; and (vi) Social/Cultural. According to previous attitudinal SOP studies, these six behavioral dimensions are latent factors that explain the variation in attitudinal responses to a set of statement given in Table 4.X, of site visitors.

Looking at the correlation among responses for these statements can provide insight on how responses move or correlate with each other. For example, statements on satisfaction should strongly correlate, either positively or negatively with each other. More specifically, if respondents rate the statement “I am satisfied with the food/dining options,” favorably, the response to “I am satisfied with the amenities (i.e. benches for sitting, etc.)” should also correlate positively. Similarly, correlations between the two statements “[This site] makes me afraid to walk/bike around,” and “[This site] involves a risk of unpleasant encounters with people when traveling through or to it,” should correlate positively across sample of responses, but possibly negatively with other sets of statements, for example the previous two on satisfaction. In order to look at the latent factors that help explain these strong correlations, either positive or negative, among responses from the sample of visitors, a factor analysis is conducted to identify these latent factors (Washington et al. 2011; Bollen 1987). From the perspective of methods for data distillation, factor analysis seeks to explain the covariance of responses as a small set of latent factors. Consequently, factor analysis begins with examining the correlation matrix of responses, which a scaled covariance matrix where the correlation is between -1 and 1.

The next section examines the correlation matrix of responses among the three sites combined and individually. The following section conducts an exploratory factor analysis to identify latent factors that may explain this correlation. Furthermore, this factor analysis will serve to determine the appropriateness of previously identified latent factors for SOP; if different latent factors are identified, these dimensions may be supplemented with these new factors.

4.2 Correlation in Responses Across Sites

Figure 1 below shows the correlation of responses for attitudinal statements across all three sites. Looking for sections or areas in Figure 1 of strong correlation, responses to statements governed by the same latent factor identified in previous studies should show strong positive (or negative

correlation). For example, past studies showed the latent factor “satisfaction” to explain responses to the statements “I am satisfied with the food/dining options,” and “I am satisfied with the amenities (i.e. benches for sitting, etc.)” Consistently, responses these should show strong positive correlation in this study.

Looking at Figure 4.1, which reflects all three sites, positive correlations exist between five sets of statements, where the correlation was 0.4 or higher. Satisfaction statements overall shows a relatively significant positive correlation among themselves, though overall not as strong as other groups of statements. The strongest positive correlations were observed from four other groups: (a) Attachment and Dependence; (b) Aesthetics; (c) Social statements relating to non-safety issues; and (d) Social statements relating to safety issues.

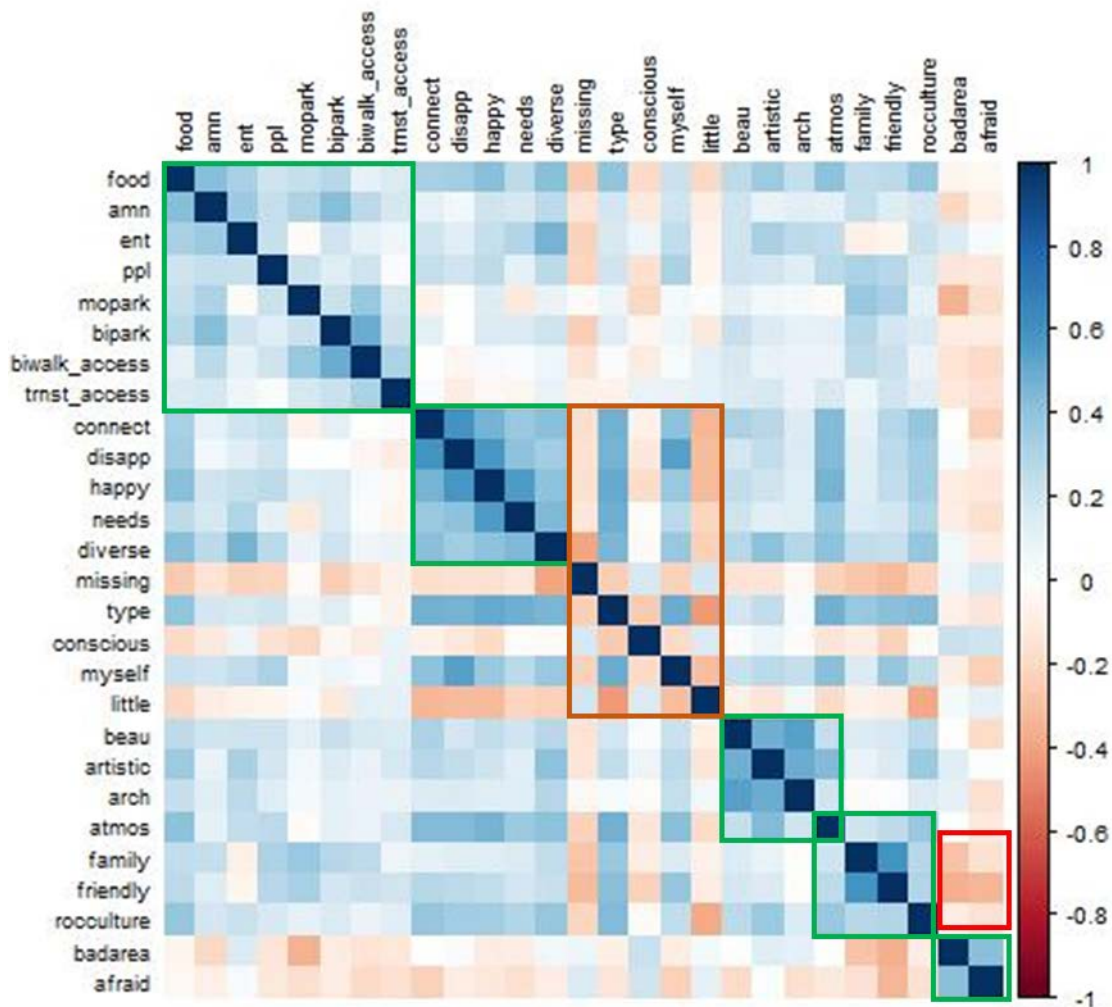


Figure 4.1: Correlation Matrix for Attitudinal Statements across all Three Sites

Interestingly, statements originally associated with a Social/Cultural latent factor could be segmented into two groups here, depending on the topics; if statements relate to safety in the neighborhoods, they correlate positively with each other but negatively with other statements, such as “[This site] reflects the culture of Rochester.” A second interesting result is that the previously defined dimensions of Attachment and Dependence are both strongly positively correlated with each other. While both the Social and Identity dimensions show a mixture of correlations, with some statements being positively while others are negatively correlated, for the Identity dimension there is no clear pattern to this segregation. For Social/Environment dimensions, there a clear segmentation between statements relating to safety and others, which is not present among Identity statements. One reasons for the lack of clear trends is the assumption here that all sites the same, and that site heterogeneity is negligible. Segmented responses by there respective sites may reveal different correlations from the ones present in Figure 4.2.

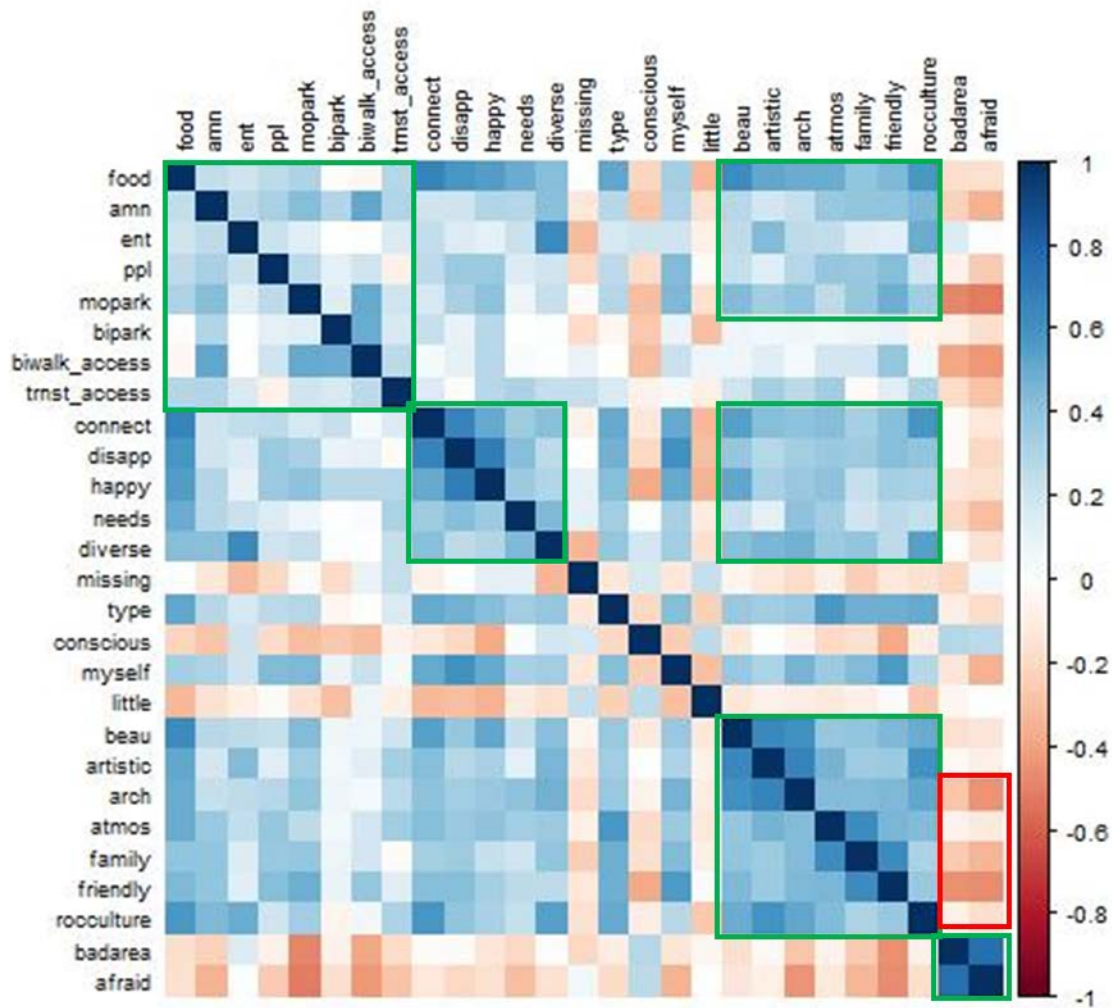


Figure 4.2: Correlation Matrix for Attitudinal Statements for College Town

Looking at Figure 4.3 a different pattern of correlation emerges relative to the one with all three sites in Figure 4.1. There is still a positive correlation among Satisfaction related statements. However, the strongest correlations, exist for statements related to Attachment/Dependence, Aesthetics and Social/Environment. Additionally, there is positive correlation among statements related to (i) Satisfaction; (ii) Attachment/Dependence and (iii) Aesthetics/Social/Environment. Similar to Figure 4.3, statements related to safety show strong positive correlation among each other and negative correlation with other statements related to the Social dimension. As with Figure 4.3, there is a mix of correlations, both positive and negative related to Identity.

Overall, visitors to College Town show strong positive and negative correlations with respect to Aesthetics and Social/Environmental statements. The strong consistent response to Aesthetics could be related the relative new construction of College Town and to the type of visitors that visit. From a socio-demographic perspective, the visitors were more homogenous at College Town relative to other sites. Additionally, from a design standpoint College Town is very homogenous lacking variation, possibly leading to homogeneity in responses. However, with respect to the frequency of agreement to positive statements on the social atmosphere, College Town still lags behind Rochester Public Market. For example, looking at responses to the statement “[This site] reflects the culture of Rochester,” only 64% agreed to some level. Statements related to Identity continue to produce mixed responses suggesting possible mixed interpretation of statements from respondents.

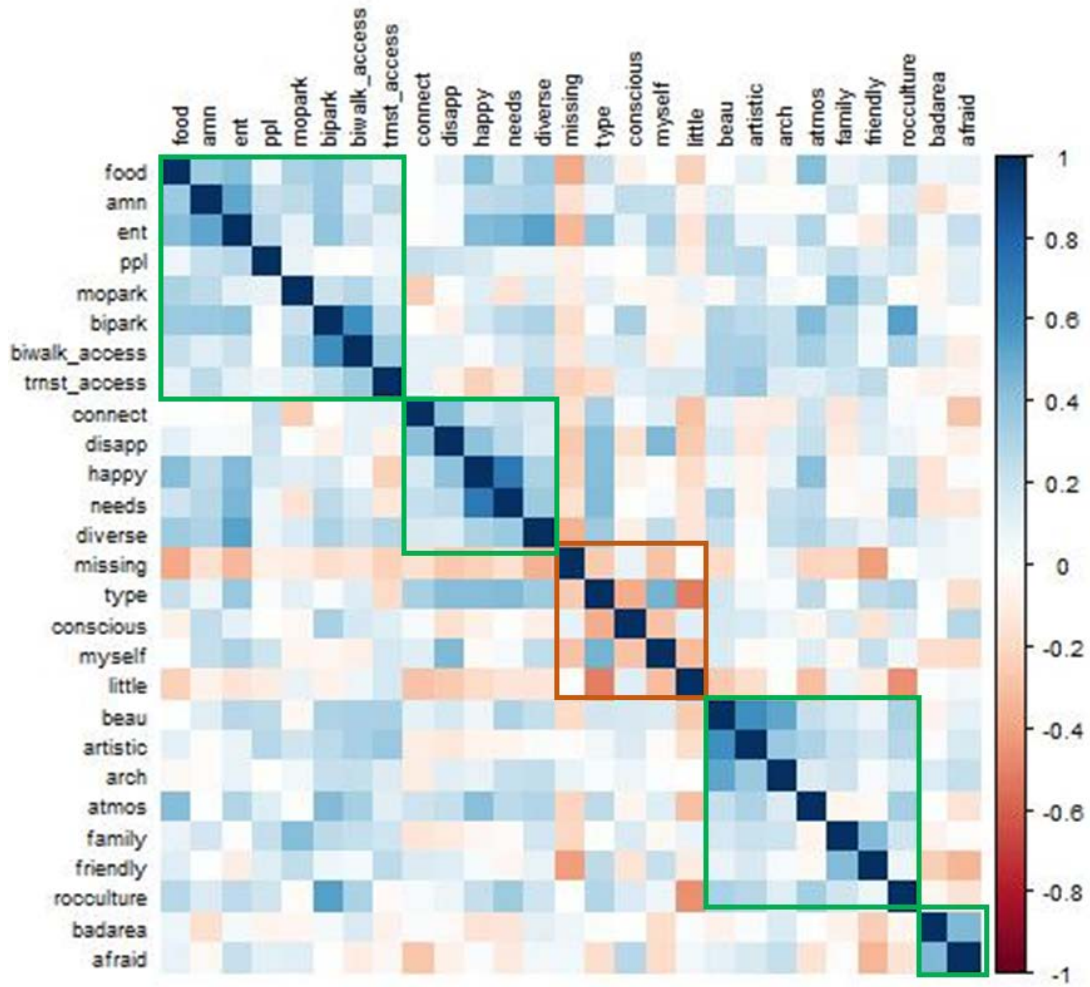


Figure 4.3 Correlation Matrix for Attitudinal Statements for East End

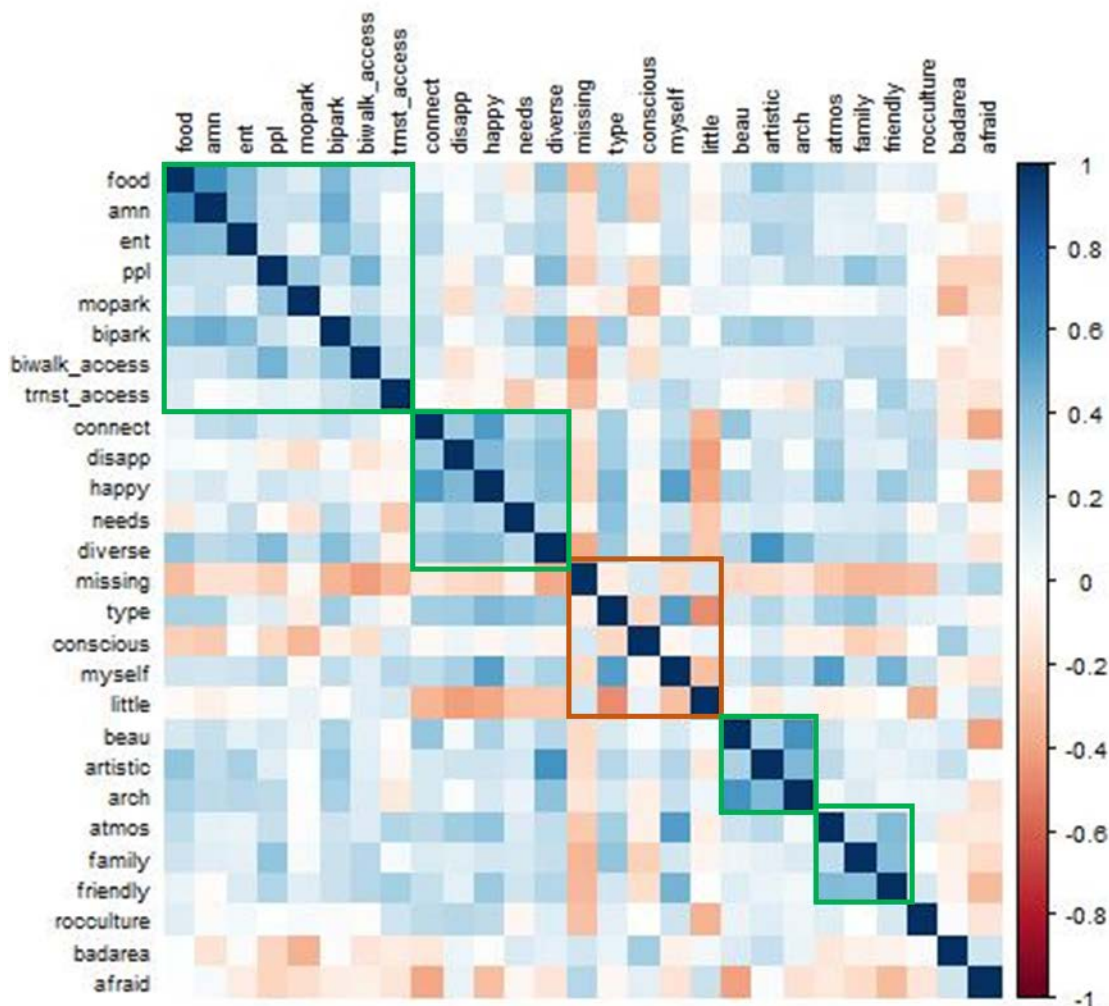


Figure 4.4. Correlation Matrix for Attitudinal Statements for Rochester Public Market

Looking at the correlation matrices for East End (Figure 4.3) and Rochester Public Market (Figure 4.4) reveals a contrast from the one for College Town (Figure 4.2). Both the East End and Public Market sites show a weaker correlation among attitudinal responses, relative to College Town. There is still a positive correlation among Satisfaction related statements. Statements related to Attachment and Dependence continue to show a strong positive correlation, with the exception of the statement “The stores here are missing items that I want and that I can find elsewhere.” This follows naturally from sites eliciting a strong dependence and attachment from respondents; if visitors feel a strong attachment or dependence, they less likely perceive the site to be missing items needed. Statements associated with Identity continue to show mixed correlations, with no clear segmentation. Social dimensions continue to show a strong positive correlation. However, for the Rochester Public Market, the statements associated with Aesthetics and Social dimensions are positively correlated with similar statements, but not with each other. Furthermore, for Rochester Public Market, there is a weaker correlation, both positive and negative, for statements regarding safety.

4.3 Synthesis of Correlation Matrices

Overall several common trends can be seen from the correlation of responses across all three sites. First, regardless of the site, there is a positive correlation among satisfaction statements. Respondents that rate high satisfaction for one Satisfaction statement tend to rate others favorably as well. Second, the dimensions of Attachment and Dependence, while separated in past studies, also show high positive correlation in this study. One explanation for this could be the similar nature of these two; if you have strong dependence to a particular site, you will have strong attachment. While a strong positive correlation between Aesthetic and Social statements existed previously for College Town this seems to have weakened for East End and Rochester Public Market. Overall, the strong correlations present in College Town were diluted for East End and Rochester Public Market. Several possible explanations exist for this dilution. One is the homogeneity in visitors to the respective sites. While East End and Public Market attract visitors from a wide range of beliefs and backgrounds, the visitors to College Town were more homogenous with respect to socio-demographic characteristics. A second perspective is the homogeneity in the design attributes. College Town has features that tend to be more uniform, while the remainder two sites are more variable in the design attributes of the sites. Without further analysis, the effects of these two possible sources of variability cannot be disentangled.

4.4 Factor Analysis of Attitudinal Responses

From the perspective of methods for data distillation, factor analysis seeks to explain the covariance of responses as a small set of latent factors. A factor analysis was conducted on each of the three sites in order to distill the attitudinal responses to a handful of factors. The results of the factor analysis for these three sites are presented below in Tables 1 to 3.

Before discussing the factors for each site individually, an examination of results for all three sites reveals some commonalities. The majority of variation can be explained with six to eight factors.

- 1) Transportation Related Factor – All three sites revealed factors that reflect and weight on transportation related statements. These statements are exclusively associated with the Satisfaction dimension according to the literature. For College Town, Factor 4 is heavily loaded onto the transportation related statements. For East End and Rochester Public Market, there is no single factor weighted heavily for transportation related statements. For East End, these are Factors 4 and 6, the key difference being Factor 6 is weighted heavier on Motor Vehicle Parking and Factor 4 is weighted towards non-motorized travel. For the Public Market, Factors 4 and 7 both relate to transportation, but Factor 7 is weighted more heavily on transit. Factor 4 weighs heavily on motor vehicle parking.
- 2) Satisfaction Related Factor – Across all three sites, there is a factor related to satisfaction related statements not involving transportation issues. These factors include satisfaction for food, amenities and entertainment. Factors 5, 1 and 1 reflect these for College Town, East End and Rochester Public Market respectively. Interestingly food is weighed heavily

by one factor in College Town and Rochester Public Market, but not for the East End neighborhood.

- 3) Aesthetics and Environment Factor – Correlation among statements relating to Aesthetics and the Social atmosphere of the environment also help explain the variation. For College Town, this Factor 2 relates to Aesthetics strongly. For East End, this was Factor 3. Surprisingly, the responses for Public Market showed no strong weighting on a factor related to all three statements on Aesthetics. However, Factor 5 weight heavily on two of the Aesthetics statements.

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6
food	0.684	0.416	0.182		0.141	
amn	0.199		0.257	0.505	0.377	0.229
ent		0.286	-0.135		0.642	0.158
ppl	0.315		0.118	0.187		0.448
mopark	0.192	0.293	0.466	0.386		0.170
bipark				0.551		
biwalk_access			0.308	0.888		
trnst_access	0.124	0.279	0.210	0.255	0.283	-0.379
connect	0.686	0.300			0.140	0.140
disapp	0.793	0.167		0.125		0.188
happy	0.748	0.204		0.325		
needs	0.515		0.302		0.367	
diverse	0.287	0.259			0.778	0.197
missing			0.136		-0.285	-0.529
type	0.529	0.235	0.150		0.139	0.317
conscious	-0.253		-0.241	-0.288	0.324	-0.158
myself	0.512	0.196	0.190	0.182		0.390
little	-0.428					
beau	0.425	0.581	0.145		0.117	0.100
artistic	0.144	0.959			0.202	
arch	0.289	0.608	0.339		0.231	0.157
atmos	0.400	0.358		0.165	0.166	0.303
family	0.246	0.273	0.303		0.111	0.603
friendly	0.318	0.299	0.470	0.224		0.475
roculture	0.384	0.468			0.400	0.129
badarea			-0.908	-0.110		
afraid			-0.813	-0.210		-0.106
SS loadings	4.236	2.894	2.683	2.006	1.959	1.868
Proportion Var	0.157	0.107	0.099	0.074	0.073	0.069
Cumulative Var	0.157	0.264	0.363	0.438	0.51	0.579

Table 4.1. Factor Analysis of College Town

Interestingly for College Town specifically, Factor 3 is negatively weighed with respect to statements on safety. This suggests that there is a strong negative correlation between responses on neighborhood safety and other statements. Another interesting point is that the Factor 4 which is strongly associated with transportation is also heavily loaded by amenities. This suggest that for College Town, travel related characteristics, such as transit access, are related to perceptions of amenities.

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
food	0.353		-0.105	0.23	0.273	0.391	0.24	0.153
amn	0.632	-0.142		0.103		0.154		-0.184
ent	0.861			0.136	0.21			0.159
ppl	0.252		0.246	-0.163		0.178	0.129	
mopark	0.111					0.659		0.104
bipark	0.308	-0.227	0.165	0.717	0.104	0.18	0.179	
biwalk_access			0.248	0.753		0.192		
trnst_access	0.214		0.32	0.236	-0.313	0.294	-0.239	-0.124
connect		0.45		0.141		-0.139		-0.119
disapp		0.618	0.122		0.279			
happy	0.268	0.218			0.925			
needs	0.334	0.206	0.17	0.227	0.644	-0.285		-0.175
diverse	0.518	0.265	0.114	0.238	0.12			0.122
missing	-0.355	-0.341				-0.312	0.14	
type	0.267	0.677			0.189		0.327	
conscious		-0.517	0.2	0.169				
myself	0.434	0.541		-0.148	-0.299		0.145	-0.149
little		-0.324	-0.111				-0.795	
beau	0.183		0.914	0.145			0.133	
artistic		-0.106	0.655	0.134		0.294	0.23	
arch			0.577	0.154	0.117			0.16
atmos	0.133	0.213	0.123	0.393	0.317	0.113	0.261	
family		-0.104	0.195	0.157		0.484		-0.141
friendly		0.326				0.532		-0.357
rocculture	0.14		0.16	0.442	0.154		0.576	-0.152
badarea				0.181	-0.117			0.712
afraid	0.141	-0.321	0.234	-0.264				0.722
	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
SS loadings	2.441	2.354	2.13	1.986	1.927	1.651	1.457	1.44
Proportion Var	0.09	0.087	0.079	0.074	0.071	0.061	0.054	0.053
Cumulative Var	0.09	0.178	0.256	0.33	0.401	0.463	0.517	0.57

Table 4.2. Factor Analysis of East End

For the East End neighborhood, Factor 7 interestingly loads negatively on the Identity statement, “[This place] says little about myself,” and the positively for the statement “[This place] reflects Rochester culture.” One interpretation of Factor 7 is that The East End DOES reflect Rochester culture and says a lot about the person. The statement related to Food Satisfaction was not explained by any single factor. However, Factor 1 shows a strong association with amenities, entertainment and the diversity of services and product offered.

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Factor8
food	0.729		0.163	0.117		0.216		-0.267
amn	0.782	0.108		0.21				
ent	0.537					0.108	0.113	0.194
ppl	0.11	-0.112	0.292	0.502	0.152	0.375	0.128	
mopark			-0.102	0.579		0.132	0.113	
bipark	0.635		0.142		0.176	0.189	0.233	0.282
biwalk_access	0.258	-0.247	0.167	0.323		0.13	0.316	0.31
trnst_access			0.19				0.831	-0.192
connect	0.141	0.59		0.194	0.363		0.113	0.22
disapp		0.614	0.19	-0.209		0.237		
happy		0.636	0.377	0.103	0.278	0.114		
needs		0.248	0.203	-0.203			-0.16	0.718
diverse	0.27	0.326	0.129		0.13	0.866		0.144
missing	-0.198	-0.129	-0.149	-0.203	-0.104	-0.229	-0.394	
type	0.335	0.383	0.56				-0.175	0.175
conscious	-0.16		-0.182	-0.572			0.228	
myself	0.128	0.332	0.718				0.175	
little		-0.658	-0.117		0.104		0.146	
beau	0.179				0.893			
artistic	0.376	0.121	0.161	-0.25	0.191	0.506		
arch	0.296		0.159		0.564	0.322	-0.143	
atmos		0.231	0.556		0.105		0.264	
family	0.109		0.425	0.273		0.105		0.231
friendly			0.49	0.226	0.103	0.144	0.39	0.21
rocculture		0.402					0.225	-0.164
badarea				-0.552		0.193	-0.102	
afraid	0.112	-0.214		-0.328	-0.46		-0.224	
SS loadings	2.524	2.398	2.139	1.874	1.745	1.612	1.579	1.117
Proportion Var	0.093	0.089	0.079	0.069	0.065	0.06	0.058	0.041
Cumulative Var	0.093	0.182	0.262	0.331	0.396	0.455	0.514	0.555

Table 4.3 Factor Analysis of Rochester Public Market

Based on the factor analysis of responses for Rochester Public Market, there are strong factors relating to transit access, diversity of product and services, the beauty of the site and amenities that help explain the variability in responses to attitudinal statements. This is consistent with the character of RPM which is one of diversity in offerings.

4.5 Confirmatory Factor Analysis (CFA)

This section presents a preliminary factor analysis of the attitudinal statement responses. The literature agrees that Sense of Place (SOP) is a latent construct that indicates the relationship between visitors and/or community members and a specific location. As a preliminary analysis to the integrated latent factor choice model presented in the next chapter, a series of confirmatory factor analyses were conducted for each of the three sites.

The SOP literature suggests six latent constructs that help inform SOP: (i) Satisfaction; (ii) Attachment; (iii) Identity; (iv) Dependence; (v) Aesthetics and (vi) Social. These were described previously. We conduct a confirmatory factor analysis (CFA) for all six latent constructs for each of the three sites. However, based on the survey results, not all constructs were statistically significant

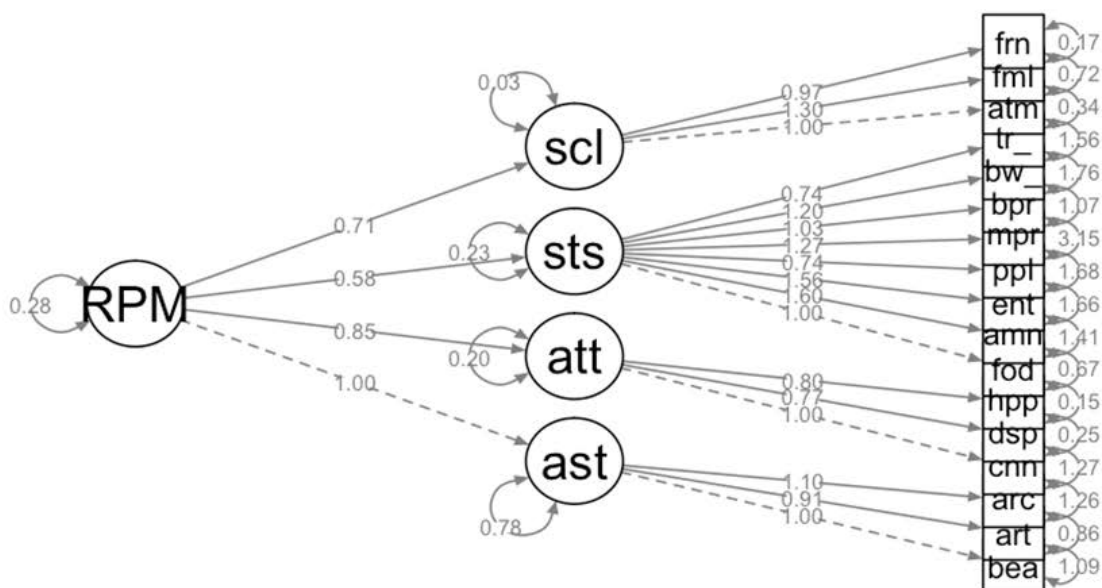


Figure 4.5: CFA for RPM

Figure 4.5 shows the factor structure for RPM. The dotted lines represent the scaling variable (factor loading is assumed to equal 1). Abbreviations for the observed variables can be found in Table 4.5. According to the CFA, the factor structure for RPM consists of four latent variables aesthetics (aes), attachment (att), satisfaction (sts) and social (scl). Factors dependence and identity (idn) were statistically insignificant at 95% confidence level.

4.5.2 Confirmatory Factor Analysis (CFA): East End (EE)

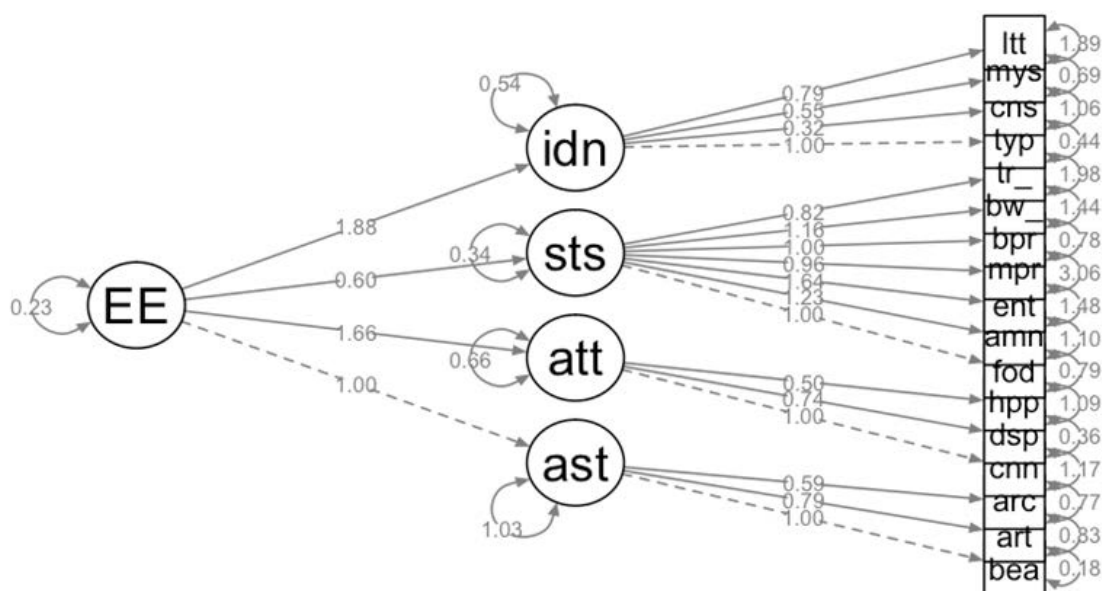


Figure 4.6: CFA for EE

Figure 4.X shows the factor structure for EE. The four factors used are aesthetics (ast), attachment (att), satisfaction (sts) and identity (idn). In comparison to RPM and CT, Social (scl) factor was insignificant, but identity (idn) was statistically significant.

4.5.3 Confirmatory Factor Analysis (CFA): College Town (CT)

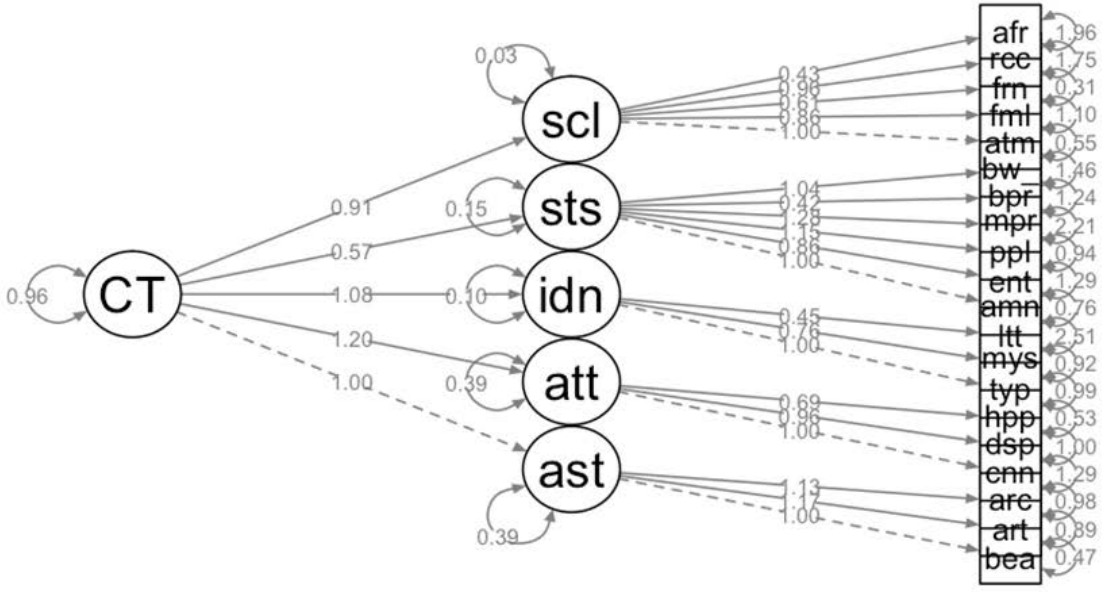


Figure 4.7: CFA for CT

Figure 4.7 shows the factor structure for CT. CT has a five-factor structure consisting of aesthetics (ast), attachment (att), satisfaction (sts), identity (idn) and social (scl). In all the three cases dependence was not included in the factor because we collected data for three observed variables. However in each location at least one observed variable (response) did not pass through the t-test. Leaving only two variables to inform dependence.

Sense of Place Attitudinal Statement	Code
I am satisfied with the food/dining options	Fod
I am satisfied with the amenities (benches for sitting, etc.)	Amn
I am satisfied with the entertainment options	Ent
I am satisfied with the amount of people	Ppl
I am satisfied with the motor vehicle parking	Mpr
I am satisfied with the bicycle parking	Bpr
I am satisfied with the bicycle/Walking access	bw_
I am satisfied with public transit access	tr_
I feel a strong connection with the place	Cnn
I would be disappointed if it did not exist	Dsp
It makes me feel happy	Hpp
It meets my need better than any location	
It has more diversity than any other place	
It has stores that has lacking things	
It reflects the type of person I am	Typ
It makes me feel too self-conscious	cnsc
It makes me feel I can be myself	Mys
It says very little about me	Ltt
It is a beautiful place	Bea
It has artistic value	Art
It has visually appealing architecture	Arc
Has a definite social atmosphere	Atm
It is a great family-friendly (including kids) place to be	Fml
Has generally friendly people around	Frn
Reflects the culture of Rochester	Rcc
Involves a risk of unpleasant encounters with people when traveling to and through it	Bad
Makes me afraid to walk/bike around	Afr

Table 4.4: Coding for Attitudinal Statements in CFA Figures

Chapter 5: Integrated Latent Variable Choice Model

One approach to examining the relationship between Sense of Place (SOP) and observed travel responses, such as mode choices and site visit frequency are integrated latent variable choice models, which combine a latent variable approach, such as factor analysis, with econometric choice models. Examples of latent variables in the transportation field include transit reliability and telecommunication adoption. Both measures are unobserved and likely help explain observed travel choices. In the current study, Sense of Place is modeled as a latent variable that informs observed stated travel responses. These responses were collected as part of an intercept survey at three neighborhood sites in Rochester, NY. The stated travel responses modeled were bike/walk and visit frequency to each of the three sites. This chapter first presents the theoretical and modeling framework for the integrated choice model. Second, the model specification used to examine SOP and travel in this study is presented and described. Finally this chapter ends with a presentation of estimation results.

5.1 Modelling Framework and Approach

Latent variables which are unobserved but measurable through responses to indicators arise frequently in the transportation and geography areas. The framework for this study models Sense of Place (SOP) as a latent variable, similar to those found in other contexts. The observed stated choices for neighborhood site walking/biking access and visit frequency are modeled as an ordinal choice model. The data used for estimating these models were collected from an intercept survey that collected responses to attitudinal measurement indicators and other respondent information. These attributes pertaining to the decision-maker, the location or setting, trip-making, the travel modes available and ICT adoption will also be included in the estimation and final model to the extent possible. The final model specification is an integrated model of the latent construct and observed stated travel choices. The model is jointly estimated using full information maximum likelihood in order to reduce efficiency loss from a sequential estimation (Walker 2001; Ben-Akiva and Lerman 1984).

The Sense of Place latent construct are estimated from attitudinal and perceptive responses obtained through the survey tool. In the integrated model latent constructs are linked to the utility of an ordinal choice model of bike/walk and visit frequency. This modeling approach integrates latent constructs with choice models in an attempt to explicitly analyze psychological factors and their effects on behavior which cannot be determined through revealed preferences alone. The entire model system is shown below in Figure 5.1. Utility, latent variables and indicators all have measurement and other errors indicated as ε , η and v respectively. Model estimation is accomplished through simulated maximum likelihood estimation (Walker and Ben-Akiva 2002). The estimated model parameters of the model provide the best fit for both the choice utilities and latent variable indicators that collectively describe Sense of Place and travel mode choices.

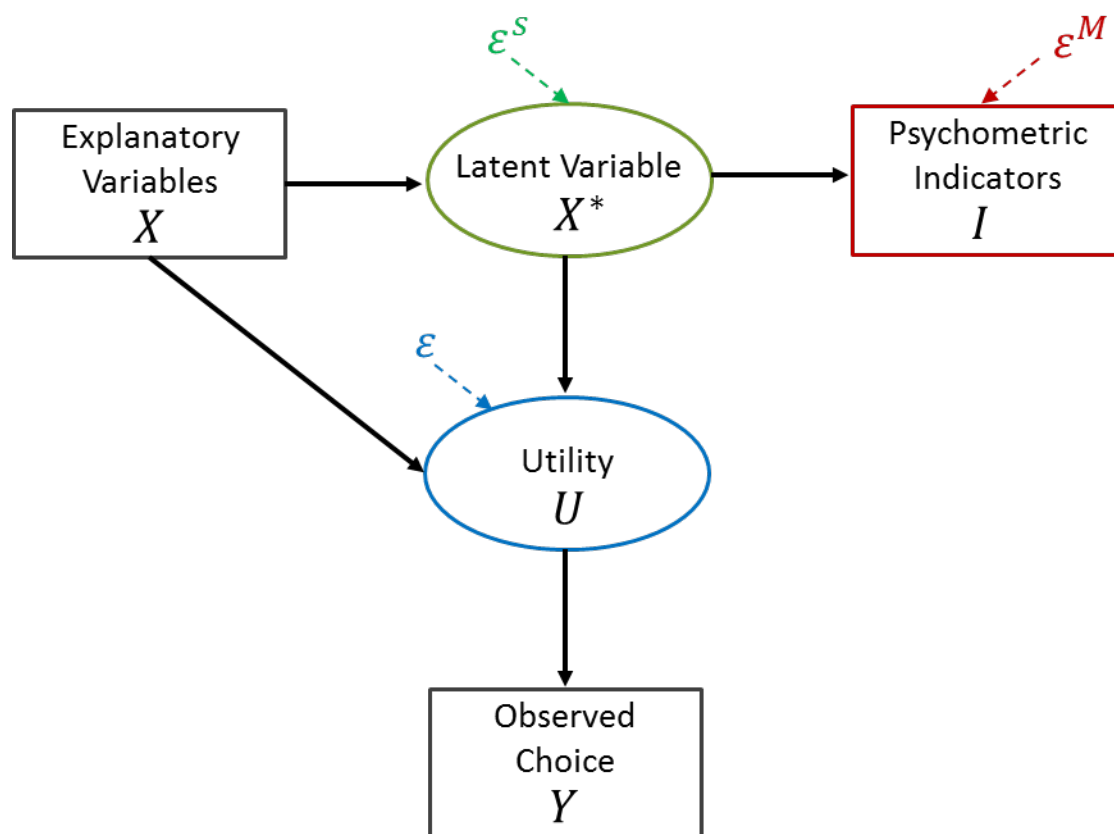


Figure 5.1: Framework of Integrated Latent Factor and Discrete Choice Models

In the transportation literature, similar approaches have been used to investigate constructs of (a) perceived benefit from telecommuting (Bernardino 1996), (b) satisfaction with traffic information systems (Polydoropoulou 1997) and (c) comfort on transit modes, typically linking latent constructs with observed choice behaviors such as mode choice (Morikawa et al. 2002).

Other behavioral and social science fields have investigated similar latent constructs in consumer/marketing, sociological and psychological studies (Jarvis et al. 2003). In the proposed work, the latent constructs are measured through (i) rating responses towards important sense of place dimensions indicated by the literature and (ii) observed attributes of the respondent, which includes ICT adoption and use, setting or site attributes, which include indicators of network accessibility and connectivity, and travel mode choice alternatives. The discrete choice model

portion of the integrated model is estimated given observed attributes of the respondent, setting/site and latent constructs. The main components of the modelling framework in Figure 5.1 are as follows:

Explanatory Variables (X): These include observed attributes of the decision-maker, the setting/site and ICT adoption decisions. These are all observed or collected through the survey developed and distributed, or through the site visits.

Latent Variables (X*) or Constructs (including Utility U): These singularly (if only one latent variable) or collectively describe Sense of Place, typically perceptions, attitudes or preferences. Perceptions indicate how respondents view the setting/site. Example of potential latent constructs for sense of place include: (a) environmental friendliness or (b) community. Attitudes are latent constructs that reflect individuals' needs, values, tastes and capabilities, such as the importance of community. For example, attitudes of about toothpaste include importance of health benefits, cosmetic benefits and price. Individual's preferences are also assumed to be latent variables that represent the desirability or utility of alternative choices.

Attitudinal and Perceptual Indicators (I): These consist of ratings towards statements regarding the dimensions of sense of place that are latent and psychological. The literature review in Task 1 will help inform and refine the final set of indicators and statements. The marketing field has long developed scales that evaluate latent consumer perceptions (Bearden and Netemeyer 1999). This proposed work adopts a similar approach, aiming to develop scales and indicators for sense of place. For example, respondent were asked to rate from 1 (strongly disagree) to 7 (strongly agree) to 27 indicators of Sense of Place taken from the literature. Three example statements include:

- iv) I feel a strong connection with this place.
- v) This place makes me happy
- vi) This place reflects the culture of Rochester.

Travel Responses (Y): Observed stated responses to transportation related the respondents surveyed. These include both revealed modes from the observed trip/visit to the site and mode choices from scenarios in the online survey. These two questions were stated as follows:

- i) Which statement best describes how often do you visit this location?
- ii) Which statement best describes how often do you bike/walk to this location during the summer and spring months?

Survey respondents had the following options for responding to these two statements:

- i) Less than once a month
- ii) Once a month
- iii) Once in three weeks
- iv) Once in two weeks

- v) Once a week
- vi) Twice a week
- vii) Three or more times a week
- viii) Every day (Daily)

For bike/walk frequency the first option (i) was: I never bike/walk here (0 times).

5.1.1 Model Formulation

This section presents the theoretical model formulation. The literature in transportation on discrete choice models with latent variables has a growing history (Walker 2001, Greene and Hensher, 2003). Latent variables that are unobservable to the analyst and arise often when examining travel choices. Utility in disaggregate choice models is one example of a latent variable that is measure indirectly as a function of observed variables.

5.1.1.1 Latent Variable Model Component

Due to its latency, latent variables are modeled as random variables characterized by a structural equation:

$$X^* = h(X|\beta^S) + \varepsilon^S \quad (\text{Eq. 1})$$

X^* a latent variable (i.e. utility, reliability, etc.)

X a vector of explanatory variables, observed and/or unobserved

β^S a vector of parameters to be estimated from the data

ε^S a random error term

The most common specification for $h(\cdot)$ is a linear in parameters specification, shown below for K parameters:

$$h(X|\beta^S) = \beta_0^S + \beta_1^S X_1 + \beta_2^S X_2 + \cdots + \beta_K^S X_K \quad (\text{Eq. 2})$$

The analyst obtains information about latent variables through observed decisions or behaviors that provide an indirect measurement. For example, in discrete choice theory, the utility of an alternative is indirectly measured through observed choices. Measurement equations characterize the relationship between a latent variable and observed measurements. The measurement equation has the following functional form:

$$Z = m(X^*, X | \beta^m) + \varepsilon^m \quad (\text{Eq. 3})$$

- X^* a latent variable (i.e. Utility)
 X a vector of explanatory variables, both observed and unobserved
 β^m a vector of K parameters to be estimated from the data
 ε^m a random error term

The most common specification for $m(\cdot)$ is a linear in parameters specification, shown below for K parameters:

$$m(X^*, Y | \beta^m) = \beta_0^m + \beta_1^m Y_1 + \beta_2^m Y_2 + \dots + \beta_K^m Y_K \quad (\text{Eq. 4})$$

If observed discrete ordered variables are available as measurements, another function for the measurement equation is necessary, relating the measurement equation (Eq. 4) to an observed response to the measurement indicator I . One example of these type of measurements are responses to psychometric or marketing indicators revealing latent variables associated with attitudes and perceptions. In a majority of instances, these are coded using a Likert scale. These types of scales are used across a wide range of fields for latent constructs (X^*) such as altruism (Rushton et al. 1981; Lusk et al. 2007), attitudes towards green products (Hartmann and Apaolaza-Ibanez 2012), and trust in e-shopping (Lee and Turban 2001).

Assume the measurement indicator is represented by an ordered discrete variable I taking the values j_1, j_2, \dots, j_M , as follows:

$$I = \begin{cases} j_1, & Z < \tau_1 \\ j_2, & \tau_1 \leq Z < \tau_2 \\ \vdots & \\ j_M, & \tau_{M-1} \leq Z \end{cases} \quad (\text{Eq. 5})$$

For example, in this study respondent were asked to rate from 1 (strongly disagree) to 7 (strongly agree) to 27 indicators of Sense of Place taken from the literature; $M = 7$ in this case for each of the Likert scale levels. $\tau_1, \tau_2, \dots, \tau_{M-1}$ are parameters to be estimated, such that:

$$\tau_1 \leq \tau_2 \leq \dots \leq \tau_{M-1} \quad (\text{Eq. 6})$$

The probability of a given response j_i is:

$$Pr(j_i) = Pr(\tau_{i-1} \leq Z < \tau_i) = Pr(\tau_{i-1} \leq Z < \tau_i) = F_{\varepsilon^m}(\tau_i) - F_{\varepsilon^m}(\tau_{i-1}) \quad (\text{Eq. 7})$$

$F_{\varepsilon^m}(\cdot)$ is the cumulative distribution function (CDF) of the error term ε^m . If a normal distribution is assumed, the model above becomes an ordered probit, where $F_{\varepsilon^m}(\cdot)$ is the normal CDF. In the case of a binary choice, there are two categories: chosen or not chosen (i.e. $M=2$). The measurement equation for discrete choice models is:

$$Z_{in} = U_{in} - \max_j U_{jn} \quad (\text{Eq. 8})$$

Such that

$$I_{in} = \begin{cases} 0, & z_{in} < 0 \\ 1, & z_{in} \geq 0 \end{cases} \quad (\text{Eq. 9})$$

Similarly, in the case that there are seven measurement levels $M=7$, we define six parameters τ_i and their relationships as follows:

$$\tau_1 = -\delta_1 - \delta_2 - \delta_3 \quad (\text{Eq. 10})$$

$$\tau_2 = -\delta_1 - \delta_2 \quad (\text{Eq. 11})$$

$$\tau_3 = -\delta_1 \quad (\text{Eq. 12})$$

$$\tau_4 = \delta_1 \quad (\text{Eq. 13})$$

$$\tau_5 = \delta_1 + \delta_2 \quad (\text{Eq. 14})$$

$$\tau_6 = \delta_1 + \delta_2 + \delta_3 \quad (\text{Eq. 15})$$

The probability of a given response assuming a normal error term is an ordered probit model:

$$\begin{aligned} Pr(I_i = j_i) &= Pr(\tau_{i-1} \leq Z \leq \tau_i) \\ &= Pr(\tau_{i-1} \leq \beta_{0i}^m + \beta_i^m \bar{X}^* + \sigma_i^* \varepsilon_i^* \leq \tau_i) \\ &= Pr\left(\frac{\tau_{i-1} - \beta_{0i}^m - \beta_i^m \bar{X}^*}{\sigma_i^*} \leq \varepsilon_i^* \leq \frac{\tau_i - \beta_{0i}^m - \beta_i^m \bar{X}^*}{\sigma_i^*}\right) \\ &= \Phi\left(\frac{\tau_i - \beta_{0i}^m - \beta_i^m \bar{X}^*}{\sigma_i^*}\right) - \Phi\left(\frac{\tau_{i-1} - \beta_{0i}^m - \beta_i^m \bar{X}^*}{\sigma_i^*}\right) \end{aligned} \quad (\text{Eq. 16})$$

Consider the following measurement equation for the indicator i above. In this measurement equation, there is only one latent variable X^* with the function form as follows:

$$X^* = \beta_0^s + \sum_{k=1}^K \beta_k^s X_k + \sigma^s \varepsilon^s \quad (\text{Eq. 17})$$

$$X^* = \bar{X}^* + \sigma^s \varepsilon^s \quad (\text{Eq. 18})$$

$$Z = \beta_{0i}^m + \beta_i^m X^* + \sigma_i^m \varepsilon_i^m \quad (\text{Eq. 19})$$

$$\varepsilon_i^m \sim N(0,1)$$

Combining Eq. 17 into Eq. 19.

$$Z = \beta_{0i}^m + \beta_i^m(\bar{X}^* + \sigma^s \varepsilon^s) + \sigma_i^m \varepsilon_i^m \quad (\text{Eq. 20})$$

$$Z = \beta_{0i}^m + \beta_i^m \bar{X}^* + \beta_i^m \sigma^s \varepsilon^s + \sigma_i^m \varepsilon_i^m \quad (\text{Eq. 21})$$

This term $\beta_i^m \sigma^s \varepsilon^s + \sigma_i^m \varepsilon_i^m$ is normally distributed with mean 0 and variance $(\sigma_i^*)^2$, where:

$$(\sigma_i^*)^2 = (\beta_i^m \sigma^s)^2 + (\sigma_i^m)^2 \quad (\text{Eq. 22})$$

If σ^s is normalized to 1 then

$$(\sigma_i^*)^2 = (\beta_i^m)^2 + (\sigma_i^m)^2 \quad (\text{Eq. 23})$$

$$\sigma_i^m = \sqrt{(\sigma_i^*)^2 - (\beta_i^m)^2} \quad (\text{Eq. 24})$$

$$Z = \beta_{0i}^m + \beta_i^m \bar{X}^* + \sigma_i^* \varepsilon_i^* \quad (\text{Eq. 25})$$

$$\varepsilon_i^* \sim N(0,1)$$

Due to the identification problem, not all the parameters are identified from the data. We need to set the scale of the latent variables. For example, we may choose to set it to the first indicator i by normalizing as follows: $\beta_{01} = 0$ and $\beta_1^m = -1$, assuming the first indicator has a negative impact on the latent variable. For example, if the latent variable is “car loving” these values indicate as “car loving” attitude decreases, the indicator increases.

5.1.1.2 Choice Model Component

In addition to a latent variable model, the final integrated model has a choice model component. In this study, travel choices are characterized by orders responses to the frequency of biking/walking and visiting the destination. Due to the ordinal nature of the observed stated travel response, an ordered logit is used to model these observations. Assume a utility U represents a latent propensity towards biking/walking or visiting a neighborhood site more, where higher levels of U mean the person is observed stating greater frequency in both. If U is above some cutoff τ_7^U ,

the respondent indicates “strongly agree” to the attitudinal statements described previously. If U is below some cutoff τ_7^U , but above another cutoff τ_6^U the respondent indicates “agree” to the attitudinal statement. If the original 7 ordered levels are aggregated into 3 ordered levels, this ordered decision is represented:

$$Y = \begin{cases} 1, & U < \tau_1^U \\ 2, & \tau_1^U \leq U < \tau_2^U \\ 3, & \tau_2^U \leq U \end{cases} \quad (\text{Eq.26})$$

- 1 indicates never, less than once a month, or once a month
 - 2 once in three weeks, once in two weeks, or once a week
 - 3 twice a week, three or more times a week, or every day (daily)
- Y is the stated travel response from the survey respondent.

The utility can be further decomposed in to observed, comprised of attributes of the decision maker and sites X , and unobserved components, including the latent variable X^* as follows:

$$U = \beta_0 + \beta^*X^* + \beta X + \varepsilon \quad (\text{Eq. 27})$$

Once a distribution for the error term ε is specified, the probabilities can be calculated exactly. Assume ε is assumed logistic, which means the CDF of ε is $F(\varepsilon) = \exp(\varepsilon)/(1 + \exp(\varepsilon))$. The probability of observing the response 2 for the indicator in Eq. 26 above is given as:

$$\begin{aligned} Pr(Y = 2) &= Pr(\tau_1^U - \beta_0 - \beta^*X^* - \beta X \leq \varepsilon < \tau_2^U - \beta_0 - \beta^*X^* - \beta X) \quad (\text{Eq. 28}) \\ &= \frac{\exp(\tau_{i-1}^U - (\beta_0 + \beta^*X^* + \beta X))}{1 + \exp(\tau_{i-1}^U - (\beta_0 + \beta^*X^* + \beta X))} - \frac{\exp(\tau_i^U - (\beta_0 + \beta^*X^* + \beta X))}{1 + \exp(\tau_i^U - (\beta_0 + \beta^*X^* + \beta X))} \end{aligned}$$

5.1.1.3 Likelihood Function

Due to the inclusion of the normally distributed term β^*X^* , the joint latent variable choice model becomes a mixed logit where the distribution of β^*X^* is the mixing distribution. The final joint likelihood function of the latent variable and choice model is for the observed sample is:

$$L_n(Y, I|X; \beta, \beta^S, \beta_r^M, \tau^U, \tau, \Sigma) = \int_{\varepsilon_r^*} Pr(Y = i) \cdot \prod_{r=1}^R Pr(I_r = j_{in} | \varepsilon^S) \cdot \Phi(\varepsilon_r^*) d\varepsilon_r^* \quad (Eq. 29)$$

The estimation of the integrated model can be done sequentially or jointly, using full information maximum likelihood for Eq. 29. For a sequential estimation, the latent variable model is estimated first (Eq. 17-19). Using the estimated coefficients, the latent variable X^* value is determined for each observation in the sample, and the choice model component is estimated subsequently on X^* and X . For a FIML estimation, both components are estimated jointly using the likelihood function for the sample in Eq. 29.

5.1.2 Model Specifications

Given the theoretical formulation, this section provides the model specifications for (i) bike/walk and (ii) visit frequency to the site neighborhood. For both models, a single latent variable for Sense of Place (SOP) was estimated jointly with the observe travel stated responses. This latent variable was modeled on the bases of responses to a 27 Likert scale indicator responses, of which only 11 were found to be statistically significant in the final model specification. The structural equation was specified as follows:

$$X^* = \beta_0^S + \beta_1^S X_1 + \beta_2^S X_2 + \dots + \beta_K^S X_K + \varepsilon^S \quad (Eq. 30)$$

X^* a latent variable, in this case Sense of Place (SOP)

X a vector of explanatory variables, observed and/or unobserved

β^S a vector of parameters to be estimated from the data

ε^S a random error term, which is assumed to be normally distributed $N(0,1)$

The measurement equation Z that related the latent variable X^* to the observed responses to indicators I was specified as follows:

$$Z_i = \beta_{0i}^m + \beta_i^m X^* + \sigma_i^m \varepsilon_i^m \quad (\text{Eq. 31})$$

$$I_i = \begin{cases} j_1, & Z_i < \tau_1 \\ j_2, & \tau_1 \leq Z_i < \tau_2 \\ \vdots & \\ j_7, & \tau_6 \leq Z_i \end{cases} \quad (\text{Eq. 32})$$

X^* a latent variable, in this case Sense of Place (SOP)

Z_i the measurement equation for indicator i , which is a function of the latent variable X^*

β_i^m a vector of parameters for indicator i to be estimated from the data, for indicator

ε_i^m a random error term for indicator i , which is assumed to be normally distributed $N(0,1)$

I_i response to an a indicator statement, such as an attitudinal statement $i=1$ to 27

The choice model based on stated responses to bike/walk and visit frequency is specified next. Since both responses are ordinal in nature, the ordinal logit model is used. Specify the utility as follows:

$$U = \beta_0 + \beta^* X^* + \beta X + \varepsilon \quad (\text{Eq. 33})$$

X^* a latent variable, in this case Sense of Place (SOP)

X a vector of explanatory variables

β a vector of parameters to be estimated from the data

ε a random error term, assumed to be logistically distributed

In the final model specification, only 11 of the original 27 Likert scale indicators for Sense of Place (SOP) were found statistically significant. The final specification for the integrated latent choice model had the following equations:

- a) 1 structural, for the single latent variable SOP (Eq. 30)
- b) 11 measurement equations, one for each of the SOP indicators retained (Eq. 31)
- c) 1 utility function for the choice of frequency level for bike/walk and visits (Eq. 33)

The final likelihood function for the observed sample is:

$$L_n(Y, I|X; \beta, \beta^S, \beta_r^M, \tau^U, \tau, \Sigma) = \int_{\varepsilon_r^*} Pr(Y = i) \cdot \prod_{r=1}^{11} Pr(I_r = j_{in} | \varepsilon^S) \cdot \Phi(\varepsilon_r^*) d\varepsilon_r^* \quad (Eq. 34)$$

The final model was estimated using Full Information Maximum Likelihood (FIML) using the likelihood function in Eq. 34.

5.2 Estimation Results

Based on the specification presented previously, this section presents the estimation results for the integrated latent variable model. Responses from an intercept survey were used for estimation. This model consist of one single latent variable labeled as Sense of Place (SOP), which was estimated as a driving motivator to observed responses to indicator statements used as measurements for SOP. The original survey had 27 Likert scale indicators for SOP; however, only 11 were retained as statistically significant in the final specification. Furthermore, while the single latent variable SOP could be further partitioned into multiple latent constructs that represent the dimensions of SOP found in the literature, such as satisfaction and dependence. However, to produce easily interpretable results, SOP was modeled as a single latent variable. For the latent variable model, the first indicator, satisfaction with food offerings at the site, was scaled to $\beta_{01} = 0$ and $\beta_1^m = 1$, indicating a higher value for the latent variable SOP would contribute towards a higher rating for that statement.

The estimation results for the observed visit frequency are presented first, followed by walk/bike frequency. For each choice dimension, we first discuss the latent variable model estimation results, followed by those for the choice model. Finally, while a joint model on both observed stated frequencies is possible, to limit the computational requirements, these were estimated separately.

5.2.1 Model of Visit Frequency

To assess the relationship between SOP and visit frequency to a particular neighborhood site, survey respondents answered the following statement:

“Which statement best describes how often do you visit this location [*Rochester Public Market, East End or College Town*]?”

Respondents selected one of the following discrete alternatives, which were subsequently aggregated into three ordered responses:

- 1) Less than once a month, once a month
- 2) Once in three weeks, Once in two weeks, Once a week
- 3) Twice a week, Three or more times a week, Every Day (Daily)

The latent variable model indicates that the respondent age positively impacts the latent variable SOP. The estimation results indicate that older visitors perceive a higher SOP relative to those less than 45 years of age. A similar trend also holds for respondents that have lived in Rochester from 1 to 10 and more than 10 years. Both of these results are intuitive and suggest that SOP improves with age and length of residency in Rochester. Additionally, observations from Rochester Public Market (RPM) seem to perceive a higher SOP on average over respondents at the other two sites. One of the main hypothesis of this study was the impact of ICT usage on SOP. While the coefficient of respondents searching and reviewing online information was positive, indicating a positive impact on SOP, it was found to be statistically insignificant.

With respect to the attitudinal statements, dimensions with the most statistical significance in explaining SOP were attachment, dependence and identification. Most statements related to satisfaction and social, were statistically insignificant. The dimension of aesthetics did not have any statistically significant statements for the measurement model. This seems to suggest that the design and architecture of the location does not contribute much to SOP. This reflects much of the literature on SOP which agrees on the connection with the environment SOP embodies. The dimensions of satisfaction, social and aesthetics, were additional dimensions uncovered by (Deutsch et al. 2013; Deutsch and Goulias 2010; Deutsch and Goulias 2011).

The choice model for visit frequency indicates that the latent variable Sense of Place (SOP) has a positive impact that is statistically significant, such that locations with a higher SOP see higher stated visit frequencies. Additionally, respondents that have lived in Rochester a longer number of years showed a higher stated frequency relative to those less than one year of residency. Additionally, with respect to specific locations, respondents from RPM state lower visit frequencies, relative to College Town, while the East End respondents stated higher visit frequencies. However, the lower frequencies for RPM may be attributable to the limited hours the market is open. While the shops around the market are open most days of the week, the actual market is only open Tuesdays, Thursdays and Saturdays.

Latent Variable Model - Sense of Place (SOP)

Structural Model	Value	Standard Error	t-statistic	Measurement Model	Value	Standard Error	t-statistic
Respondent Age is 45 to 54 years (1/0)	0.489	0.173	2.83	Intercept Satisfaction - Food	0.000	---	---
Respondent Age is 55 or more years (1/0)	0.344	0.152	2.26	Intercept Satisfaction - Amount of People	0.485	0.23	2.11
Intercept Term	0.958	0.253	3.79	Intercept Attachment - Connection	-1.110	0.328	-3.37
Location - Rochester Public Market (1/0)	0.990	0.122	8.15	Intercept Attachment - Dissappointed	-0.090	0.333	-0.27
Search/Review Online Information on Location (1/0)	0.176	0.125	1.41	Intercept Attachment - Feel Happy	0.363	0.202	1.80
Respondent Years in Rochester: 1-10 years (1/0)	0.373	0.189	1.97	Intercept Dependence - Diversity in Activities	-0.355	0.221	-1.61
Respondent Years in Rochester: +10 years (1/0)	0.470	0.179	2.63	Intercept Dependence - Needs	-0.669	0.278	-2.41
Measurement Model	Value	Standard Error	t-statistic	Intercept Identification - Myself	0.685	0.212	3.23
Satisfcation - Food	1.000	---	---	Intercept Identification - Type of Person	-1.060	0.24	-4.39
Satisfaction - Amount of People	0.731	0.121	6.02	Intercept Social - Friendly Encounters	1.070	0.164	6.55
Attchment - Connection	1.610	0.172	9.38	Intercept Social - Rochester Culture	-0.014	0.23	-0.06
Attachment - Dissappointed	1.850	0.213	8.70	Sigma-Star Satisfcation - Food	1.000	---	---
Attachment - Feel Happy	1.190	0.124	9.60	Sigma-Star Satisfaction - Amount of People	1.530	0.122	12.51
Dependence - Diversity in Activities	0.955	0.111	8.57	Sigma-Star Attchment - Connection	1.540	0.134	11.44
Dependence - Needs	1.210	0.138	8.75	Sigma-Star Attachment - Dissappointed	1.330	0.148	8.97
Identification - Myself	0.950	0.116	8.20	Sigma-Star Attachment - Feel Happy	0.957	0.0911	10.51
Identification - Type of Person	1.240	0.115	10.77	Sigma-Star Dependence - Diversity in Activities	1.270	0.1	12.72
Social - Friendly Encounters	0.742	0.0919	8.07	Sigma-Star Dependence - Needs	1.490	0.123	12.07
Social - Rochester Culture	0.928	0.121	7.68	Sigma-Star Identification - Myself	1.230	0.109	11.32
Delta 1	0.459	0.036	12.74	Sigma-Star Identification - Type of Person	1.070	0.0877	12.16
Delta 2	0.829	0.0555	14.94	Sigma-Star Social - Friendly Encounters	0.951	0.0837	11.36
Delta 3	1.290	0.0767	16.77	Sigma-Star Social - Rochester Culture	1.390	0.111	12.51

Table 5.1: SOP Latent Variable Model Component – Visit Frequency

Ordinal Choice Model - Visit Frequency to Destination

Explanatory Variable Name	Value	Standard Error	t-statistic
Location - East End (1/0)	1.430	0.378	3.78
Location - Rochester Public Market (1/0)	-1.380	0.374	-3.68
Sense of Place (latent)	0.393	0.157	2.50
Respondent Years in Rochester: 1 to 5 years (1/0)	1.390	0.433	3.20
Respondent Years in Rochester: 6 to 10 years (1/0)	1.310	0.596	2.20
Respondent Years in Rochester: +10 years (1/0)	1.090	0.388	2.80
Tau	0.334	0.417	0.80
Delta	2.440	0.208	11.73
Number of Observations	263		
Log-Likelihood (initial)	-7533.841		
Log-Likelihood (final)	-3906.493		
-2(LL(β_0)-LL(β))	7254.695		
Rho-Squared	0.481		

Table 5.2: Choice Model Component – Visit Frequency

The results also indicate differences in SOP perception attributable to location design.

5.2.2 Model of Walk/Bike Frequency

To assess the relationship between SOP and non-motorized travel, in particular bike/walk access frequency to a particular neighborhood site, survey respondents answered the following statement:

“Which statement best describes how often do you bike/walk to this location [*Rochester Public Market, East End or College Town*] during the summer and spring months?”

Respondents selected one of the following discrete alternatives, which were subsequently aggregated into three ordered responses:

- 1) Almost Never, Once a month
- 2) Once in three weeks, Once in two weeks, Once a week
- 3) Twice a week, Three or more times a week, Every Day (Daily)

For the bike/walk frequency model, estimation results for the latent variable model were similar to those for the visit frequency model. The estimates indicate that respondent age positively impacts the latent variable SOP, with older visitors perceiving a higher SOP relative to those less than 45 years of age. Respondents that have lived in Rochester from 1 to 10 and more than 10 years show have a similar impact. Both of these results are intuitive and suggest that SOP improves with age and length of residency in Rochester. Additionally, respondents from Rochester Public Market (RPM) seem to perceive a higher SOP on average over respondents at the other two sites. One hypothesis of this study was the impact of ICT usage on SOP. While the coefficient of respondents searching and reviewing online information was positive, indicating a positive impact on SOP, it was found to be statistically insignificant, similar to previous models. One reason behind this may be the variability in interpretation of the question.

With respect to the attitudinal statements, dimensions with the most statistical significance in explaining SOP were once again attachment, dependence and identification. This result is consistent with the site visit frequency model. Most statements related to satisfaction and social, were statistically insignificant. Also, the dimension of aesthetics did not have any statistically significant statements for the measurement model. This seems to suggest that the design and architecture of the location does not contribute much to SOP. This reflects much of the literature on SOP which agrees on the connection with the environment SOP embodies. The dimensions of satisfaction, social and aesthetics, were additional dimensions uncovered by (Deutsch et al. 2013; Deutsch and Goulias 2010; Deutsch and Goulias 2011).

The choice model for bike/walk frequency indicates that the latent variable Sense of Place (SOP) has a positive impact that is statistically significant, such that locations with a higher SOP see higher stated walk/bike frequencies. Additionally, respondents that have lived in Rochester a longer number of years showed a higher stated frequency relative to those less than one year of residency. Additionally, with respect to specific locations, respondents from RPM state lower visit frequencies, relative to College Town, while the East End respondents stated higher visit frequencies. However, the lower frequencies for RPM may be attributable to the limited hours the market is open. While the shops around the market are open most days of the week, the actual market is only open Tuesdays, Thursdays and Saturdays.

Latent Variable Model - Sense of Place (SOP)

Structural Model	Value	Standard Error	t-statistic	Measurement Model	Value	Standard Error	t-statistic
Respondent Age is 45 to 54 years (1/0)	0.488	0.173	2.82	Intercept Satisfaction - Food	0.000	---	---
Respondent Age is 55 or more years (1/0)	0.346	0.152	2.27	Intercept Satisfaction - Amount of People	0.485	0.23	2.1
Intercept Term	0.958	0.253	3.79	Intercept Attachment - Connection	-1.090	0.327	-3.33
Location - Rochester Public Market (1/0)	0.994	0.122	8.16	Intercept Attachment - Dissatisfied	-0.087	0.332	-0.26
Search/Review Online Information on Location (1/0)	0.179	0.125	1.44	Intercept Attachment - Feel Happy	0.358	0.202	1.77
Respondent Years in Rochester: 1-10 years (1/0)	0.466	0.18	2.59	Intercept Dependence - Diversity in Activities	-0.356	0.221	-1.61
Respondent Years in Rochester: +10 years (1/0)	0.377	0.19	1.99	Intercept Dependence - Needs	-0.657	0.277	-2.37
Measurement Model	Value	Standard Error	t-statistic	Intercept Identification - Myself	0.678	0.212	3.19
Satisfaction - Food	1.000	---	---	Intercept Identification - Type of Person	-1.050	0.24	-4.39
Satisfaction - Amount of People	0.732	0.129	5.68	Intercept Social - Friendly Encounters	1.070	0.164	6.56
Attachment - Connection	1.590	0.228	6.98	Intercept Social - Rochester Culture	-0.020	0.23	-0.09
Attachment - Dissatisfied	1.850	0.293	6.3	Sigma-Star Satisfaction - Food	1.000	---	---
Attachment - Feel Happy	1.190	0.139	8.59	Sigma-Star Satisfaction - Amount of People	1.530	0.122	12.51
Dependence - Diversity in Activities	0.956	0.123	7.79	Sigma-Star Attachment - Connection	1.540	0.135	11.47
Dependence - Needs	1.200	0.162	7.38	Sigma-Star Attachment - Dissatisfied	1.330	0.148	8.96
Identification - Myself	0.955	0.133	7.19	Sigma-Star Attachment - Feel Happy	0.954	0.0909	10.49
Identification - Type of Person	1.240	0.143	8.63	Sigma-Star Dependence - Diversity in Activities	1.270	0.1	12.72
Social - Friendly Encounters	0.741	0.0978	7.58	Sigma-Star Dependence - Needs	1.490	0.124	12.08
Social - Rochester Culture	0.932	0.145	6.45	Sigma-Star Identification - Myself	1.230	0.108	11.31
Delta 1	0.460	0.0361	12.74	Sigma-Star Identification - Type of Person	1.070	0.0877	12.16
Delta 2	0.831	0.0556	14.94	Sigma-Star Social - Friendly Encounters	0.951	0.0837	11.36
Delta 3	1.290	0.0768	16.78	Sigma-Star Social - Rochester Culture	1.390	0.111	12.51

Table 5.3: SOP Latent Variable Model Component – Bike/Walk Frequency

Ordinal Choice Model - Bicycle/Walking Frequency to Destination

Explanatory Variable Name	Value	Standard Error	t-statistic
Location - East End (1/0)	0.911	0.348	2.62
Location - Rochester Public Market (1/0)	-1.330	0.382	-3.49
Number of Bikes in HH	0.261	0.098	2.65
Number of Vehicles in HH	-0.639	0.156	-4.09
Sense of Place (latent)	0.250	0.164	1.53
Tau	-0.255	0.433	-0.59
Delta	0.844	0.123	6.85
Number of Observations	263		
Log-Likelihood (initial)	-6492.264		
Log-Likelihood (final)	-3887.699		
-2(LL(β_0)-LL(β))	5209.130		
Rho-Squared	0.401		

Table 5.4: Choice Model Component – Walk/Bike Frequency

5.3 Synthesis

This section presented estimation results from two integrated latent variable choice models. The intent was to investigate the impact of SOP on two dimensions of travel. The first dimension, was site visit frequency, for which SOP had a positive impact which was statistically significant. Respondents that perceived a higher level of SOP at a site, had a higher likelihood of visiting that site more frequently. Similarly, SOP had a positive impact on walk/bike frequency to the site. However, in this case it was found to be statistically insignificant.

With respect to the latent variable SOP, many observed responses were found to be positively impacted by it. The latent variable estimation for both models was similar. For both models, SOP was found to explain responses to statements on identity, dependence, and attachment. SOP also explained Social and Satisfaction dimensions, however, fewer of the attitudinal statements from the two dimensions were statistically significant. Aesthetics had no statements which were explained by SOP in a statistically significant manner. This is consistent with past social science literature on SOP which has characterized it as mainly a connection with the environment. The dimensions of social, satisfaction, and aesthetics were additional dimensions found later by other researchers. Respondents from RPM were found to perceive a higher SOP in general, relative to the other three sites.

Chapter 6: Digital Narratives of Place: Learning about SOP through Online Reviews

6.0 INTRODUCTION AND BACKGROUND

Increasingly transportation and urban planners have focused on fostering and building livable communities that benefit community well-being along several dimensions, including health and socialization. Livable communities critically require *Sense of Place* (SOP), which characterizes how humans interact with their natural and built environments, and each other, collectively. Locations with a strong SOP can facilitate lasting connections between visitors and the location. Additionally, SOP has gradually entered several organizational decision-making levels, from local municipalities and neighborhoods (Soini et al. 2012; Tester et al. 2011) to international discussions on ecology, the environment and sustainability (Newman & Jennings 2012). SOP has also gained momentum in many other research fields, ranging from anthropology to environmental psychology. Applications include the planning and design of urban spaces (Billig 2005; Deutsch et al. 2013) and natural resource management (Brown & Raymond 2007). Furthermore, the United Nations Environmental Program (UNEP) has identified SOP as an essential feature of sustainable environments, including aspects of the surrounding ecosystem (Newman & Jennings 2012).

SOP has both human and physical dimensions (Stedman 2003a). The human dimensions have been researched extensively and often considered core to SOP (Tapsuwan et al. 2011; Stedman 2003a; Deutsch et al. 2013). These human dimensions find their basis in attitude theory which defines three distinct factors: affective, cognitive and conative. Subsequently, researchers have characterized SOP along these three dimensions (Jorgensen & Stedman 2001). *Place Attachment*, the affective component, is defined as the positive bond developed between a person and their environment (Low & Altman 1992). *Place Dependence*, the cognitive component, measures the perceived strength of association between a person and a place (Stokols & Shumaker 1982). *Place identity*, the conative component, represents the individual's identity in relation to the physical environment (Proshansky et al. 1983; Proshansky 1978). Other studies have identified additional influential aspects, such as *Place Satisfaction*, social and architectural/aesthetic settings. *Place Satisfaction* is the summary judgment of the perceived quality of a place/environment (Mesch & Manor 1998). The social and aesthetics settings are more loosely defined. Aesthetics includes views on architecture, the beauty of the place, the balance of decorative and functional attributes, artistic value, peaceful and relaxing atmosphere. Social includes the topics such as social atmosphere, the level of crowdedness, amount of activity, safety, the level of friendliness to people (generally), kids and family and safety of walking around (Deutsch & Goulias 2010; Deutsch & Goulias 2011; Deutsch et al. 2013).

From an implementation and practitioner standpoint, urban design and natural resource management contexts have shown the strongest interest in SOP. Within urban design, SOP is considered a guiding principle for designing public spaces and built environments, to shape social contexts and foster social connections. From the perspective of the natural environment, SOP can also provide a framework for encouraging or strengthening commitment and environmental stewardship towards a given place, such as national parks, which is necessary for growth and maintenance (Williams & Stewart 1998).

Given that SOP explores the perceptual and psychological relationships between people and places, researchers are beginning to explore the applicability of SOP in travel behavior. First, SOP advances behavior models by adding a psychological element to choice process which is usually modeled based on economic realism. Researchers have explored the influence of some or all aspects of SOP as an explanatory variable for travel choice modeling. Zandvliet et al. (2006) studied place identity and its relation to destination choices in Netherlands (Zandvliet et al. 2006). A series of research papers from University of California, Santa Barbara explore many travel behavior facets of visitors (arrival time, mode, frequency, sequence of activities, companionship, and long distance travel) and SOP of two malls in Santa Barbara (Lee et al. 2015; Deutsch & Goulias 2010; Deutsch et al. 2013).

Quantitative approaches towards *Sense of Place* (SOP) measurement are typically multidimensional and examine the strength that each SOP dimension associates with a particular location. Intercept surveys containing Likert scale attitudinal statements are typically used to measure these dimensions (Stedman 2003b). Responses can estimate and measure the strength of each statement response towards each dimension. Factor analysis and structural equation modeling are common methodological approaches for relating SOP with other observed exogenous variables, such as trip frequency (Jorgensen & Stedman 2001; Deutsch et al. 2013; Tapsuwan et al. 2011; Lee et al. 2015). Researchers have also used qualitative methods to evaluate SOP, such as visitor interviews and engaging community members with face-to-face conversation and photos of the location (Kyle & Chick 2007; Stedman et al. 2004). Despite its applicability in many areas, few guidelines or codes exist for designing SOP and evaluating its strength or presence. Approaches that provide more systematic evaluations about a location that also relate to the attitudes and behavior of people visiting a place may be helpful for both practitioners and researchers.

6.1 Opportunities in Data Mining

The recent explosion in mobile information and communication technologies (ICT) allows place/site visitors to share experiences and online text feedback or reviews over a more granular temporal and geographic scale that can inform SOP (Humphreys & Liao 2013; Afonso Dias et al. 2013; Schwartz 2015). An opportunity exists to examine SOP through the lens of data mining, i.e., extracting information and data online and forming digital narratives of place. In particular, text-mining, which falls under the umbrella of data mining, is promising from the standpoint of systematically analyzing text based on the usage and association or “clustering” of words, and subsequent interpretation.

Text mining uncovers strong trends and/or topics within textual data, such as online consumer text reviews. With respect to assessing a location’s SOP, their application towards collected online reviews is virtually non-existent in the research and practitioner literature. Several applications of qualitative approaches exist, such as face-to-face interviews, followed by case specific interpretation by analysts. Dias et al. analyzed online reviews of vacation rentals in Portugal through a qualitative approach and identified broad themes that described the surrounding landscape and leisure activities affiliated with a place and recommendations for rental owners and future visitors (Afonso Dias et al. 2013). In another study, Oz and Temizel qualitatively analyzed FourSquare reviews from Turkey to identify parts of speech indicating *place attachment* (Oz &

Temizel 2015). A qualitative approach is infeasible in the age of mobile ICT where millions of visitors share massive quantities of text reviews on place experiences. Text-mining serves as a feasible approach for analyzing this large volume of online text data, potentially revealing topics of concern related to SOP.

Intercept surveys conventionally used for SOP studies, require resources of money and time to survey visitors at sites of interest. Text-mining can passively collect and analyze reviews across many geographic levels. Additionally, text-mining may reveal issues or topics related to the attractiveness of locations that are missed in these intercept surveys that are location specific. For example, a text-mining of reviews for a neighborhood may reveal a strong attractiveness with respect to the local food served at food establishments, but a conventional SOP intercept survey that broadly addresses SOP may miss this issue.

Within the field of computer science, approaches that uncover topics within a text are termed *topic models*. *Topic models* can potentially elicit themes, which in the case of this study will be SOP dimensions (i.e. attachment, satisfaction, etc.), from online text reviews left by visitors. Successful application of *topic models* in other fields includes inferring topics from academic journal websites and Wikipedia and finding patterns in genetic data (Blei 2012). An output from topic models is a list of words or terms representing a “topic”. The list of words is formed based on the frequency of reoccurrence in the corpus. A corpus is a collection of documents, which in this study is a collection of online text reviews. The analyst needs to make a qualitative judgment on the meaning of the topics identified in the topic models. For example, Blei (Blei 2012) implemented a topic model on 17,000 articles from the academic journal Science. One of the popular topics identified was “Computer” based on the following list of words outputted from the model: *computer, models, information, data, computers, system, network, systems, model, parallel*.

Unlike topic models for academic journals and news articles, which has seen successful applications (Zhao et al. 2011; Wang & Blei 2011), interpreting SOP topics from online reviews is challenging. Online reviews contain informal language; identifying SOP dimension from a list of words requires a deeper understanding of the words and their context. For example, an identified topic related to “food” can contain the words: *food, wings, love, beer, chicken*. However, relating this topic to a SOP dimension is not straightforward and requires additional context. For example, this topic could be associated with satisfaction, in terms of food options available, but this association is not easily determined based solely on the identified topic.

6.2 Study Objectives

Given the improvements in ICT access, an opportunity exists to reexamine the concept of *Sense of Place* (SOP) from new forms of online data, especially narrative reviews and text feedback from site or place visitors. While responses from conventional attitudinal surveys and qualitative approaches continue to inform practitioners of place-making, analyzing online visitor responses may permit reconstructing a digital narrative of place and thereby revealing new dimensions of *Sense of Place* (SOP) through a new lens. Furthermore, understanding SOP can help inform travel demand models which seek to understand the destination choices of travelers. This work is part of a broader study to evaluate the SOP of neighborhoods in Rochester, NY using different approaches

such as visitor intercept survey, data mining online reviews, and evaluation of architectural/design considerations.

The main objective of this paper is to analyze visitor feedback collected from online websites devoted to soliciting and posting text reviews. Two websites used are Yelp and Trip Advisor, though the analysis could be applied to any website with text reviews that are publically accessible. Reviews for places and locations within neighborhoods, such as food establishments and parks, are analyzed through text-mining to reveal new topics or dimensions of SOP that may contribute or reinforce previously established SOP dimensions. Within this overarching objective, this study has the following broad goals:

1. Investigate SOP through the lens of text-mining online text reviews for topics;
2. On the basis of these topics, identify areas of improvement for existing intercept survey tools, including topics or issues previously unidentified about SOP;

To accomplish these goals, the methodological approach in this study consists of three main components:

1. Collecting and processing online reviews from Yelp and Trip Advisor;
2. Performing a topic model to identify themes most prevalent across the reviews, with a particular focus on topics relating to SOP;
3. Comparing the identified topics with those found in the literature and existing sources on SOP, in addition to those used in an intercept survey in the broader study.

6.3 Online Data Collection and Processing

This section briefly presents the approach taken to collect and process online reviews of neighborhoods from websites with visitor feedback for evaluating SOP. Broadly, the process involves generating a list of web addresses or Uniform Resource Locator (URLs), each containing reviews about places in the neighborhoods of interest. A Java-based “web-scraper” was developed to extract reviews and associated meta-data, such as visitor ratings. Finally, the reviews are processed for further analysis.

6.3.1 Defining Neighborhoods of Interest

The neighborhoods chosen for the analysis are: (i) College Town, (ii) East End and (iii) Rochester Public Market. These were selected based on their architectural relevance and popularity in Rochester. Additionally, each offers a contrast from the remaining two. College Town (CT) is a mixed-use development/sub-neighborhood located in Upper Mount Hope near the University of Rochester. CT is characterized by shopping, dining, working, hospitality and upscale living within walking distance of each other. The location attracts mostly college students from the University of Rochester, though visitors to the medical center are also frequent. The East End (EE) neighborhood is located in downtown Rochester marked between East Ave, Alexander Street, and Main Street. It is characterized by vibrant nightlife and cultural attractions. Rochester Public Market (RPM) is a local farmers market that offers fresh produce, ethnic delicacies, specialty items, general merchandise and so much more. Also, an array of local businesses-cafes, food stands, coffee shops, florists, specialty food purveyors, breweries, and more can be found on Market grounds and in the surrounding Market District.

6.3.2 List of Attractions and Locations

Neighborhoods, by themselves, do not have an online presence where visitors provide reviews about the neighborhood specifically, e.g., travel sites such as Yelp and Trip Advisor. However, attractions in the neighborhoods such as restaurants, hotels, markets, public parks and other businesses may have an online presence. Therefore, we propose to collect reviews from all the attractions in the neighborhoods with the assumption that the combined reviews contain information about the SOP of the neighborhood. We collect the list of attractions in College Town and East End from their business association websites (City of Rochester 2016a; City of Rochester 2016b). The name of a business/attraction from the business association's website were manually looked up by the authors in Yelp and TripAdvisor, and their URL's were collected. Not all locations had a web presence. Yelp was a more popular platform than TripAdvisor with more businesses enlisted in their site and had more users review about the location than TripAdvisor. Since the website utility varies across reviewers, the analysis performed here was website dependent.

Through data-mining, we collected a total of 4167 unique reviews across all three neighborhoods and both websites. For College Town a total of 769 online reviews were collected with 236 from TripAdvisor and 533 from Yelp. For East End, a total of 3180 reviews were collected with 1348 from TripAdvisor and 1832 from Yelp. For Public Market, a total of 218 reviews were collected with 77 from TripAdvisor and 141 from Yelp. Public Market only had one attraction, being the market itself. East End had 96 attractions and College Town had 23 attractions each, across both websites. The data used for analysis were extracted on March 2016, but span one year prior.

6.4 Data Collection

The data collection process involves scanning through the content in each website URL using the "web-scraper" and extracting all the necessary information. Given that the small scope (120 locations ~4000 reviews) as compared to studies that collect millions of data observations, a rudimentary web-scraper was sufficient. Figure 1 captures the major tasks of the web-scraper. The web-scraper processes one URL (one business location) at a time and loops until the end of the list. The scraper is free here (<https://github.com/CruzatAdrian/OnlineReviewScraper>). The second task segments the URLs into Yelp or TripAdvisor, which is necessary because each website has unique structure and information. In the third step, the relevant information is extracted. The scraper functions by going through the HTML version of an URL, finding specific parts of the body text to be extracted (e.g., name of the reviewer, text review, user rating, etc.). Each URL can have multiple pages. When the scraper reaches the end of a page, it automatically navigates to the next page, and the process repeats for each URL. The implementation consists of functions that would look for specific HTML tags (using regular expression or "regex") for each field of the review (e.g. <UserName>) and then clean and save the data.

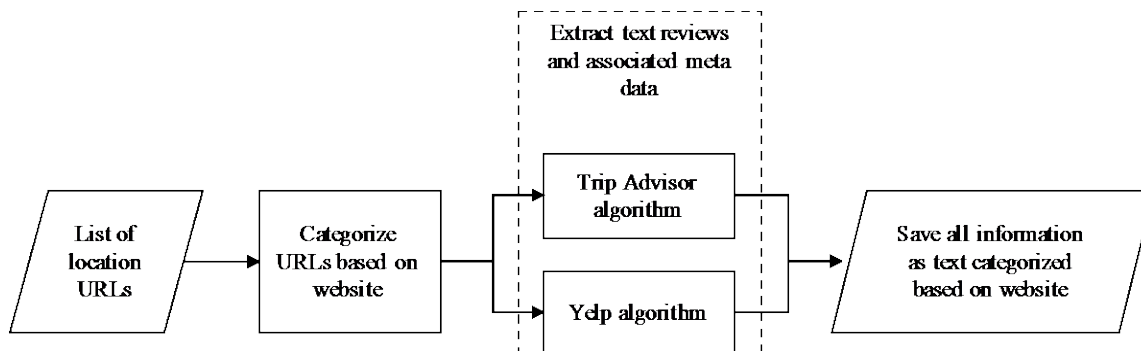


Figure 6.1: Data Extraction Process

6.5 Data Processing

Unprocessed raw online reviews contain informal language including spelling mistakes, atypical abbreviations, and slang. Therefore, it is necessary to process them for further analysis. Data Processing removes unnecessary words or characters from the reviews followed by some natural language processing steps such as stemming and stop word removal. Unnecessary words or characters in the reviews include HTML tags and special characters.

6.5.1 Stemming

The processes of stemming a word consist of eliminating any suffixes it may have to get its stem or root. (e.g. transforming the words “consisting” and “consisted” into consist). It is a well-researched process that is complex but a necessary step in obtaining accurate results. Stemming allows for words that share a common sentiment not to compete against each other instead treated as the same word. For example, the frequency of the words “Enjoys” and “Enjoyment”, that share the same root “Enjoy”, will be counted separately if not for stemming. For this project, we decided to use a third party library, Snowball (Porter 2001; Porter n.d.), to handle the stemming. This tool generates stems that are more often consistent with the English language. For further details about Stemming refer elsewhere (Porter 2001). An important disadvantage of stemming is related to words with multiple meanings. Parking is a topic that is relevant to this analysis. The root form of parking is park which could also mean public parks/garden used for recreation and also industrial parks. Therefore, care must be taken when interpreting the stemmed form of words.

6.5.2 Stop Word Removal

Stop word removal is another important processing step. During this step, *Stopwords*, the words that have no meaning on their own or lack contextual significance, are removed from the corpus. The purpose of this step is to eliminate words from the corpus that could interfere or cloud the analysis. For Topic Modelling specifically, this prevents terms such as “the”, “you”, or “another”, from occurring in a topic. Stop words provide no insight on the possible topics discussed on the reviews. For this study, we used Terrier’s stop word list (Ganeshan 2016) as the primary source of stop words.

6.6 METHODOLOGICAL APPROACH

The processed reviews are analyzed using two statistical techniques: (i) Term Frequency – Inverse Document Frequency (TF-IDF) and (ii) Latent Dirichlet Allocation (LDA), a topic modeling technique. TF-IDF provides a measure of the importance of the various terms in the corpus, while LDA is used to identify many clusters of words that co-occur in the corpus. The popular words and the topics identified are then interpreted qualitatively through the SOP framework. This section describes the statistical techniques and the interpretation approach thoroughly.

6.7 Term Frequency – Inverse Document Frequency (TF-IDF)

TF-IDF is a metric used to identify the importance of a term in a collection of documents or corpus, calculated as the product of Term Frequency (TF) and Inverse Document Frequency (IDF). TF is defined as the raw frequency of a term in a document. And IDF is the natural log of the ratio of number of documents in a corpus and number of documents in that corpus that contains a term (t). IDF ranks the importance of a term in the corpus. Eq. 1 determines TF-IDF.

$$TF - IDF = f_{t,d} \cdot \ln\left(\frac{N}{n_t}\right) \quad (1)$$

Where, $f_{t,d}$ is the raw frequency of a term (t) in a document (d), N is the total number of documents and n_t is the number of documents that contain the given term (t). A Java application was also created for calculating the TF-IDF scores. The input to the application includes the text reviews and a list containing stop words. The outputs include (i) the frequency of terms and TF-IDF values, and (ii) a corpus to be used for the Topic Modelling discussed in the next section. Each line in the corpus is considered a document and is made up of three space-separated fields, a) the ID of the document, b) the language of the document (hard coded as English for this project) and 3) stemmed terms (excluding stop words) from a given review.

6.8 Topic Modeling using Latent Dirichlet Allocation (LDA)

Latent Dirichlet Allocation (Blei et al. 2003) is a common statistical topic modeling approach that automatically indexes, searches, and clusters terms to form unstructured and unlabeled topics (Blei & Lafferty 2009). In our dataset, the documents are the text files that contains all the reviews about a neighborhood, and topics within the documents are generated through LDA. LDA accomplishes these tasks by first discovering a set of “topics” within the documents and then representing each document as a mixture of topics. In LDA, topics are explicitly created through a generative process, using machine learning algorithms to deduce the probability of terms present in each topic, and the probability of a topic found in each document through an iterative process. For more detail on the LDA process, prefer to the literature (34, 35).

We use MALLET (36), a popular third party tool for implementing LDA. MALLET generates two outputs. The first output is a text file containing k topics, each with t terms. The number of topics k and the number of terms t in a topic depends on the specification. k ranged between 10 and 50 while t ranged from 5 and 20. The second output specifies the topic composition of the document.

6.9 Qualitative Interpretation of Results

The outputs from TF-IDF and LDA are a list of terms and a list of topics respectively. A qualitative approach is used in this study to infer SOP dimensions from the outputted terms and topics. To improve reproducibility of this work, we propose the following framework. First, a list of key terms and sentences that represent each SOP dimensions is constructed using the previous SOP surveys found in the literature. Finally, we associate the terms and topics generated through TF-IDF and LDA to SOP dimensions using the list generated in the previous step.

To generate this list, we rely on an intercept survey that was conducted in the same Rochester neighborhoods, as part of the larger study beyond this paper. The intercept survey contained attitudinal statements for measuring SOP, taken from the literature. These statements provide linguistic cues for interpreting the online reviews. Table 1 provides the list of statements and example words for each SOP dimension.

The example words, in Table 1, allow for a heuristic relationship building between the output from TF-IDF and LDA, and SOP dimensions identified in the literature. For example, intercept survey statements on *Aesthetics* contains words associated with the architecture or visually appealing design of the location. *Attachment* statements relate to the connectedness of the visitors with the place. Therefore, terms in the survey that describe emotion (e.g., happy, sad) are categorized as *Attachment*. *Dependence* is the comparison of the location in question with any other similar location concerning how the location meets the needs of the consumer. *Identity* captures the intended behavior of the person. Satisfaction refers to the visitors' content with the services and products offered. Therefore, any term that is related to the goods and services provided in a place could be categorized as satisfaction. Finally, *Social* captures the friendliness of the location to family, friends, and kids and the nature of the people in the location. This list of words (Table 1) only serves as a guideline for inferring references to SOP dimensions from the outputs from TF-IDF and LDA.

As we can see from the example words for *Identity*, a single term is insufficient for inferring the SOP dimension. In those cases, a topic is interpreted with all the terms together. SOP is inferred from the terms or constructed phrases, shown in Table 1, which serves as a guide for interpretation. Given more resources, an automated process is possible for associating statements from the survey, SOP dimensions and representative terms.

TABLE 6.1 List of terms for each Sense of Place Topic

SOP Dimension	Statements from Intercept Survey	Example Representative Terms or Phrases
Satisfaction	I am satisfied with the food options	Food, products, amenities, entertainment, people, parking, car, bicycle, walking, access, public, transit, satisfied, satisfy
	I am satisfied with the products offered	
	I am satisfied with the parking space	
	I am satisfied with the proximity of the parking space	
	I am satisfied with the level of services	
	I am satisfied with the entertainment options	
Attachment	I feel a strong connection with the place	
	It is a place that makes me feel relaxed	

	I will be disappointed if it did not exist It makes me feel happy	Connection, disappointment, happy, attach
Dependence	It meets my need better than any location It has more diversity than any other place It has stores that has lacking things	Needs, diversity, missing, depend
Identity	It reflects the type of person I am It makes me feel too self-conscious It makes me feel comfortable since I identify with place It says very little about me It makes me feel I can be myself Is a good reflection of my identity I only come here when I have a specific reason in mind	Type of person, self-conscious, I can be myself, little about me, identify
Aesthetics	It has a visually appealing architecture It has a peaceful and relaxing atmosphere Has a good balance of decorative features and businesses It is a beautiful place Has artistic value	Beautiful, artistic, appealing, visually, architecture
Social/ Cultural	Has a definite social atmosphere Is a great family friendly place to be Is a great kid friendly place to be Has generally friendly people around Reflects the culture of Rochester Involves a risk of unpleasant encounters when travelling to it Is always overcrowded Has too much going on in it Makes me afraid to walk around	Social, family, friendly, culture, afraid, unpleasant, socialize

6.10 RESULTS AND SYNTHESIS

The corpus collected for each neighborhood and website are analyzed individually using the methodological framework described previously.

6.11 TF-IDF Results

First, the TF-IDF results are presented and discussed. Recall that TF-IDF provides the importance of each term in a list of terms from each corpus, with importance measured with TF-IDF score (Eq. 1). Table 2 lists the top 20 terms based on the TF-IDF score for each neighborhood and website. A “term” is defined as a stemmed form of a word, discussed in the data processing section.

Looking at Table 2, observations regarding terms frequently used in reviews are apparent. First, the most common terms across all neighborhoods and websites are: *place*, *time* and *food*. Additionally, between CT and EE, *beer* and *order* are common. The results suggest that CT and EE may have more in common with each other, than with RPM. The following is a list of terms for each location that were found in both websites:

- RPM: *vendor*, *park*, *local*, *produc*, *price*, *find* and *shop*

- EE: *beer, bar, order, little, friend, night* and *servic*
- CT: *beer, order, like, great, service, tabl* and *nice*

Interestingly, when looking for common terms between pairs of neighborhoods but specific to a website, EE and CT show more overlap in terms with each other than with RPM. For Yelp, the terms *like, time, place* and *food* were common across all three neighborhoods; between CT and EE only, the following terms were also common: *beer, order, bar, drink, fri* and *service*. For TripAdvisor, the terms: *place, time* and *food* were common across all three neighborhoods; between CT and EE these terms were also common: *room, restaur, beer service, hotel, order, like* and *tabl*. Overall, the results suggest a closer association between the College Town and East End neighborhoods, relative to Public Market.

The terms provide insights into SOP. Terms such as *food, drink, service, bar, hotel, etc.*, are interpreted to represent location products or services. Accordingly, these are reasoned to be indicative of the *Satisfaction* dimension of SOP, because these terms are used as a point satisfaction or dissatisfaction when looking back at online reviews. However, looking at Table 1, these terms are notably missing. This suggests that while these are important *Satisfaction* terms found in online reviews, they were missing from the intercept survey, which was based on the literature. Looking at Table 1, which is based on the intercept survey, the category *Satisfaction* did address *satisfaction* of *bars, drinks* or *hotels*, which the TF-IDF of online reviews indicates as important.

Another set of terms that were prevalent are words related to seasonality or time, such as *friday, saturday, morning, night* and *summer*. Interpretation from the analyst through reading reviews to gain context indicates these may refer to the time of visit or some form of seasonality in activities. Interestingly, these terms do not represent any of the six SOP dimensions, according to the association put forth in Table 1. However, seasonality could be a potential new SOP dimension or an expansion of a previous dimension. For instance, a visitor could identify with a place only during a certain times or season annually.

TABLE 6.2: Top 20 Terms based on the TF-IDF Number

Rochester Public Market (RPM)				East End (EE)				College Town (CT)			
Yelp		Trip Advisor		Yelp		Trip Advisor		Yelp		Trip Advisor	
vendor	92.46	vendor	50.36	beer	1148.85	room	734.46	Burger	483.93	Hotel	168.34
park	73.57	food	44.55	bar	1080.94	great	679.23	Beer	352.44	Room	124.67
love	70.72	find	41.22	order	1044.34	food	664.77	order	305.13	Locat	120.26
local	69.18	saturday	40.13	like	1037.3	place	637.58	Bar	304.25	Great	119.5
peopl	69.11	truck	38.71	place	1020.64	restaur	606.63	place	272.89	Beer	118.06
like	68.92	visit	36.66	great	1002.09	beer	591.76	Fri	260.93	Nice	114.49
produc	68.82	best	36.43	food	997.39	time	559.34	Like	259.93	Stay	111.82
time	67.06	shop	36.41	drink	993.02	servic	533.84	Food	257.61	Order	107.41
price	66.93	place	36.06	time	944.48	nice	533.41	great	248.76	Restaur	107.23

will	65.94	great	35.99	littl	870.56	hotel	530.07	time	245.96	New	105.68
find	65.94	price	35.43	friend	858.86	order	525.4	back	226.94	Food	105.2
shop	65.11	produc	34.63	tri	849.55	friend	519.76	friend	226.69	Like	98.22
best	64.62	day	34.16	wing	834.09	bar	503.23	servic	225.29	Custard	97.92
place	64.3	fresh	32.96	night	826.8	like	493.68	cooki	221.66	Place	96.22
chees	64.09	local	32.66	nice	804.97	littl	490.93	tabl	218.27	Tabl	92.58
week	63.08	farmer	32.25	back	794.03	night	489.02	came	217.84	Staff	92.12
buy	63.07	offer	31.82	sauc	778.38	stay	488.19	wait	215.16	Time	91.13
food	62.41	park	31.3	servic	769.92	tabl	481.4	drink	215.11	Service	89.6
dont	60.28	time	30.47	menu	758.15	dinner	479.33	tri	212.52	Menu	87.8
stand	59.9	good	30.46	fri	756.56	love	466.87	nice	210.86	Clean	86.84

A critical challenge with TF-IDF is that many terms such as *friend*, *like*, *great* are associated with more than one SOP dimensions. For example, the term *like* can convey Dependence or Satisfaction, depending on its usage and context. The statement, “*I like the food here*” denotes Satisfaction, while the statement, “*The quality of products here are like no other in Rochester*” denotes Dependence. Therefore, clean and clear-cut interpretations may require qualitatively looking at each review containing the terms. Furthermore, one popular location with a significantly higher number of reviews compared to a second location in the neighborhood may bias the results. In such cases, the top terms from TF-IDF would likely represent that one location. However, we do not consider this as a shortcoming because one of the objectives is to identify aspects of a neighborhood that is of importance to respondents (visitors) and overrepresentation means the location is popular therefore important for analysis. If these aspects differ from the context of an intercept survey, a case can be made for their inclusion.

6.12 LDA Topic Modeling Results

The challenge of interpretation present in TF-IDF may be resolved using topic modeling. Using the LDA algorithm presented and discussed previously, ten topics, each containing five terms, were generated. For two websites and the three neighborhoods, a total of 60 topics were generated. The topics provided more context and allowed to establish a relationship with SOP. Due to difficulties in interpretation, topics with more than five terms were avoided. Table 3 shows a partial list of topic generated for Rochester Public Market along with authors’ interpretation of the topics. For a complete list, interested readers can access the list from here (<https://goo.gl/ufCvDs>). While other interpretations are certainly possible, a robust approach would be collecting the interpretation from many individuals.

With respect to Sense of Place (SOP), each topic generated can refer to multiple SOP dimensions, while others refer to none. For example, the first topic generated using the reviews for RPM “love food summer wegman truck” is interpreted by the authors as “I love food trucks during the summer.” and “(RPM) is better than Wegmans.” This interpretation suggests LDA-generated topics contain two dimensions of SOP: *Satisfaction* and *Dependence*. The love for food trucks is interpreted as expressing *Satisfaction*. Comparing Wegmans, a supermarket in the Rochester area, with RPM indicates *Dependence*. As a second contrasting example, consider the LDA-generated topic “food dont sure weekend like” which is difficult to clearly interpret. To

assess the reference to SOP, an interpretation would be needed. Interpretations which cannot be associated with any SOP dimensions also exist. For example, authors' interpretation of the topic "time park select home place" is a statement about the location without any SOP dimensions associated with it.

Finally, looking at the collection of topics relative to SOP dimensions found in the literature, locations were characterized by homogenous set of dimensions. For example, topics identified from East End and College Town were mainly about satisfaction of various products and services offered in the neighborhood. This lack of granularity of topics likely results from the motivation for many of the online reviews to provide feedback on a service or product experienced. This motivation can also explain why almost none of the topics generated covered SOP dimensions such as Aesthetics and Social. To gain a broader set of topics, a future study might collect reviews from a broader set of businesses and services in the neighborhood for the analysis.

TABLE 6.3: Sample of Topics, Interpretations and Association with SOP dimensions generated through LDA for Rochester Public Market. (Abbreviations used in the Table: Aesthetics – AES, Attachment – ATT, Dependence – DEP, Identity – IDT, Satisfaction – SAT, Social – SOC)

Website	Topics from RPM	Interpretation	Sense of Place Dimensions						Missing & Interested Themes	
			AES	ATT	DEP	IDT	SAT	SOC		
Yelp	love food summer wegman truck	I love food truck during the summer. And (RPM) is better than Wegmans.			X			X		Seasonality or Time
Yelp	park great place fresh price	Great place to find fresh food at great prices but parking is an issue.		X				X		Parking
Yelp	saturday morn love week fresh	Go there on Saturday morning to get fresh produce for the week.			X					Seasonality or Time
Yelp	food dont sure weekend like	<i>Cannot interpret</i>								Seasonality or Time
TA	time park select home place	Parking, time, place and home								Parking, Seasonality or Time

One theme missing from the current SOP intercept survey is time or seasonality consideration. Visitors typically travel to a site or neighborhood year around. Some aspects of SOP that may work well in one season may not hold in other seasons. The food trucks at Public Market are an excellent example. Conceivably, these might help foster a *Sense of Place*, but since they only occur in the summer, there is an underlying seasonality dimension. Additionally, factors explaining SOP might also vary by time of day. Evenings and weekends restrict the social atmosphere associated with the East End neighborhood. Thus, considering these timing and

seasonality issues is important as suggested by the text-mining. Parking is the only transportation-related topic identified through this exercise and reviews about parking always represent satisfaction.

Overall, topic modeling allows for easier interpretation and association of topics to dimensions thereby making it a useful tool for SOP researchers using online reviews. However, there are caveats. Online reviews cannot completely replace intercept surveys because only certain SOP dimensions, such as satisfaction, are represented well in the online reviews. Given that SOP is multidimensional concept information about all the dimensions are necessary to measure SOP.

The methodology presented here cannot measure the positive or negative aspect of any SOP dimension. For example, the terms “love food” can be associated with satisfaction but it also can represent dissatisfaction when interpreted as “do not love”. To overcome this shortcoming, reviews must be converted from a negative form to a more direct/affirmative form. For example, “I do not love the food here” to “I hate the food here”.

6.13 Conclusion

As mobile ICT adoption increases, the potential for insight and volume of feedback provided by location visitors will grow continuously, in particular text feedback through the form of online reviews. Along with this growth, analyzing these collections of reviews or the corpus, with respect to location attractiveness requires new methods, especially for integrating the outcomes with existing travel demand analysis approaches.

This study examines the *Sense of Place* through the lens of text-mining. Specifically, topic modeling approaches, TF-IDF and LDA, are applied to online text reviews to identify the main topics of concern to visitors. These identified topics are compared with the key dimensions of SOP found through the literature and implemented in intercept surveys used to infer the degree of SOP associated with a location.

The exploratory analysis reveal that as a standalone analysis, text-mining using topic modeling, requires supplemental domain expertise to interpret the outcomes appropriately. For a sentiment analysis the task of interpreting favorable versus unfavorable reviews is easier relative to the context of interpreting the SOP dimensions which require context. The study results indicate that seasonality and timing of activities are particularly important to visitors. Additionally, “food” as a means of describing the attractiveness of a place is currently inadequately captured in SOP dimensions defined through the literature and carried over into intercept surveys.

Future work includes automating the current “interpretation” process described in this paper, possibly using Amazon’s Mechanical Turk. Future work also includes a more explicit consideration of integrating the identified topics from the topic models into existing travel demand models and discrete choice models.

Chapter 7: Evaluation of the Built Environment: Architectural Design Perspectives on Sense of Place

7.1 Opportunities for Improving Place

Place is a complex concept that embodies the set of tangible and nontangible qualities of a location that resonate with visitors to feel a connection. Place is different from space; place is composed of a unique collection of qualities and characteristics, whereas the former is physical (Edward 2012). According to the design literature, for each place, a set of key indicators defining its Sense of Place (SOP): (i) physical, (ii) visual, (iii) social and (iv) economic (Mastura et al. 2013; Cross 2001). “Place is, at once, the buildings, streets, monuments, and open spaces assembled at a certain geographic spot and actors’ interpretations representations and identifications (Gieryn 2000).” In contrast to space which has no meaning, places are built or manipulated; they are interpreted, narrated, perceived and felt (Tuan 1977). According to Tuan (1977), the study of space belongs to sociology whereas the study of location belongs to geography; only human beings can have a sense of place (SOP).

Many researchers from collateral fields such as sociology, geography, environmental psychology and architecture and urban planning have long theorized an emotional connection between people and places. Urban designer and architects play important and determining roles in defining the physical qualities and characteristic of a space. In order to make a place meaningful, the space creators need to make the space carry certain distinguishing characteristics, so users can attach their emotional and psychological interpretations to physical objects. Objects carrying social meanings and cultural heritage can help users to associate the space with their inner emotions and experiences, therefore helping them to form a Sense of Place. A guiding principle in designing the built environment for sustainability and livability is SOP. Constructing and making a place dynamic and effective depends on human perception about the space, social interaction, economies, cultures and histories (Bott et al. 2003). The physical environment plays important roles on people’s perceptions about place, and perceptions of place are constantly changing due to the time and context which could make or unmake the place. Architects and designers concentrate on the physical environment in crafting a sense of place, understanding the interaction and influence between perception and place making could further benefit these designs.

In 2010, the Gallup and Knight Foundations teamed up and conducted a three-year study entitled “Soul of the Community.” The study answered questions such as: (i) What makes residents love where they live? and (ii) What attracts people to a place and keeps them there? This study found the most important factors in creating emotional bonds between people and their community were not jobs and economy, but rather physical beauty, opportunities for socializing and a city’s openness to all people (Soul of the Community 2017).” Urban designers and architects understand the importance of place-making and have different methods to measure the sense of places. Most methods are qualitative. Jackson (1994) measures SOP through recurring events under the perspective that place is “something that we ourselves create in the course of time.... A sense of place is reinforced by what might be called a sense of recurring events.”

Norberg-Shulz (1979) believed that SOP could be best described through three-dimensional spatial organization. “Space denotes the three-dimensional organization of the elements which make up a place, and character denotes the general atmosphere which is the most comprehensive property of any place (Norberg-Shulz 1979).” Urban planner/designer Kevin Lynch develop a qualitative framework to measure the sense of place which contain several key indicators and establish the potential relation between physical forms and people’s perception. According to Lynch, “sense is the interaction between person and place [and] depends on spatial form and quality, culture, temperament, status, experience and current purpose of the observer (Lynch 1960, Lynch 1981).” Table 7.1 list previous published book regarding sense of place from collateral fields.

Title	Author	Field	Year	Approach
A Space for Place in Sociology	Gieryn	Sociology	2000	Qualitative
Space and Place: The Perspective of Experience	Duan	Geography	1977	Qualitative
Place and the Promise of Conservation Psychology	Bott et al.	Ecology	2003	Qualitative
Towards a Phenomenology of Architecture	Norberg-Schulz	Architecture	1979	Qualitative
A Sense of Place, a Sense of Time	Jackson	Landscape	1994	Qualitative
The Image of the City	Lynch	Architecture and Urban Design	1960	Qualitative
A Theory of Good City Form	Lynch	Architecture and Urban Design	1981	Qualitative

Table 7.1: SOP Literature from Collateral Fields

However, it has always been challenging to quantify the relation between physical environment and human’s emotional attachment. With the good intention to create a high quality space to stimulate users’ positive emotion about a place which eventually could leads to a “better sense of place, most current design guidelines have taken a prescriptive approach without providing transparent reasons behind certain requirements. For instance, the City of Los Angeles’ downtown design guide requires that each sidewalk provide a minimum of 6 feet of continuous path of travel, and an 18 to 24 inch wide access zone next to the curb. There is a lack of transparency in how we set up the prescriptive requirement and how the consensus being reached on those universal numbers. The lack of transparence and clarity could result to three types of confusion: 1) unclear of the requirements: It is not clear whether the physical spaces and dimensions are needed only for practical reasons, such as car parking size, car turning radius, etc, or physiological comfort of pedestrian; 2) lack of scientific support: most guidelines are coming from the designers’ field experience and observations that have been proved to be effective in certain condition, however, so far there is no well-agreed upon research result supporting the a universal design guideline could

suitable for all different urban context; 3) uncertainty of the effectiveness: there is really no proven feedback about the effectiveness of those design guides. For anyone who has experienced downtown Los Angeles, a 6 foot long continuous travel path certainly is not the key component in creating a sense of place or vibrant urban environment. There is rich history of discussion and theory that has developed over the last century by researchers from geography and sociology filed exploring the connection between physical environment and users' perception, however there exists very small body of literature from architecture and urban design field that takes integrated quantitative and qualitative approach to sense of place.

7.2 Architecture and Urban Design Traditions

7.2.1 Design Traditions

Two schools of thoughts for understanding urban design tradition are (a) urban design as a visual-artistic tradition versus urban design as a social-environment tradition. The design literature identifies two traditions in architecture and urban design; however in recent years, the two have become synthesized into a third labeled the “making places” tradition (Carmona 2003). Design traditions in architecture and urban design could be categorized into four traditions: (i) Visual-artistic tradition; (ii) Social-environment tradition; (iii) place-making tradition; (iv) philosophical and political traditions. Visual-artistic tradition is what majority urban design guidelines based on, this tradition has a focus on “aesthetic qualities and visual experience of a place instead of social, connection, [and the] emotional (Sitte 2013).” Other related literature includes Cullen’s “The Conscious Townscape” (Cullen 2015) and Unwin’s “Town planning in practice” (Unwin 1971). The social-environment tradition has a broader perspective, focusing not only on physical form and aesthetic quality, but also the perception of receivers. Kevin Lynch’s “The Image of the City” (Lynch 1979) and Jane Jacob’s “The Death and Life of Great American Cities” (Jacobs 1972) were two of the pioneer works along the third tradition where place-making is the response to the demand of more livable and sustainable built environment, the cities, the towns and the neighborhoods at all scales. New urbanism is an example, in most new urbanism projects, characters play important roles in defining the sense of place could be perceived by residents. New urbanism principles include: walkability, connectivity, mixed-use and diversity, mixed housing, quality architecture and urban design, traditional neighborhood structure, increased density, green transportation, sustainability, quality of life, which is a mixed of social and visual consideration of place-making.

7.2.2 Perceptual Qualities of Place from Design

The urban design literature indicates the variety perceptual qualities of the physical environment could affect human behaviors. In the design realm, most studies have taken qualitative approaches or hybrid approaches. Ewing and Handy (2006) have listed 51 perceptual qualities that have direct correlation to physical built environment. However, most urban design literature do not provide empirical evidence to support this due to the difficulties to measure and understand how perceptual qualities stimulate the positive SOP. Out of the 51 qualities, R. Ewing identify eight most important qualities and successfully validate five of eight: imageability, visual enclosure, human scale, transparency and complexity. Bentley pointed out five key issues in place-making will have impact on the sense of place can be perceived through the urban design: permeability, variety,

legibility, robustness, visual appropriate (Bentley 1985). Beidler and Morrison (2016) identified four dimensions of SOP: (i) the self, (ii) the environment, (iii) social interaction and (iv) time. Green uses a 21 rating scale to measure the residents' perception of town character and identified 19 environment stimulus, both natural and man-made that affect SOP. These include beach, lighthouses, the ocean, restaurants, shops, rainforest area and pubs (Green 1999). We suspect the reason for this lack of quantitative approaches comes from two major causes. The first is concern of losing creativity from a design perspective; if a Sense of Place (SOP) could be bonded by observable measured criteria the designers may feel constrained. Second, the origin and history of urban design stems from philosophical and political traditions which are typically qualitative (Raymond 1909, David et al 1984). Without a scientific or quantitative approach, evidence supporting the impact of built forms and the physical environment on creating a sense of place is not well established. Even with the best intention, urban design based on design guideline insufficiently helps residents to form a strong bond with the space. The following is a list of example of the current design guidelines in several different cities. The challenge for today's urban designers is to integrate the quantifiable and quantifiable aspects of place making with feedback from the perception of the users.

City	Methodology	Focus area
Los Angeles—Downtown Design Guide	Quantitative and qualitative	Sustainability, sidewalks, setbacks, ground floor, parking and access, massing, street walls, open space, architectural detail, signage, streetscape, public art
Virginia—Fairfax County Urban Design Checklist	Qualitative	Context/location, access, function, amenities, form
London—Illustrate Urban Design Principles		Urban structure, streets, built form, façade details, setbacks, parking, massing and scale, materials, density, building type
Edinburgh—Standards for Urban Design	Qualitative	City wide views and context, city edges, image and legibility, network of green and civic spaces, local identity, distinctive urban form, coherent layouts, street character, pedestrian access, open space, public space
Seattle—Design Guidelines	Qualitative	Natural systems and site features, urban pattern and form, architectural context and character, open space connectivity, walkability, street-level interaction, transportation, exterior elements and finishes
Rochester—City-wide Design Guidelines	Qualitative	Building elevations, entrance, roofs, waterfront view
Baltimore—Design Guild lines	Qualitative	Building typology, building forms, fenestration, entries, materials

Table 7.2 Design Guidelines

7.3 Methodological Approach

The research methodology is a combination of on-site survey, field investigation, and panel auditing to verify the validity the relation between physical environment and of perceptual qualities of place. It is assumed that the perceptual qualities are the key factors contributing to the SOP from

the design perspective, based on previous literature review. For the perceptual qualities of place, this research has chosen to exam the four categories based on Ewing's study which are most closely related to current urban design guidelines: (i) imageability; (ii) visual enclosure; (iii) human scale and (iv) complexity.

7.3.1 Field Investigation

A field investigation was conducted to evaluate the space and physical forms against current urban design guidelines and compliance. Reports and other outputs from the field investigation were compiled for the panel audit. For the physical environment, the researcher has extracted four most common categories being implemented based on variety of design guidelines, and a checklist was created to guide the field investigation. The four categories are: (i) natural system and site feature, (ii) urban pattern and form, (iii) streetscape and (iv) architectural character.

Research team conducted two site investigations for each site via students in a studio class. For each site the team produced minimum three street sections, building typology map and picture map illustrating the different street façade height, architecture language, urban form, urban patterns, colors, materials and ratio between streets and street walls. Also the team documented the different types of open space and adjacent buildings height and design. Team then complied all information into maps and pictorial reports.

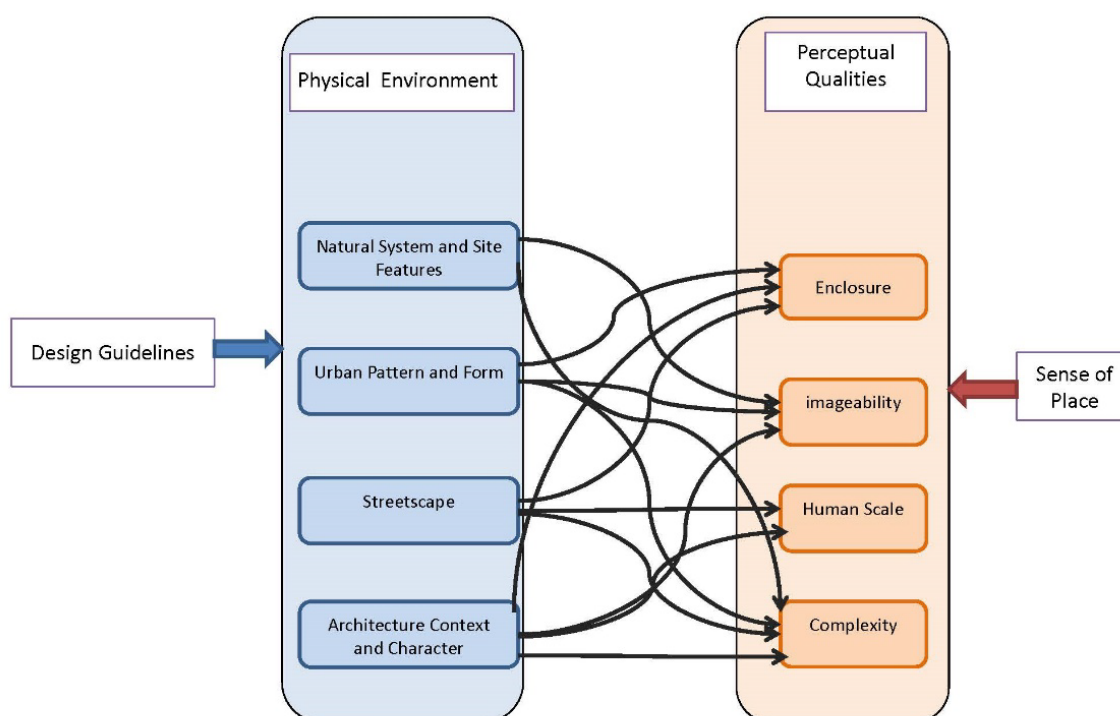


Figure 7.1: Relationship between Physical Environment and Perceptual Qualities

7.3.2 Field Investigation Outcomes

Natural Systems and Site Features: All three sites have similar topographic condition without natural features such as water feature, forest. All three sites are relatively flat.

Urban Form and Patterns: East End is essential part of a Rochester historic district with many historical buildings, such as Eastman Music Hall and School. Compare to RPM and CT, EE has the most diverse building types, side walk types, building typologies, building height, building mass, and open space types. Although CT provided a variety of open spaces, the overall building form, height, mass is homogenous and lack of diversity. RPM only has one type open space, but the building form and pattern have different types since most buildings are existing buildings and been converted to commercial use from their original industry or residential function. One significant character about East End is the visual enclosure at end of major streets: there are distinguishing buildings or public art to provide visual identity recognized by visitors.



Figure 7.2: East End Street Views

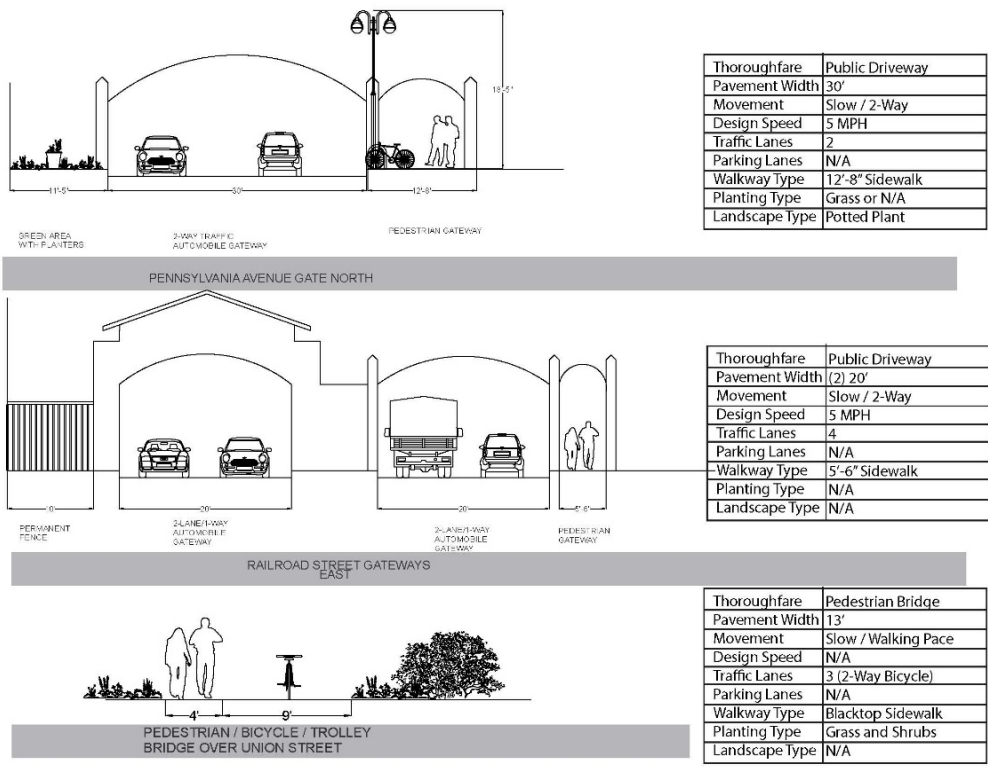


Figure 7.7: Public Market Street Sections

URBAN SENSE OF PLACE: EAST END 2 June 2016, 3-5p.m.
4 June 2016, 6-7 p.m.

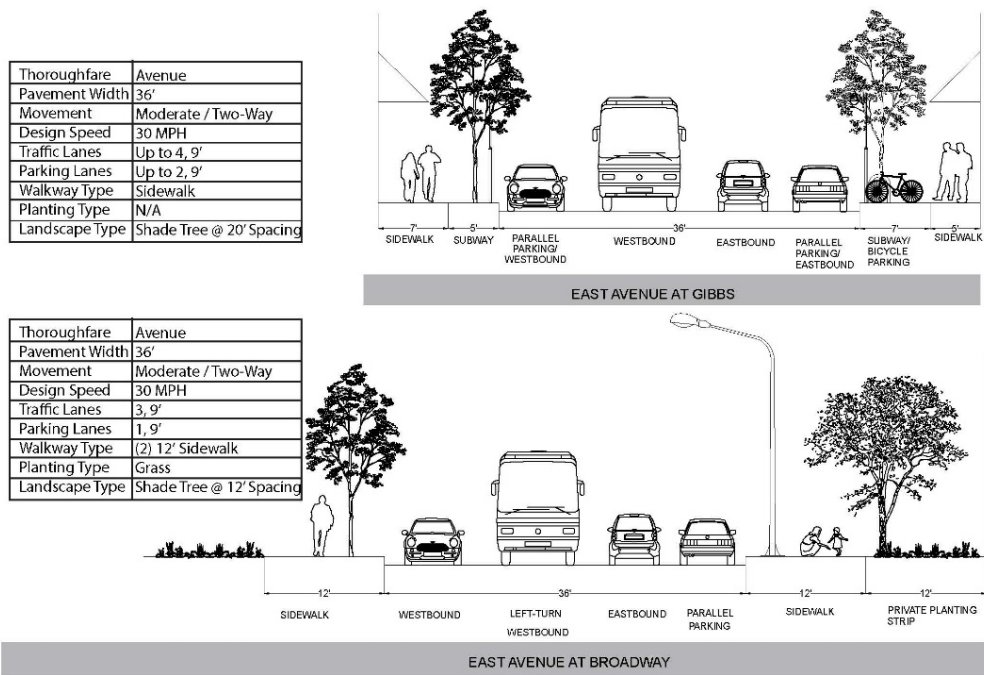


Figure 7.8: East End Street Sections

Architectural Context and Character: Public market has kept most existing buildings, reusing them to adapt to new and different modern functions. The Rochester Public Market was built at 1905. The open arch structure has a distinguished character using local materials and built particular for open market use. The ground pavement is also of local materials. The majority buildings in EE were built between 1920 and 1980, new buildings built after 2000 only account for 2% (City of Rochester Property Information). EE has 3 buildings designated as state historical landmark buildings and national registered historical buildings. These three buildings are: (a) Little Theater; (b) Sibley Triangle building; (c) National Company Building. Those buildings carry a distinguished and unique architectural detail representing the regional and local identity of Rochester. All buildings in CT were developed between 2012 and 2014 (City of Rochester Property Information), and by a single developer. The uniform architectural language provides consistency in appearance; however the lack of diversity makes the entire development “unexciting” based on the feedback from local residence. All buildings in CT do not present any particular local architectural style or character. The use of conventional façade materials and construction types instead of local materials isolate CT from the nearby University of Rochester main campus.



Figure 7.9: Public Market View



Figure 7.10: College Town View



Figure 7.11: East End View

Streetscape: The streetscape of a space is connected with its human scale. EE provides a variety of outdoor seating options, weather protection covers and shelters. EE also has clear signage, protected seating, street lamps, all of which provide the safety for pedestrians and other visitors. Safety and comfort encourages public interaction and activities, which help develop memories about a place. East End also has more bus stops and connected streets compare to CT and RPM. RPM's schedule and function is fixed and its visibility, fenced wall and gateway provide safety for all activities within the public market boundary however, this isolates RPM from the adjacent neighborhoods. CT and Rom are not bike accessible even though they all provide bike racks on site; however there is no designated marked and protected bike lane/trails leading to those two sites.

7.4 Panel Audit

A group of panelist scored the perceptual qualities of different sites based on the field investigation written and graphic reports. An association between physical environment elements and perceptual qualities of place were heuristically determined. For panelists unfamiliar with terminology, rating these sites is difficult. Asking panelists unfamiliar with design concepts to rate imageability, enclosure, or complexity likely produces inconsistent responses. The final panel is composed of either design professionals or the general public who understand the basic vocabulary of urban design. During the panel audit, the panel evaluates the same set of visual images and pictorial reports from the field evaluation and use definitions for dimensions to rate these, given by the research team. Using a same set of images and information, each panelist gives a score to same sites at the same time. The panel is composed of two urban design and planning professionals, two regular citizens, two researcher/academic from fields other than architecture, landscape and urban design.

7.4.1 Definitions

The participants evaluated the design evaluation outputs along four dimensions. The assumption is that a higher rating along these dimensions indicates a higher SOP. These four dimensions are defined as follows:

Imageability: We asked the panel to rank the significance of imageability based on: (i) Natural System and Site Features; (ii) Urban Form and Pattern and (iii) Architectural Context and Character. Subcategories include: number of historical or landmark buildings, number of building with *distinguishing* characteristics; density of open spaces; variation in outdoor dining; density of major landscape features; crowdedness; and number of public art works.

Visual Enclosure: In most urban design guidelines visual enclosure catches several important factors, and those related to the building height, set back dimension, ratio between building height and width of the surrounding open space, for example streets, plaza, square, etc. In the Los Angeles downtown design guide, designers face strict height limitations and setbacks for different types of street walls. For example, the minimum street wall height for the Civic Center should be 75', for the City Market should be 25', and 35' for little Tokyo. We asked the panel to rank the significance of visual enclosure based on pictures from the site for: (a) urban form and patterns; and (b) architectural context and character.

Human Scale: We asked the panel to rank the significance of human scale at each location based on: urban form and pattern, architectural context and streetscape. Personal interaction distance plays an important role in defining human scale; different culture has different measurement of personal distance. The published ranges according to Gehl (2007) are: (a) intimate distance 0 to 15 feet; (b) personal distance 1.5 to 4.5 feet; (c) social distance 4.5 to 12 feet and (d) public distance more than 12 feet. Most urban design guidelines have chapters designated to street scale design, including glass to wall ratios, architectural details and signage design. Those physical environments are within intimate and personal distance which help create a human scale for visitors. Also street trees and urban furniture, such as benches, can moderate the scale of tall buildings and wide streets. In some sections of EE and CT, the street width is the same, but East End has more mature trees providing canopy that simulate a personal space experience. Consequently East End appears more human/pedestrian friendly to the panelists.

Complexity: The panel score complexity based on all four categories. Subcategories include: (a) diversity of building types; (b) diversity of social activities; (c) diversity of landscape; (d) layers of street boundary; (e) layers of street boundary, which refer to sidewalks, plant strips, arcades, and the building façade.

7.4.2 Panel Audit Response Summary

Urban form, urban patterns and architectural form have a relationship with the perceptual quality of the place, as indicate in [Figure 7.12](#) below. In general nature and ecosystems do not have identifiable contribution to SOP in urban setting. Architectural context and character is potentially effective attribute to impact on how people perceive the place. This study does not let us conclude that architecture plays an important role in defining SOP. Also, similar study is needed for other sites which has significant natural system and feature.

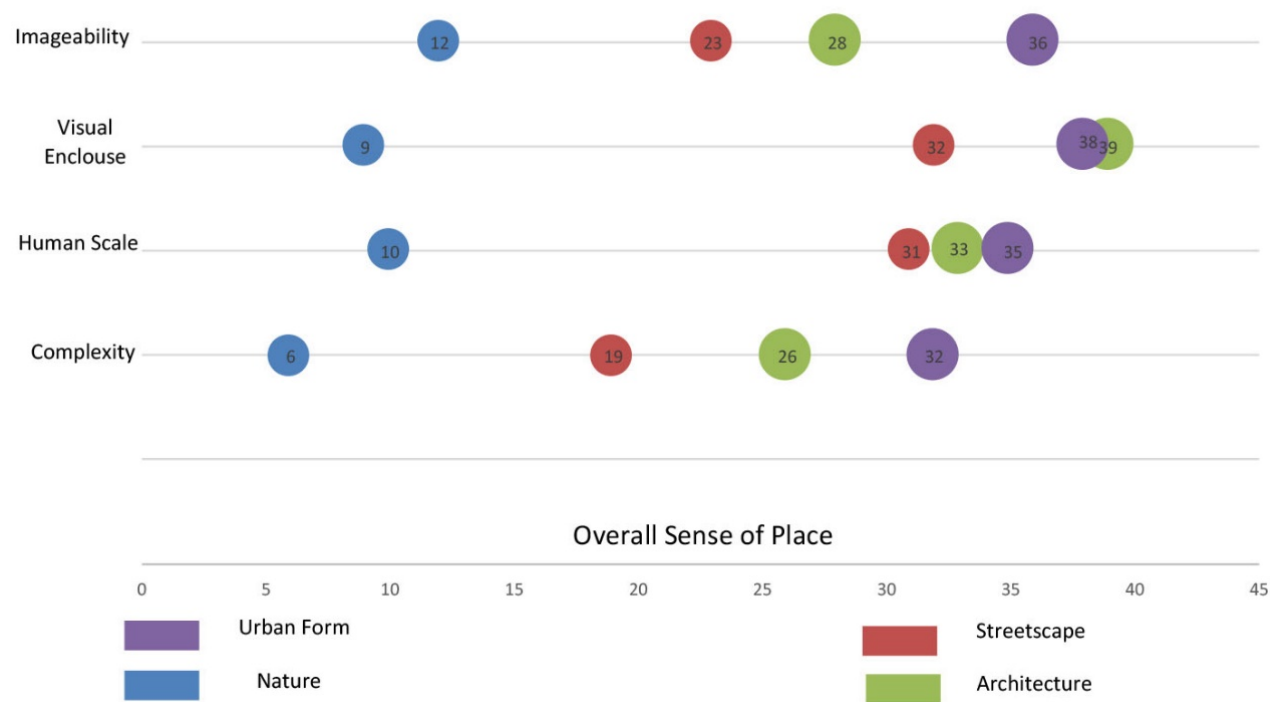


Figure 7.12: Panel Audit Response Summary

7.5 COMPARISON AND CONCLUSION

From the onsite visitor survey and estimation results from the previous chapter, there is no direct relation between artistic value of a neighborhood and the SOP; these attitudinal statement responses were not statistically explained by the latent variable SOP. However, from the field investigation and panel auditing of design evaluation outputs, we found that architectural context and character has higher impact on the forming SOP, assuming SOP leads to higher ratings for the four dimensions considered in this section: (i) imagenability; (ii) visual enclosure; (iii) human scale and (iv) complexity. The misalignment between residents' attitudinal perception about the SOP of a place and physical environment based on design guideline clearly showed in public market. Among the three sites, overall public market has lowest score from panel auditing, which could be due to the lack of diverse urban form and pattern as well as oversimplified architectural character, the panelists do not seem to think the public market could provide a SOP. This contrasts with the findings of previous chapters which suggest a stronger SOP associated with RPM, relative to the remaining two sites. This is intuitive, given RPM's recognition as an important landmark that could represent the identity of city of Rochester by local residence, local citizens recognize there's strong sense of place in public market. This discrepancy indicates the gap and potential for urban design improvements. Designers and planners who wish to embrace a SOP as a design guide for the built environment should therefore look beyond the physical dimension and consider a more holistic sociocultural experience when attempting to design or plan for SOP.

SOP varies across individuals and is related to the physical form of the built environment that has value beyond aesthetics. Just like human personalities, the sense of place is a composite of its

natural endowment (the material forms created by creators) and acquired traits (the characteristics given to it by users). In order to stimulate and create a comprehensive image of place, designers need to provide a variety of spatial experiences with distinguished physical identity, so visitors can form their own SOP. Visitors' environmental images may be characterized by three components: identity, structure, and meaning. Identity refers to the ways in which an object is distinct from other things. Natural system and site features may lack distinguishing characteristics, creating opportunities for designers to introduce distinguishing artificial features that differentiate a particular place from others. Second, the image formed by visitors of the surrounding environment must include the spatial or pattern relationship of the object to the observer and to other objects. Urban patterns and architectural forms play important roles in providing a structure that provides cues for observers to move through the space and form their own experiences, memories and eventual SOP. Finally, this built environment object must have meaning for the observer, whether practical or emotional. This may explain disconnects between pure artistic value from architecture and SOP. For example, based on on-site survey, College Town received the most consistent response among all the SOP attitudinal factors which may result from the consistent but generic urban and architecture design. Although College Town is considered beautiful according to the visitor survey, but with less artistic value, the consistent response does not directly contribute to better SOP in comparison to the other two sites, according to the design evaluation. The generic character of urban form and architecture language is the product of generic design guidelines. Most current design guidelines use consistent, common and generic terms to describe the requirements for urban design and place making, following such design guidelines would lead to generic and consistent place making. The beautiful and visually pleasing does not directly contribute to the artistic value of architecture. There's clear lack of sophisticated architecture design but public market holds the symbolic meaning of the city past, therefore local residence could be able to form the strong SOP. While on the other hand, College Town (CT) has yet to create its own meaning. Overall, a more robust understanding of space and place-making could help architects and urban designers to improve built environment designs. A hybrid quantitative and qualitative approach would also promise a more comprehensive evaluation, but requires more research on the exact mechanisms of this interaction. The findings of the design evaluation allude to dimensions that may help improve SOP, such as architectural context and building characteristic.

Chapter 8: Conclusions

This work examines the relationships between: (i) Sense of Place (SOP); (ii) non-motorized sustainable travel choices and accessibility; and (iii) adoption and use of information and communication technologies (ICT). In an information era, ICT provides visitors access to ubiquitous information and communication across multiple timeframes and geographies, expanding interaction with the location to include both physical and virtual interactions. Engagement with the location occurs pre and post-trip through information acquisition. Further contributing to developing a SOP are non-motorized travel modes that allow more direct exposure to the location may have a more positive influence on sense of place, relative to private modes, such as personal autos. This research produced three broad sets of outcomes.

ICT and Online Information: One direction this study pursued was examining Sense of Place (SOP) through the lens of text-mining. Specifically, topic modeling approaches, TF-IDF and LDA, were applied to online text reviews to identify the main topics of concern to visitors. As a standalone analysis, text-mining requires additional domain expertise to interpret the outcomes appropriately. While text-mining produces a data distillation of text responses, interpretation into topics still requires a human lens. In contrast, for a sentiment analysis which only involves interpreting favorable versus unfavorable reviews is relatively easy. In the context of interpreting the SOP dimensions additional domain expertise is necessary to properly associate the output from text mining which require contextual knowledge. Furthermore, our data mining showed that seasonality and timing of activities across a wide range of timeframes are particularly important to visitors. This suggests that characterizing SOP may need a time dimensions in addition to the conventional attitudinal and design related dimensions.

Built Environment and Design: Urban patterns and architectural forms play important roles in providing a structure and cueing visitors moving through the space and forming their own experiences, memories and eventual SOP. The design study finds that there is a gap between pure artistic value from architecture and the intended goal of developing a SOP; locations can be aesthetically pleasing, but homogeneity in design may work against developing a strong connection with the place. Although the newly developed College Town is considered beautiful according to many visitors, but with less artistic value, the consistent response does not directly contribute to better SOP in comparison to the other two sites, according to the design evaluation and the survey results. The generic character of urban form and architecture language is the product of generic design guidelines. Most current design guidelines use consistent, common and generic terms to describe the requirements for urban design and place making, following such design guidelines would lead to generic and consistent place making. The beautiful and visually pleasing does not direct contribute the artist value of architecture. There is a clear lack of sophisticated architecture design in the public market, but it holds the symbolic meaning of the city past, therefore local residence could be able to form the strong SOP. College Town (CT) has yet to create its own meaning.

Attitudinal and Behavior Characteristics: With respect to the latent variable SOP, many observed responses were found to be positively and statistically explained through SOP. The latent variable estimation for both visit and bike frequency models were similar. For both models, the latent variable SOP was found to explain responses to statements on identity, dependence and attachment. SOP also explained Social and Satisfaction dimensions. However, fewer of the attitudinal statements from the two dimensions were statistically significant. Aesthetics had no statements which were explained by SOP in a statistically significant manner, suggesting a low association between SOP and Aesthetics. This is consistent with past social science literature on SOP which has characterized it as mainly as a connection with the environment. The dimensions of social, satisfaction and aesthetics were additional dimensions found later by other researchers. Respondents from RPM were found to perceive a higher SOP in general, relative to other sites.

With respect to the choice model for bike/walk frequency, Sense of Place (SOP) has a positive impact that is statistically significant, such that locations with a higher SOP see higher stated walk/bike frequencies. Additionally, respondents living in Rochester several years showed a higher stated walk/bike frequency relative to those less than one year of residency. With respect to specific locations, respondents from RPM state lower frequencies. This low frequency may be explained by either the poor bike/walk access, which is affected by several factors, such as (i) safety of the neighborhood; (ii) infrastructure such as dedicated bike lanes; and (iii) operationally, the market is open Tuesdays, Thursdays and Saturdays, while the restaurants are open daily.

The choice model for visit frequency is similar to that for walk/bike frequency, indicating that the latent variable Sense of Place (SOP) has a positive impact that is statistically significant, such that locations with a higher SOP see higher stated visit frequencies. Additionally, respondents with longer residence in the Rochester area showed a higher stated visit frequency relative to those less than one year of residency, possibly also due to the higher perceived SOP. With respect to specific locations, respondents from RPM state lower visit frequencies, relative to College Town, while the East End respondents stated higher visit frequencies. However, the lower frequencies for RPM may be attributable to the limited hours the market is open.

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Appendix A: Intercept Survey

This appendix contains the written questions for the survey and other related documents, including scripts followed by survey hosts.

Rochester Sense of Place Survey

CONDUCTED BY: GOLISANO INSTITUTE FOR SUSTAINABILITY
(GIS), ROCHESTER INSTITUTE OF TECHNOLOGY (RIT)

The survey consists of four main sections, each asking for different information:

1. Attitudes about the intercept site and other similar locations visited
2. Travel and access to the intercept site and other similar locations visited
3. Internet search and use habits for information on travel and destinations
4. Personal and household attributes

The entire survey will take approximately 15 minutes to complete.

Section 1: Attitudinal Statements on Intercept Site

Please rate the following statements, for [East End, Public Market, College Town], using the provided scale, -3 for strongly disagree, 0 for a neutral opinion (you neither agree or disagree), and 3 for strongly agree.

Place attitudes about [East End, Public Market, or College Town]:

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
Satisfaction	I am satisfied with the food/dining options	-3	-2	-1	0	1	2	3
	I am satisfied with the consumer products offered	-3	-2	-1	0	1	2	3
	I am satisfied with the motor vehicle parking	-3	-2	-1	0	1	2	3
	I am satisfied with the amenities (restrooms, etc.)	-3	-2	-1	0	1	2	3
	I am satisfied with the entertainment options	-3	-2	-1	0	1	2	3
	I am satisfied with the amount of people	-3	-2	-1	0	1	2	3
	I am satisfied with bicycle parking	-3	-2	-1	0	1	2	3
	I am satisfied with bicycle/walking access	-3	-2	-1	0	1	2	3
	I am satisfied with public transit access	-3	-2	-1	0	1	2	3
I am satisfied with the travel mode access options	-3	-2	-1	0	1	2	3	
Attachment	I feel a strong connection with this place	-3	-2	-1	0	1	2	3
	This is a place that makes me feel relaxed	-3	-2	-1	0	1	2	3
	I would be disappointed if it did not exist	-3	-2	-1	0	1	2	3
	It makes me feel happy	-3	-2	-1	0	1	2	3
Dependence	It meets my needs better than any other location	-3	-2	-1	0	1	2	3
	It has more diversity in activities (eating, shopping, socializing, etc.) than any other place	-3	-2	-1	0	1	2	3
	It has stores that lack specific items I want	-3	-2	-1	0	1	2	3
Identity	It reflects the type of person I am	-3	-2	-1	0	1	2	3
	It makes me feel too self-conscious	-3	-2	-1	0	1	2	3
	It makes me feel comfortable because I identify with this place	-3	-2	-1	0	1	2	3
	It says very little about me	-3	-2	-1	0	1	2	3
	It makes me feel I can be myself	-3	-2	-1	0	1	2	3
	Is a good reflection of my identity	-3	-2	-1	0	1	2	3
	I only come here when I have a specific reason in mind	-3	-2	-1	0	1	2	3
Aesthetics	It has a visually appealing architecture	-3	-2	-1	0	1	2	3
	It has a peaceful and relaxing atmosphere	-3	-2	-1	0	1	2	3
	Has a good balance of decorative features and businesses	-3	-2	-1	0	1	2	3
	It is a beautiful place	-3	-2	-1	0	1	2	3
	It has artistic value	-3	-2	-1	0	1	2	3
Social	Has a definite social atmosphere	-3	-2	-1	0	1	2	3
	Is a great family-friendly place to be	-3	-2	-1	0	1	2	3
	Is a great kid-friendly place to be	-3	-2	-1	0	1	2	3

Has generally friendly people around	-3	-2	-1	0	1	2	3
Reflects the culture of Rochester	-3	-2	-1	0	1	2	3
Involves a risk of unpleasant encounters with people when travelling to and through it	-3	-2	-1	0	1	2	3
Is always overcrowded	-3	-2	-1	0	1	2	3
Has too much going on in it	-3	-2	-1	0	1	2	3
Makes me afraid to walk/bike around	-3	-2	-1	0	1	2	3

Repeat the attitudinal questions above for remaining two locations [*East End, Public Market, or College Town*], if the respondent is familiar with either of them.

Section 2: Questions on Travel and Access

Additional questions on travel/access to the current location; these questions only apply to the visitor's current location.

- a. Which travel mode did you use to access this location today?
 - i. personal motor vehicle (car, truck, etc.)
 - ii. walk
 - iii. bike
 - iv. public transit
 - v. other – including car-share and carpool

- b. How often do you visit this location per month (approximate)? _____ times

- c. Did you travel with other people today? (check all that apply)
 - i. Family Immediate
 - ii. Family Extended
 - iii. Friends
 - iv. Co-workers/Colleagues
 - v. Students (peers)
 - vi. Students (mentors, teacher, coach, etc.)
 - vii. Organization (sports group, non-profit, etc.)

- d. Where were you before you arrived at this location (nearest intersection/cross-street or landmark/institution)? _____

Section 3: Questions on Internet Search and Use for Travel and Destination Information

Additional questions on searching and using online information to make location and travel/access decisions; the first set applies only to the current location; the last set is general and applies to all locations.

Ask only for current intercept site [*East End, Public Market, or College Town*]:

- a. Have you ever searched for information about this place online? (yes/no)
- b. Have you ever read reviews about this place online? (yes/no)
- c. Have you ever written reviews about this place online? (yes/no)
- d. Did you use social media (e.g. Facebook, Four Square) to “check-in” to this location? (yes/no)
- e. If yes, which app (e.g. Facebook, Four Square) did you use?
- f. Do you use a smart-phone or tablet to search and access information en-route to a destination and at the destination?

Ask for all locations:

Please rate the following statement describing your online information search and use about travel/access and locations.

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
I spend a lot of time searching for information online about locations (restaurants, etc.) before visiting.	-3	-2	-1	0	1	2	3
I value and trust the reviews I find online	-3	-2	-1	0	1	2	3
I find the information and content I find online about a particular location helpful	-3	-2	-1	0	1	2	3

Note: Ask Ashok for questions in Hani’s study.

Section 4: Personal and Household Attributes

1. How many persons (including yourself) presently live in your household?
2. In which city do you live?
3. Can you give your Zip Code and nearest intersection of your home?
4. How long have you lived at that location?
5. How many years have you lived in the Rochester area?
6. How many people in your household work (employed) full-time?
7. How many children (under the age of 18) are in your household?
8. What is your relationship with the other members in your household?

- a. I live alone
 - b. I live with my immediate family
 - c. I live with my extended family
 - d. I live with friends
 - e. I live with acquaintances
 - f. Others (explain)
9. What is your age?
- a. 18-29 years
 - b. 30-39 years
 - c. 40-49 years
 - d. 50 – 59 years
 - e. 60 years and above
10. What is your gender? (male/female)
11. How many motor vehicles do you have in your household?
12. How many licensed drivers are there in your household?
13. How many bicycles do your household own?
14. Which best represents your household's income per year?
- a. Less than \$10,000
 - b. \$10,000-\$19,999
 - c. \$20,000-\$29,000
 - d. \$30,000-\$39,000
 - e. \$40,000-\$49,000
 - f. \$50,000-\$59,000
 - g. \$60,000-\$69,000
 - h. \$70,000-\$79,000
 - i. \$80,000-\$89,000
 - j. \$90,000-\$99,000
 - k. \$100,000-\$109,000
 - l. \$110,000-\$119,000
 - m. \$120,000-\$129,000
 - n. \$130,000-\$139,000
 - o. \$140,000-\$149,000
 - p. More than \$150,000

Survey Logistics

The GIS is conducting an intercept survey to understand the sense of place of various locations in Rochester in the month of September and October. Understanding sense of place helps in urban planning. The intercept survey will be maximum of 10 minutes and conducted at all the locations of interest. People above 18 years old are asked about their attitudes towards these locations. The selected locations are East end, Public market and College town. The operational and logistics details of the survey effort are described in this document.

Description

On selected days at each location volunteers will be conducting an intercept survey using tablets/laptops/smartphones. The survey will be administered by one student manager and five student survey workers. The student survey workers will be hired through an interview process at RIT. The student manager will be GRA of the project and would have completed Human Subject Assurance training. Ideally we aim to collect 180 responses at each site.

The students will be given a laptop/tablet/smartphone pre-installed with QuickTapSurvey app. The app guides the student worker through the survey questions and provides a neat interface to record the answers. The app collects the responses and they are stored in the cloud with only access to the PI.

Commented [AS1]: This is just a place holder.

Students operate from a tent/booth at each location. Written permission for setting up the booth are obtained in advance. Advertisements of the survey e.g., posters and flyers will be placed at various locations at the site. The incentive for the survey is a \$100 Amazon gift card for a one respondent selected randomly.

East End

East end is a neighborhood in downtown Rochester. It is the area between East Ave, Alexander Street and Main Street. It is characterized by vibrant night life and cultural attractions. The survey dates are expected to coincide with the Fringe Festival. Fringe Festival is a 10-day multi-arts festival in Rochester Downtown that attracts numerous visitors. Maximum visitors are expected in the weekends therefore the intercept survey will be conducted during the same time. Students will be around Martin Luther King jr park and Gibbs Street.

Public Market

The market offers fresh produce, ethnic delicacies, specialty items, general merchandise and so much more. In addition, an array of independent local businesses--cafes, food stands, coffee shops, florists, specialty food purveyors, breweries, and more--can be found on Market grounds and in the surrounding Market District. Rochester Public market is located at 280 N. Union Street. It is open on Tuesday, Thursday and Saturday 52 weeks a year. With the help of the Public market administrator/ operations manager a tent will be set up during sep 26th, Oct 8th and Oct 10th.

College Town

College Town is a mixed-use development/sub-neighborhood in Upper Mount Hope. It is characterized by shopping, dining, working, hospitality and upscale living within an engaging 24/7 environment. The interview dates are expected to coincide during the homecoming weekend of University of Rochester Oct 9-11.

Cost

Quick Tap Survey – monthly/yearly subscription

Tablets – 10

Student Workers – 5*16*7

	East End	Public Market	College Town
Time per Respondent (mins)	20	20	20
Hours per Day per Student (hrs)	4	6	6
Time per Day per Student (mins)	240	360	360
Students per Day	5	5	5
Total Sample Size per Day	60	90	90
Days per Site	3	2	2
Total Sample Size per Site	180	180	180
Potential Time/Hrs	After 2	full day	Full day
Potential Date	9/18/15 9/19/15 9/25/15 9/26/15	9/26/15 10/10/15 10/8/15	10/9/15 10/10/15 10/11/15
Booth Location	Martin Luther park (18 th) Gibbs Street (19,25,26)	??	??

Intercept Surveyor Script

Read Introductory Information.

"Good [morning, afternoon, evening]. My name is _____, and I'm here with my team-mate _____. We're part of a RIT sustainability research team surveying visitors of [the East End, Public Market, or College Town].

The results of this study will help us and the City of Rochester understand people's overall experiences visiting and spending time in [the East End, Public Market, or College Town] and how can these experiences be improved.

Would you be willing to answer some questions about your experiences as a visitor? This survey will only take a few minutes. My team-mate _____ will be recording your responses on this [tablet, laptop] while I read you the questions."

If the answer is "yes":

"Thank you. Before beginning, I need to first confirm that you are 18 years or older?"

If the answer is "yes":

"I also need to read you some informed consent information."

Read Informed Consent Information

"By indicating that you agree below, you confirm that you have heard the informed consent terms and that you consent to continue your participation in this study. You also confirm being 18 years or older. Do you agree and acknowledge this?"

If the answer is "yes" check the appropriate box.

"Thank you. First I'm going to ask you to rate some statements about your attitudes towards this place."

Read questions/statements from Section 1 of survey and record responses.

"Great, now I'm going to ask some questions about your travel and access to this place."

Read questions/statements from Section 2 of survey and record responses.

"Wonderful, we're half way done. Now I'm going to ask some questions about your online information search and use habits."

Read questions/statements from Section 3 of survey and record responses.

"We're almost done. I'm going to finish by asking some information about yourself and your household."

Read questions/statements from Section 4 of survey and record responses.

"OK, we're done. Do you have any questions?"

Answer any questions. "We appreciate your time and interest. Thanks for helping make our project a success."

[GIS LOGO GOES HERE]

Part-time Surveyors Needed for Sense of Place Survey in Rochester

Background: The Golisano Institute for Sustainability (GIS) is looking for qualified candidates to work one or more three hour shifts on the weekdays and weekends to conduct an intercept survey at three sites in Rochester during the months of September and October 2015. The goal of the survey is to collect information on the attitudes towards these sites with respect to attachment, identity and engagement or activity. This study investigates the relationship between these attitudes and (a) non-motorized travel mode access; (b) design of the built environment; and (iii) online presence of the sites. The three sites selected include (i) Public Market; (ii) East End (between Alexander St. and Main St) and (iii) College Town (near the University of Rochester, along Mr. Hope Ave.).

Job Description: Intercept surveyors will survey site users of (i) Public Market; (ii) East End and (iii) College Town about their sense of place, what features bring them to these sites, and what types of activities and opportunities they engage at these sites. **Job would pay (\$12.00/hour).** Surveyors will be contract staff with GIS and RIT, and report directly to Dr. Roger Chen the Principle Investigator (PI) of this project, and work under the guidance of on-site survey managers. Surveyors will be paid after completion of all committed shifts.

Job Requirements: (i) **Available to work one or more 3 hour shifts per day during September and October, on Tuesday, Thursday, Friday or Saturday.** Depending on the site, shifts will either be in the morning between 9 AM and 12 PM, 1:00 PM and 4 PM or 3:30 PM and 6:30 PM. Additionally, all student workers need to attend a 1-hr orientation and survey coordination session; (ii) **Punctuality** – being on time and prepared (rain or shine) is critical for this survey; (iii) **Excellent Conversational and Listening Skills** – the success of this intercept survey requires surveyors to approach and converse with a wide range of people of varying personalities and backgrounds; *surveyors need a friendly outgoing and energetic personality to be successful*; (iv) **all surveyors need to operate a tablet or laptop** that is provided to record site user responses; (v) **Surveyors must be 18 years or older.**

Other Desired Qualifications: (i) Enthusiastic about neighborhoods, communities, non-motorized and sustainable transportation (bikes, walking, car-share, etc.) and design of the built environment; (ii) interested in learning how to conduct community intercept surveys; (iii) Bilingual in English and another language; (iv) Familiarity with one of the three sites or a regular visitor.

Applicants should send a short letter of interest (< 1 page), a resume, and contact information for one personal and one professional reference to Dr. Roger Chen (rbcgis@rit.edu) by September 1st, 2015. Please put “GIS Sense of Place Survey Applicant” in the subject line.

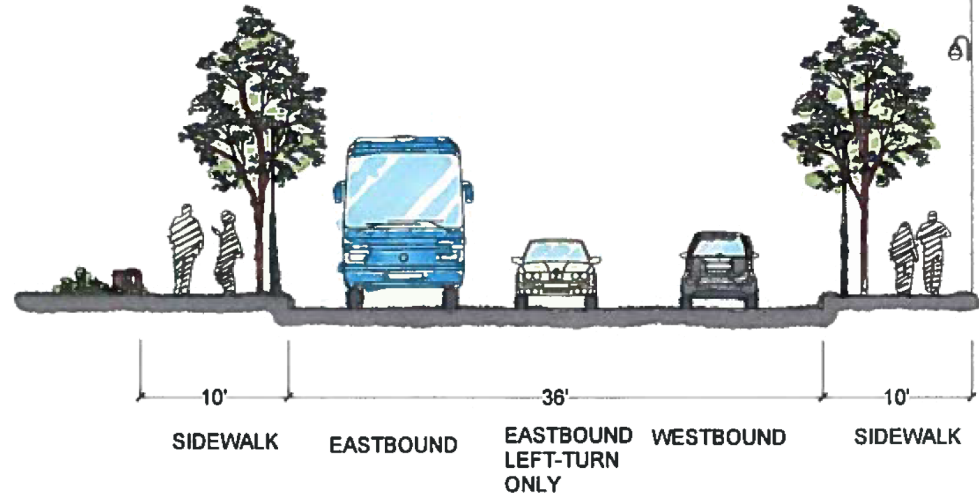
Appendix B: Design Evaluation Outputs

This appendix contains the design documents which are outputted from the field study conducted by students from an architecture design studio.

URBAN SENSE OF PLACE: COLLEGE TOWN

31 May 2016, 2-4 p.m.
10 June 2016, 6-7 p.m.

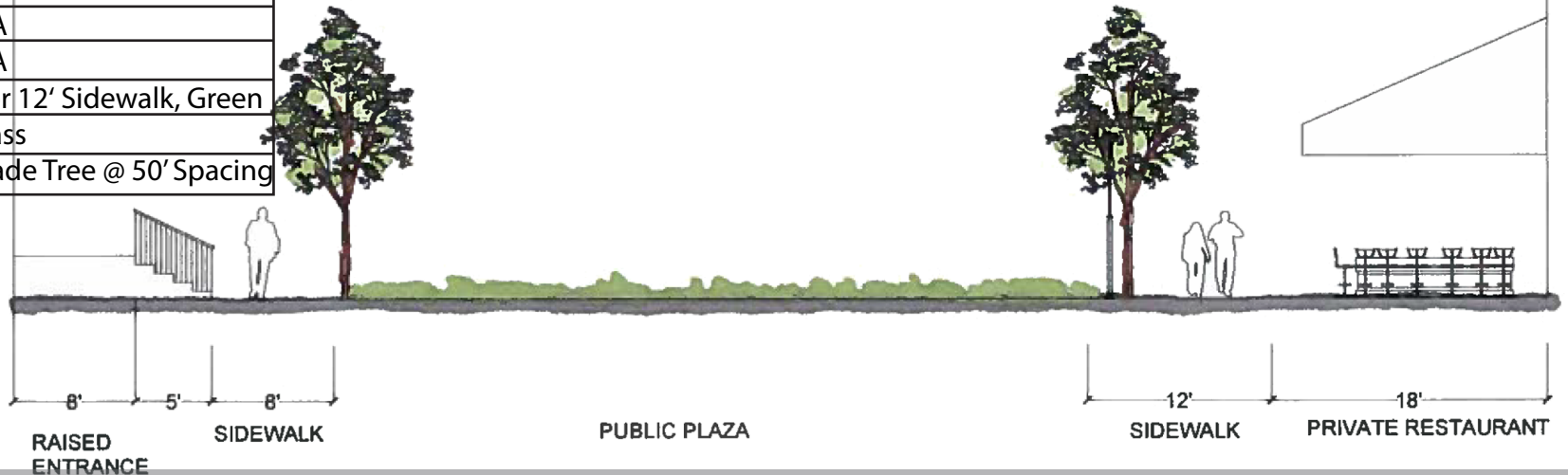
Thoroughfare	Drive
Pavement Width	36'
Movement	Moderate / Two-Way
Design Speed	30 MPH
Traffic Lanes	3, 12'
Parking Lanes	N/A
Walkway Type	(2) 10' Sidewalk
Planting Type	Grass or N/A
Landscape Type	Shade Tree @ 85' Spacing



CELEBRATION DRIVE

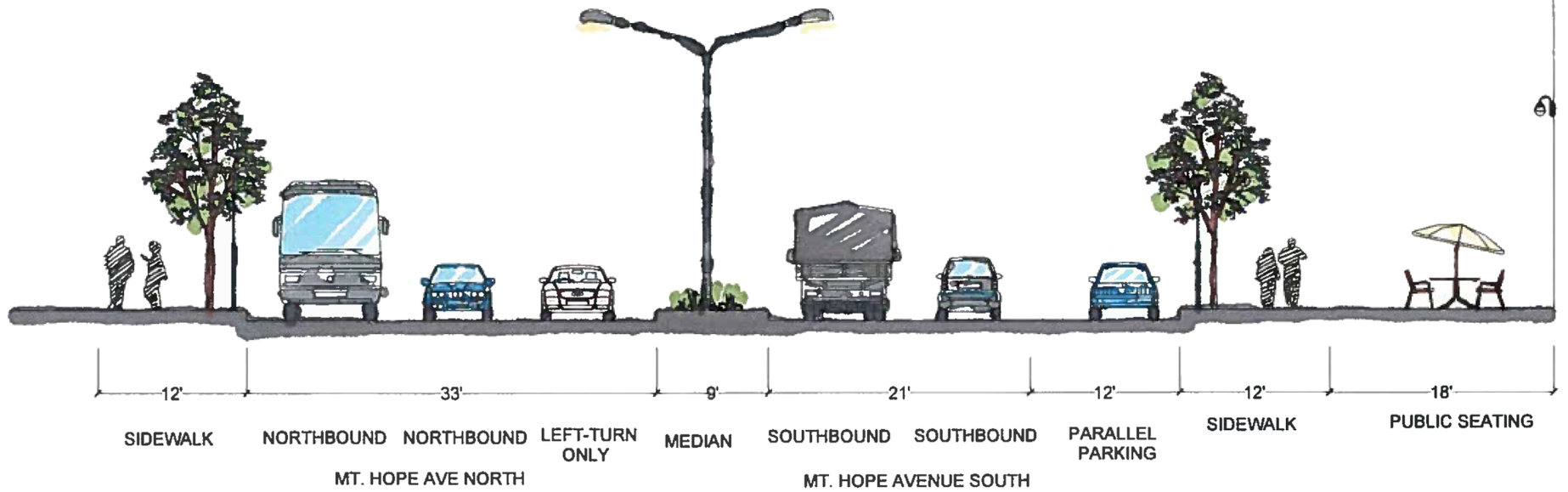
30 MPH

Thoroughfare	Public Plaza
Pavement Width	N/A
Movement	N/A
Design Speed	N/A
Traffic Lanes	N/A
Parking Lanes	N/A
Walkway Type	8' or 12' Sidewalk, Green
Planting Type	Grass
Landscape Type	Shade Tree @ 50' Spacing



PUBLIC PLAZA-CELEBRATION DRIVE

Thoroughfare	Avenue
Pavement Width	66'
Movement	Fast / 2-Way
Design Speed	30 MPH
Traffic Lanes	5, 11"
Parking Lanes	1, 12'
Walkway Type	(2) 12' Sidewalk
Planting Type	Grass or N/A
Landscape Type	Shade Tree @ 42' Spacing



MT. HOPE AVENUE
30 MPH

COLLEGE TOWN

GROUND FLOOR TREATMENT

1

1. Barnes & Noble Booksellers at the intersection of Elmwood and Mt. Hope Avenues provides bicycle racking stations, awnings for shade and wide pedestrian sidewalks.



2. Barnes & Noble Booksellers wraps the corner onto Mt. Hope Avenue where public seating and shade are provided



3. College Town on Mt. Hope Avenue consists of approximately 50% retail and 50% service storefronts. Residential apartments and office space are located above the ground floor.

Space allocated for restaurants is provided with slightly raised pavement for outdoor dining separated from the pedestrian sidewalk by a fence.



4. Restaurant outdoor dining space occupying and wrapping the corner of Mt. Hope Avenue and Celebration Drive is separated from the pedestrian sidewalk by a low brick wall and provides awnings for shade.



COLLEGE TOWN

GROUND FLOOR TREATMENT

1

5. Pedestrian through traffic is visually separated from outdoor dining space and slower, strolling-paced College Town patrons by alternative pavement materials and patterns.



6.



7. Bars serving alcohol that allow for outdoor dining are separated from pedestrian walkways by a gate with a single entry stile to control access.

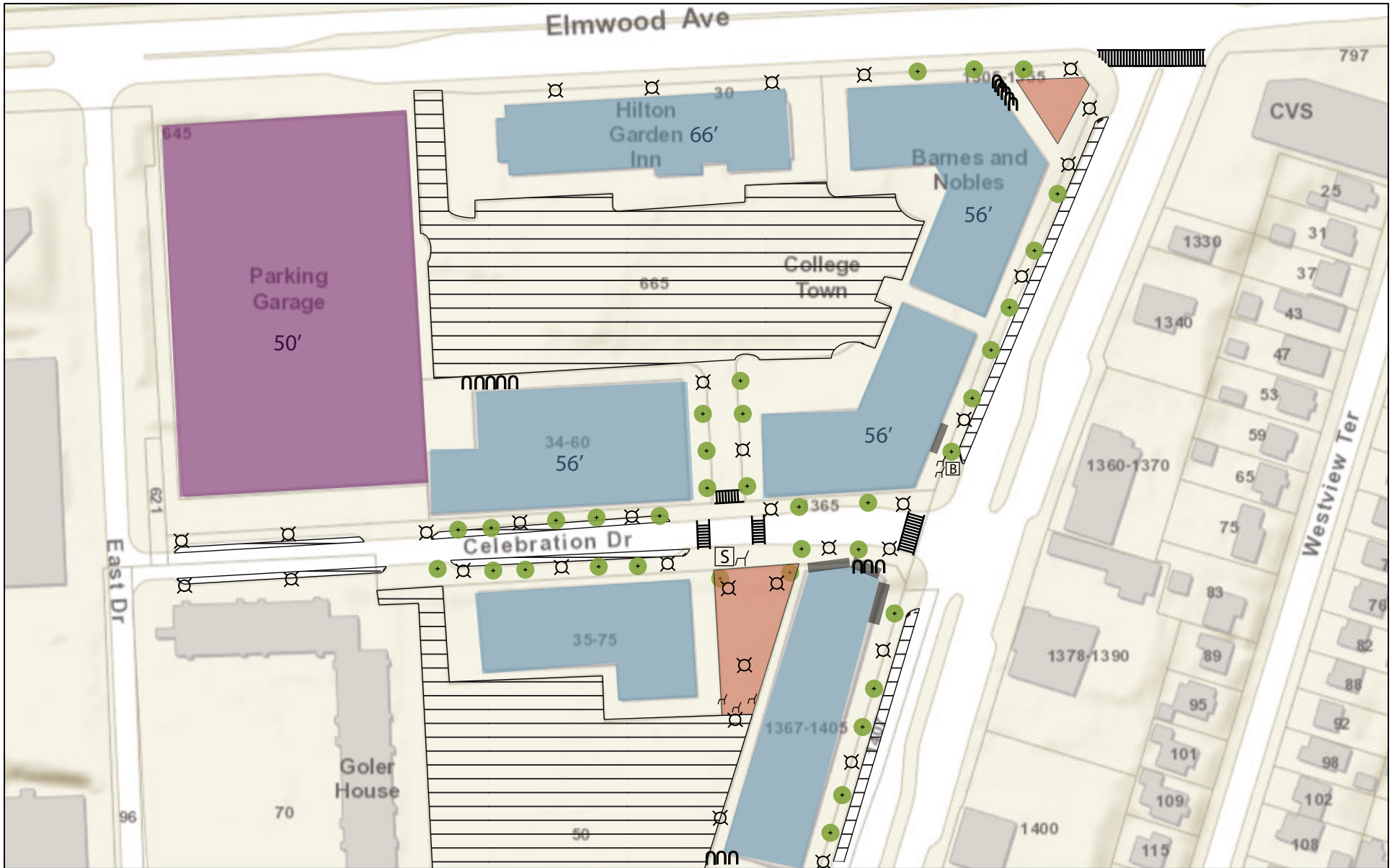
Indoor/outdoor dining spaces are less defined through the use of window-wall technology.












8. Celebration Drive is approximately 50% retail store frontage and 50% services.

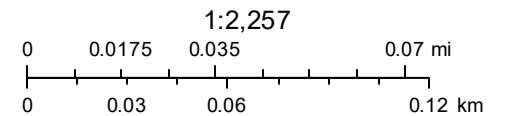


College Town



June 3, 2016

- | | | | |
|---|---|---|----------------|
|  | Mixed Use - Retail/Restaurant/Services at ground
Residential above |  | Bus Stop |
|  | Public Plaza - Mixed Planting/Seating Area |  | Public Seating |
|  | Ground Level Parking |  | Awning |
|  | Group S - Storage (Parking Garage) |  | Light Post |
| | |  | Bicycle Rack |
| | | | Planting/Tree |

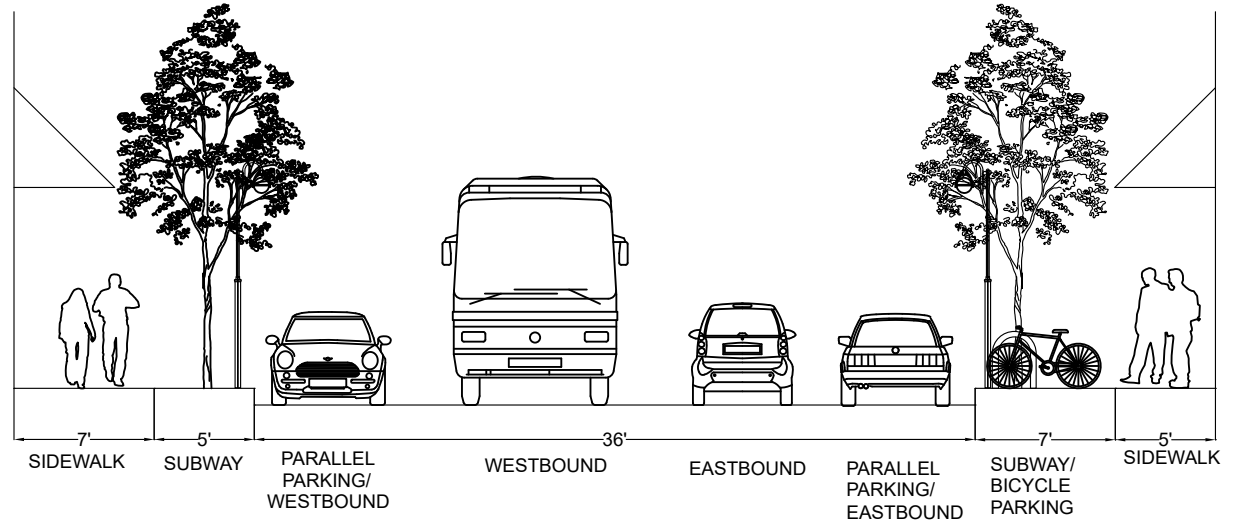


Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

URBAN SENSE OF PLACE: EAST END

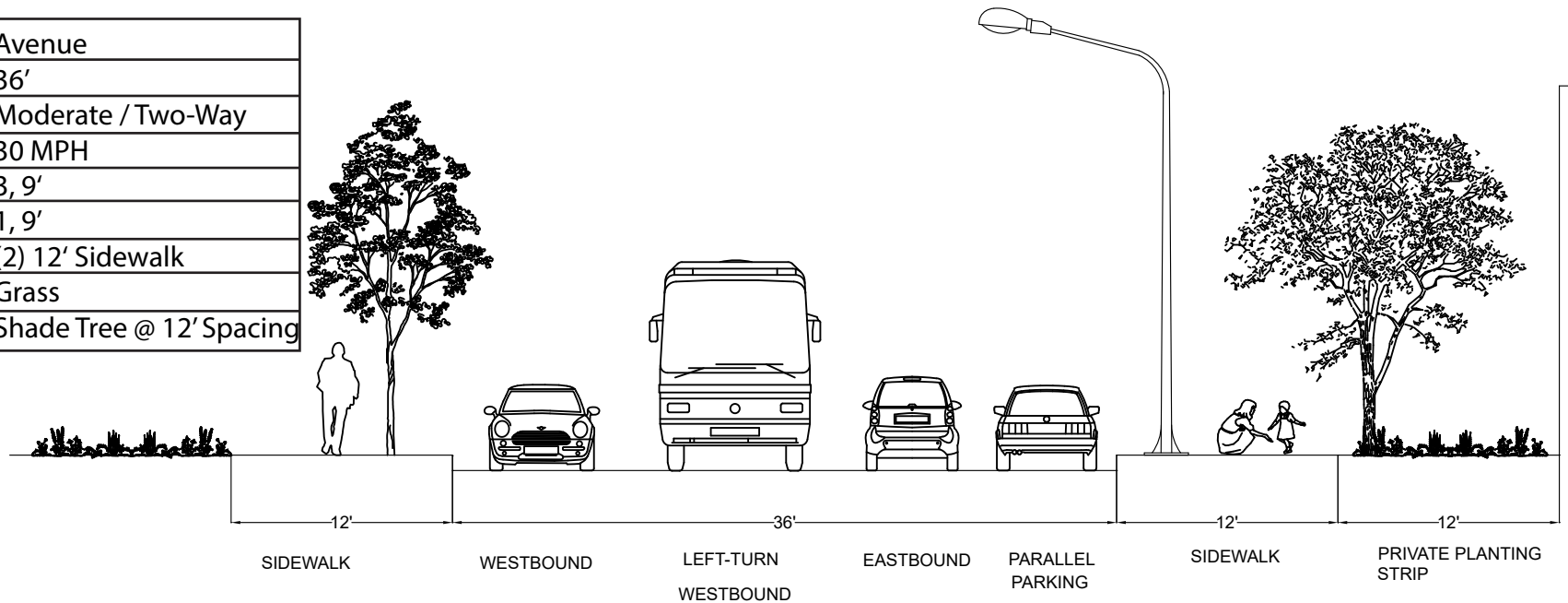
2 June 2016, 3-5p.m.
4 June 2016, 6-7 p.m.

Thoroughfare	Avenue
Pavement Width	36'
Movement	Moderate / Two-Way
Design Speed	30 MPH
Traffic Lanes	Up to 4, 9'
Parking Lanes	Up to 2, 9'
Walkway Type	Sidewalk
Planting Type	N/A
Landscape Type	Shade Tree @ 20' Spacing



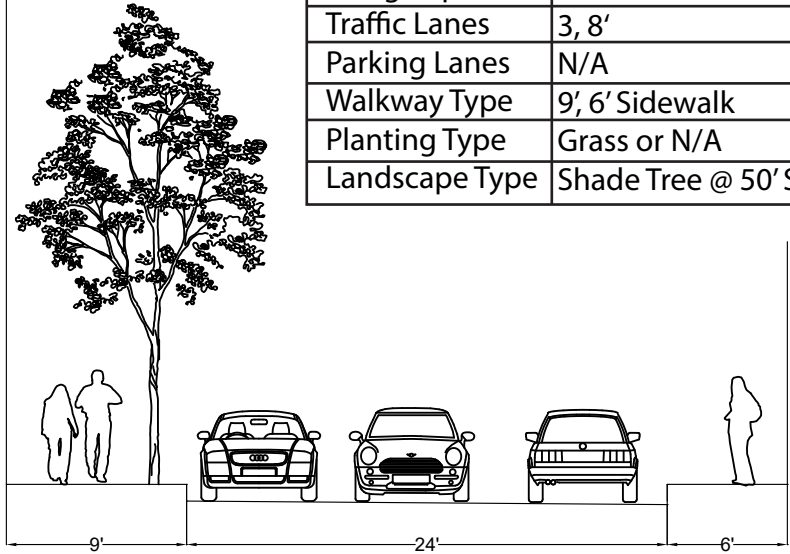
EAST AVENUE AT GIBBS

Thoroughfare	Avenue
Pavement Width	36'
Movement	Moderate / Two-Way
Design Speed	30 MPH
Traffic Lanes	3, 9'
Parking Lanes	1, 9'
Walkway Type	(2) 12' Sidewalk
Planting Type	Grass
Landscape Type	Shade Tree @ 12' Spacing



EAST AVENUE AT BROADWAY

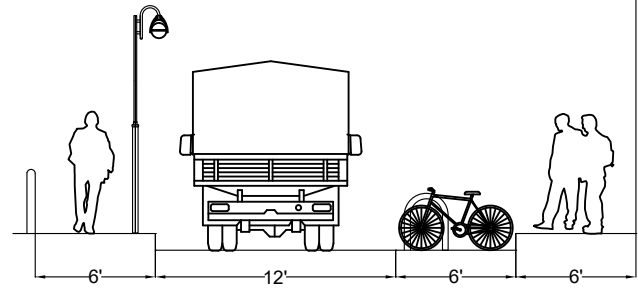
Thoroughfare	Street
Pavement Width	24'
Movement	Moderate/ 2-Way
Design Speed	30 MPH
Traffic Lanes	3, 8'
Parking Lanes	N/A
Walkway Type	9', 6' Sidewalk
Planting Type	Grass or N/A
Landscape Type	Shade Tree @ 50' Spacing



SIDEWALK RIGHT-TURN SOUTHBOUND SOUTHBOUND NORTHBOUND SIDEWALK

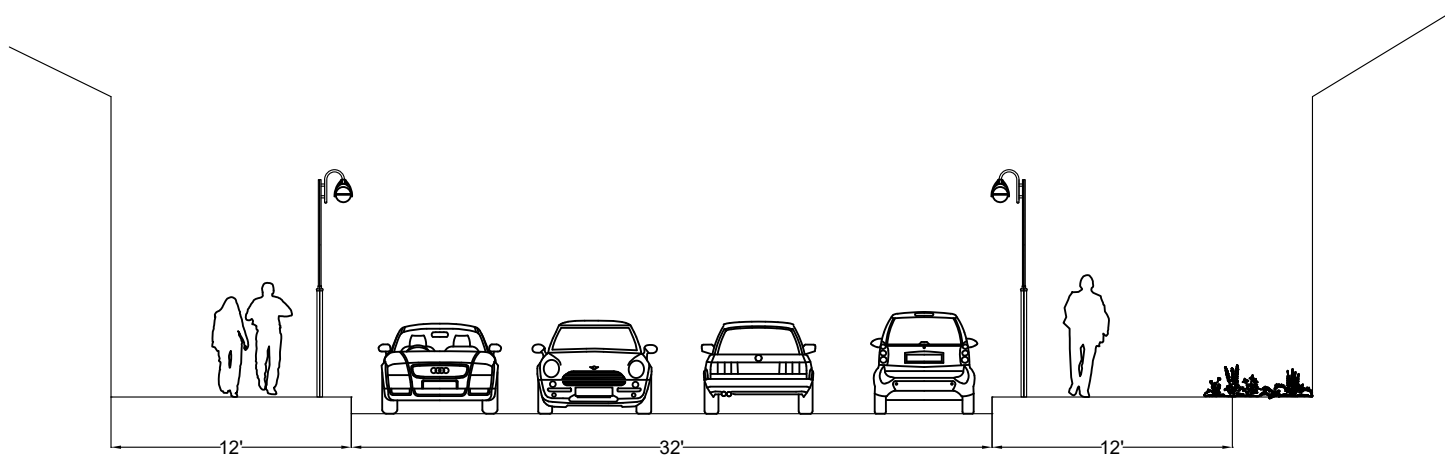
ALEXANDER STREET

Thoroughfare	Street
Pavement Width	12' or 18'
Movement	Slow / 2-Way
Design Speed	15 MPH
Traffic Lanes	1, 12' or 2, 9'
Parking Lanes	Bicycle, 6'
Walkway Type	(2) 6' Sidewalk
Planting Type	N/A
Landscape Type	N/A



SIDEWALK NORTHBOUND BIKE/ PARALLEL PARKING SIDEWALK

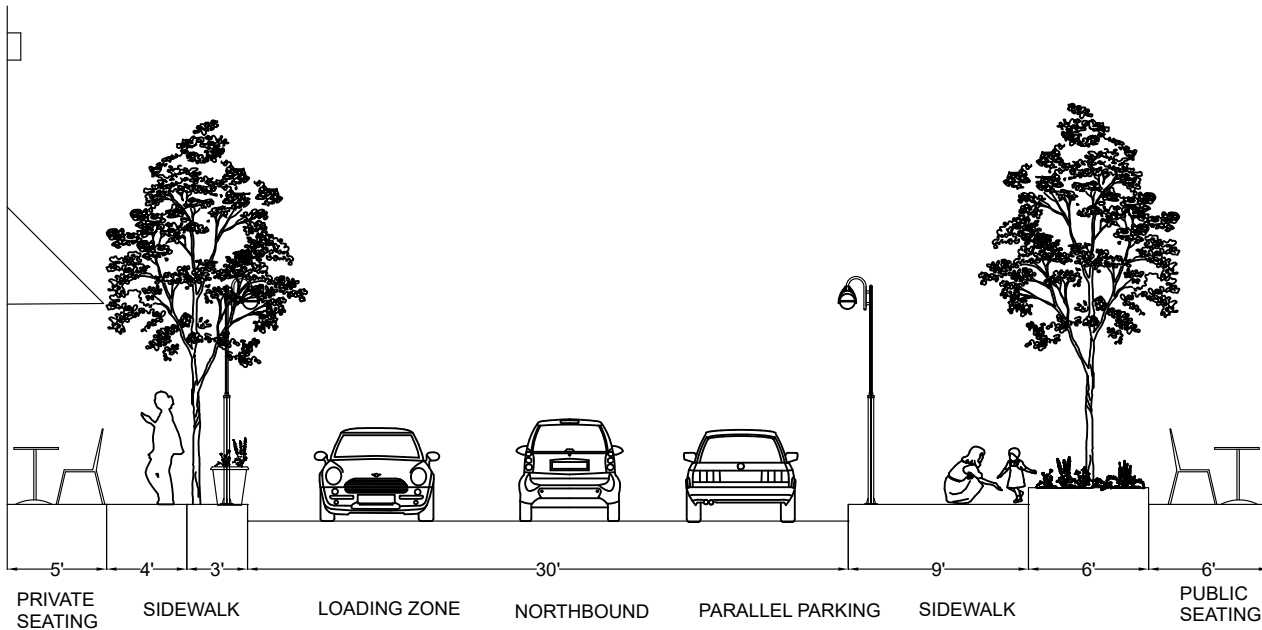
MATHEWS STREET



SIDEWALK PARALLEL PARKING NORTHBOUND SOUTHBOUND PARALLEL PARKING SIDEWALK

WINTHROP STREET

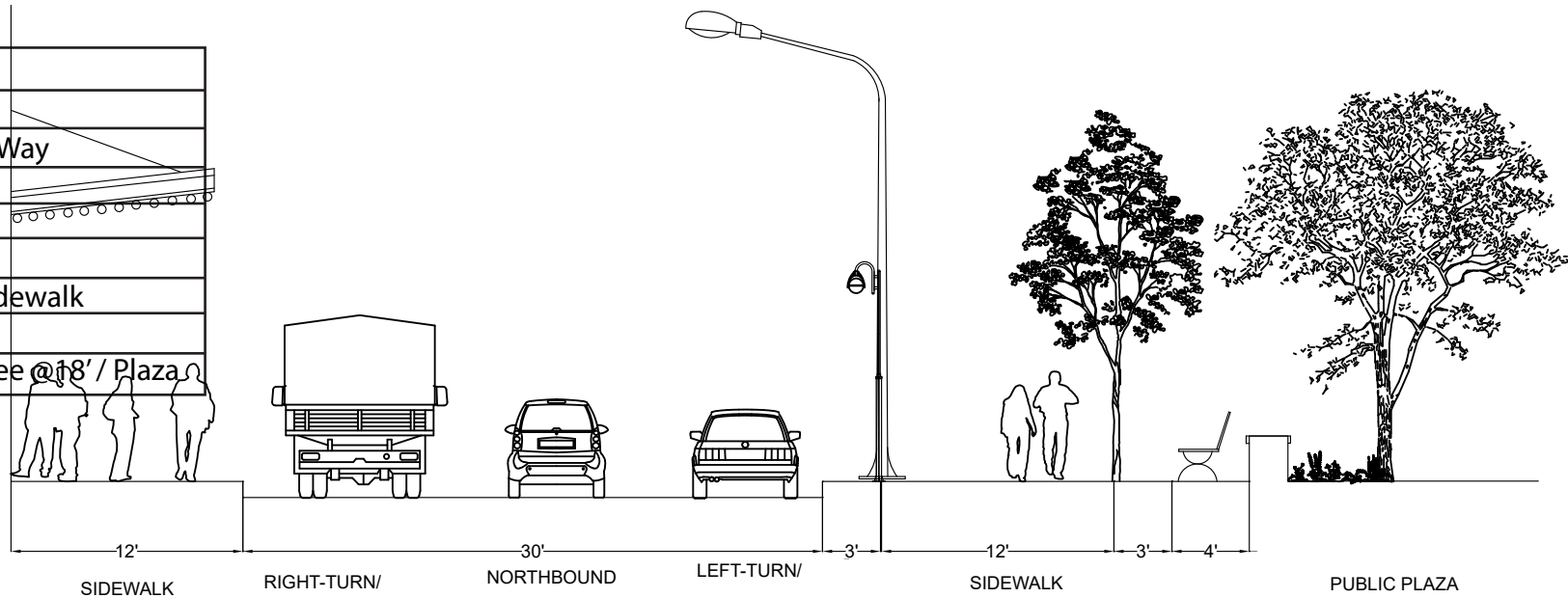
Thoroughfare	Street
Pavement Width	32'
Movement	Moderate/ 2-Way
Design Speed	15 MPH
Traffic Lanes	2, 8'
Parking Lanes	2, 8'
Walkway Type	(2) 12' Sidewalk
Planting Type	Grass or N/A
Landscape Type	N/A



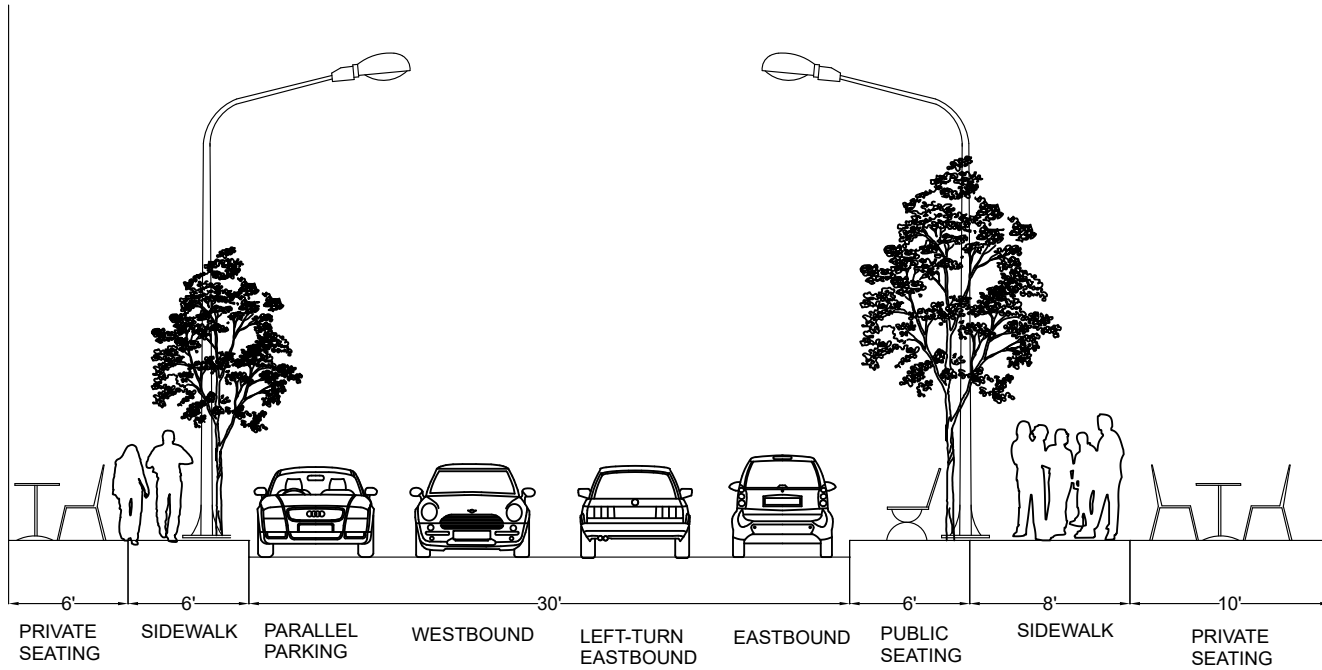
Thoroughfare	Street
Pavement Width	30'
Movement	Moderate / 2-Way
Design Speed	15 MPH
Traffic Lanes	2, 10'
Parking Lanes	1, 10'
Walkway Type	4' and 9' Sidewalk
Planting Type	Raised planter / Grass
Landscape Type	Shade Tree @ 18'

GIBBS STREET AT BARRETT ALLEY

Thoroughfare	Street
Pavement Width	30'
Movement	Slow / 2-Way
Design Speed	30 MPH
Traffic Lanes	3, 10'
Parking Lanes	N/A
Walkway Type	(2) 12' Sidewalk
Planting Type	N/A
Landscape Type	Shade Tree @ 18' / Plaza



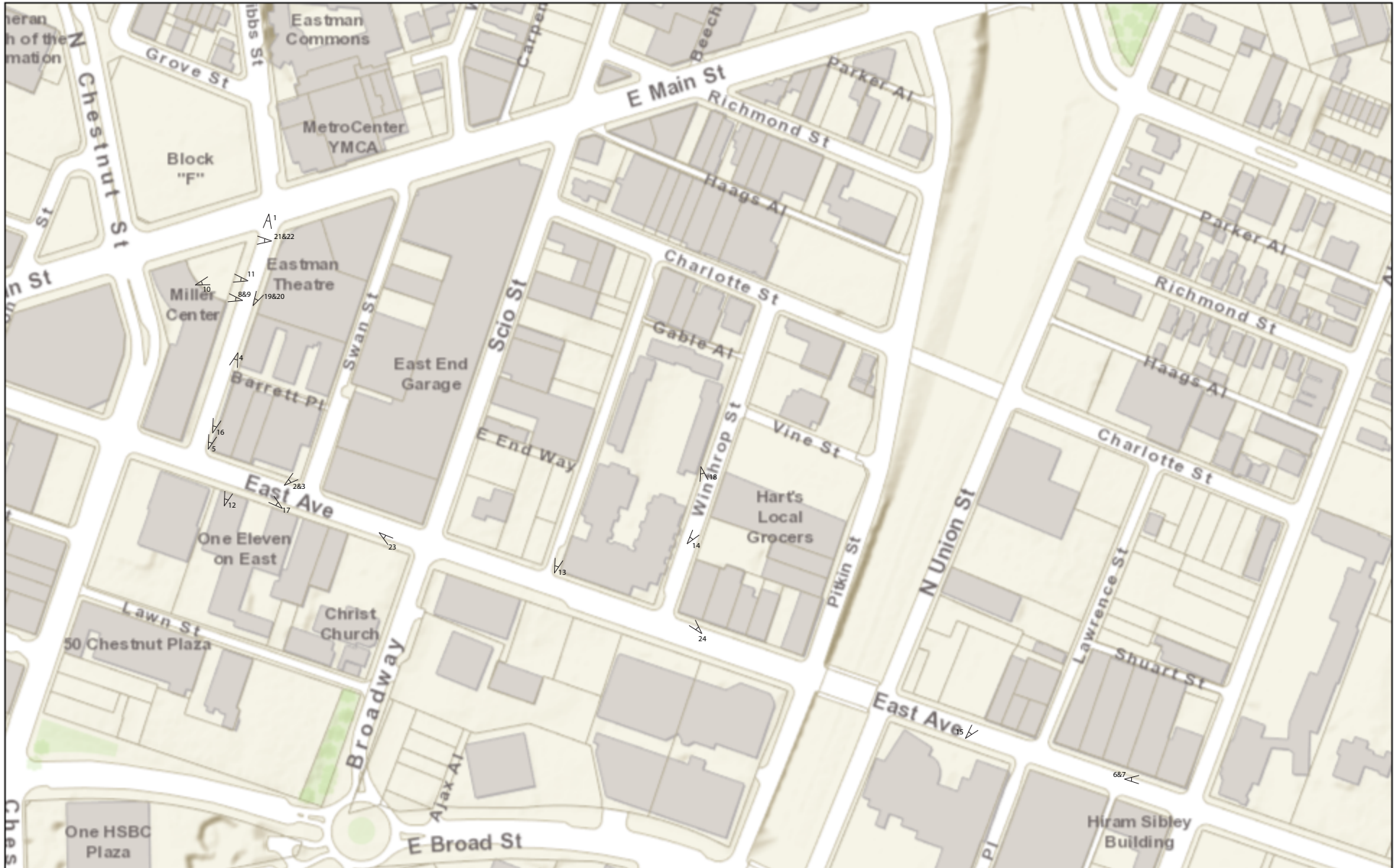
GIBBS STREET 30 MPH



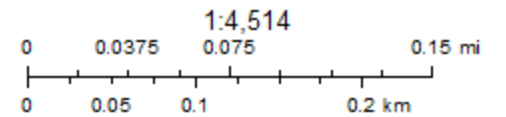
Thoroughfare	Avenue
Pavement Width	30'
Movement	Moderate /2- Way
Design Speed	30 MPH
Traffic Lanes	Up to 3, 8'
Parking Lanes	1, 6'
Walkway Type	6' or 8' Sidewalk
Planting Type	N/A
Landscape Type	Shade Tree @ 50'

EAST AVENUE AT ALEXANDER STREET

East End

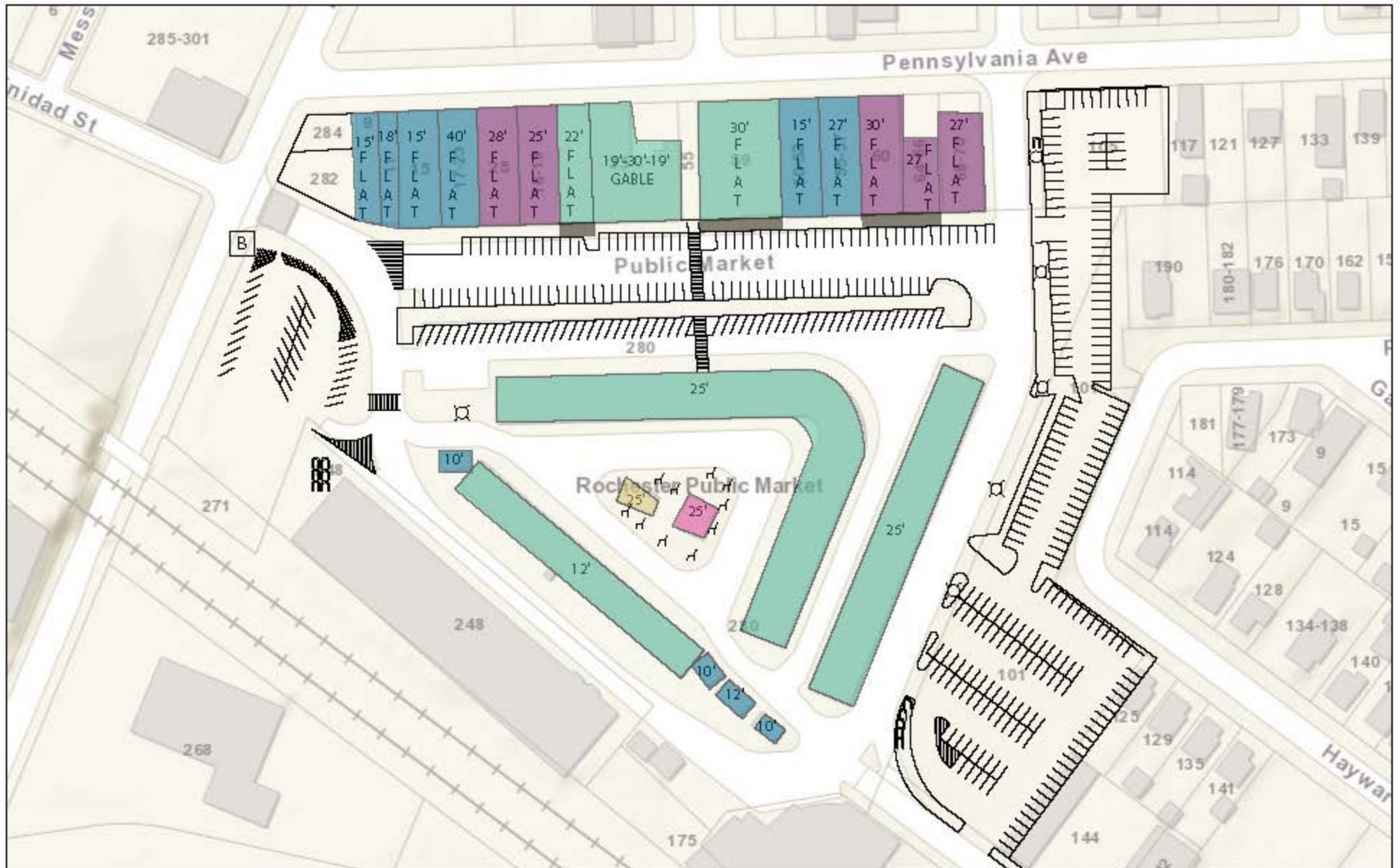


June 6, 2016





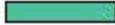







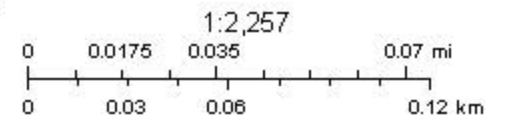
Sources: Esri, HERE, DeLorme, Intermap, Incent P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey,

Public Market



May 24, 2016

- | | | | |
|---|---|--|----------------|
|  | Group A - Assembly (Restaurants) |  | Bus Stop |
|  | Group B - Business (Offices) |  | Public Seating |
|  | Group M - Mercantile (Including wholesale) |  | Awning |
|  | Group S - Storage (Warehouses) |  | Light Post |
|  | Group U - Utility & Miscellaneous (Restrooms) |  | Bicycle Rack |



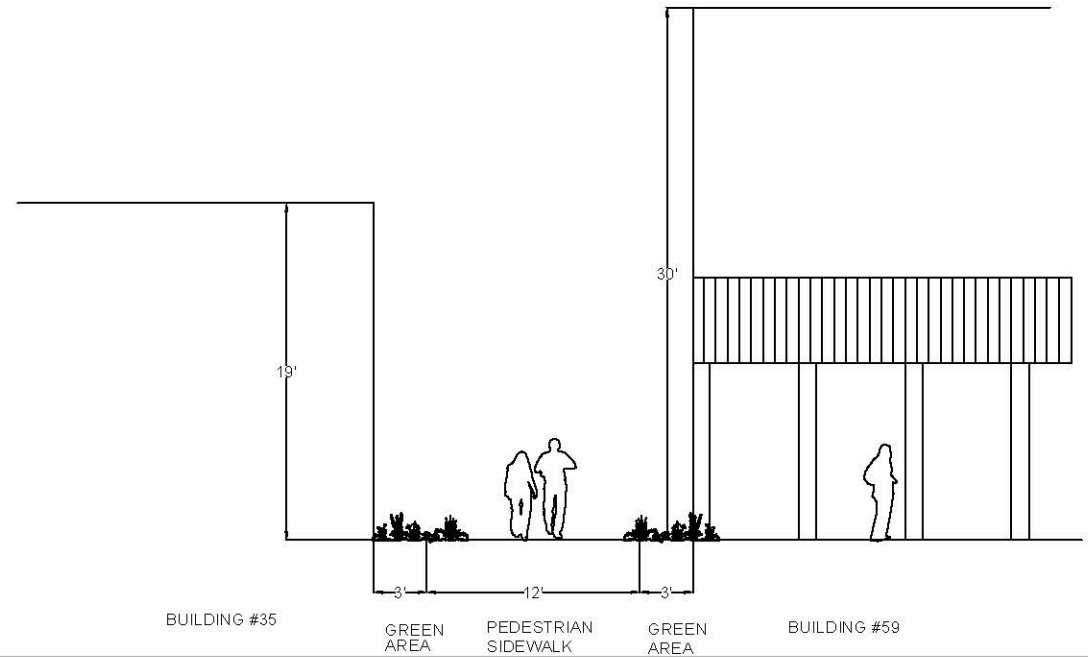
Sources: Esri, HERE, DeLorme, Intermap, increment P. Corp., GEBCO, USGS, FAO, NPS, NRCAN, Geobase, IGN, Kadaster NL, Ordnance Survey,

URBAN SENSE OF PLACE: ROCHESTER PUBLIC MARKET

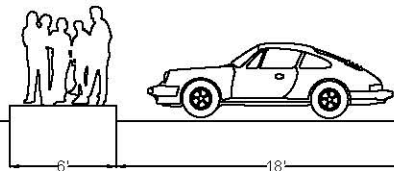
31 May 2016, 9-11 a.m.
4 June 2016, 9-10 a.m.

Thoroughfare	Public Alleyway
Pavement Width	12'
Movement	Walking Pace
Design Speed	N/A
Traffic Lanes	N/A
Parking Lanes	N/A
Walkway Type	Concrete
Planting Type	Grass
Landscape Type	None

Thoroughfare	Public Plaza
Pavement Width	45'
Movement	Slow / Multi-Directional
Design Speed	5 mph
Traffic Lanes	Up to 3
Parking Lanes	Up to 2
Walkway Type	6' Sidewalk/19'-6" @ Plaza
Planting Type	N/A
Landscape Type	N/A

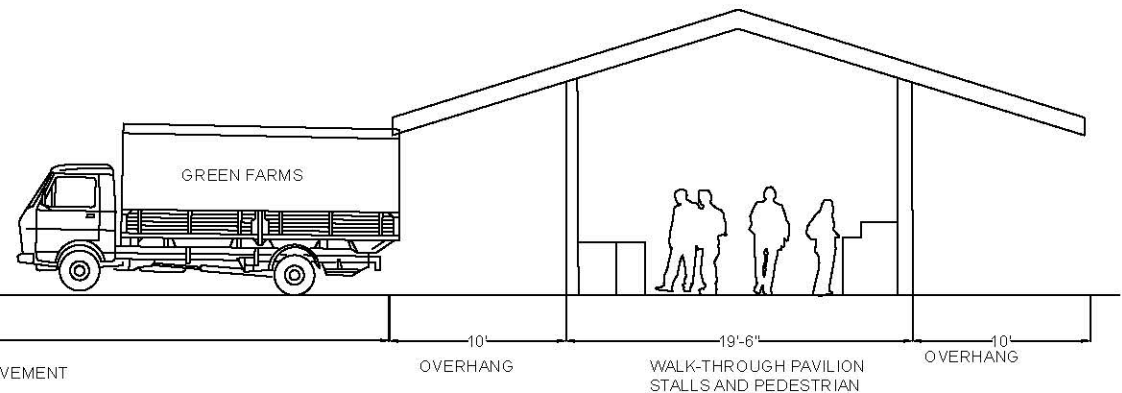


PENNSYLVANIA AVENUE
PEDESTRIAN GATE
(#55)

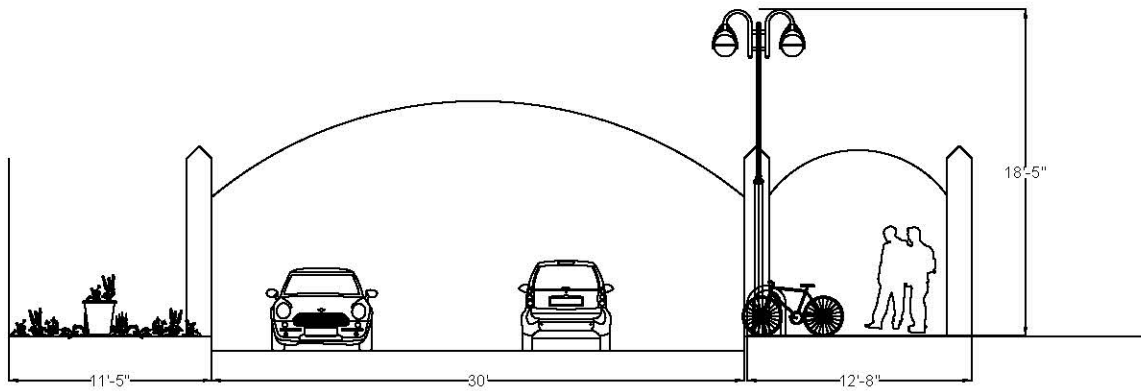


RAISED PEDESTRIAN SIDEWALK

DIAGONAL PARKING



SOUTH SECTION FROM
PENNSYLVANIA AVENUE GATE



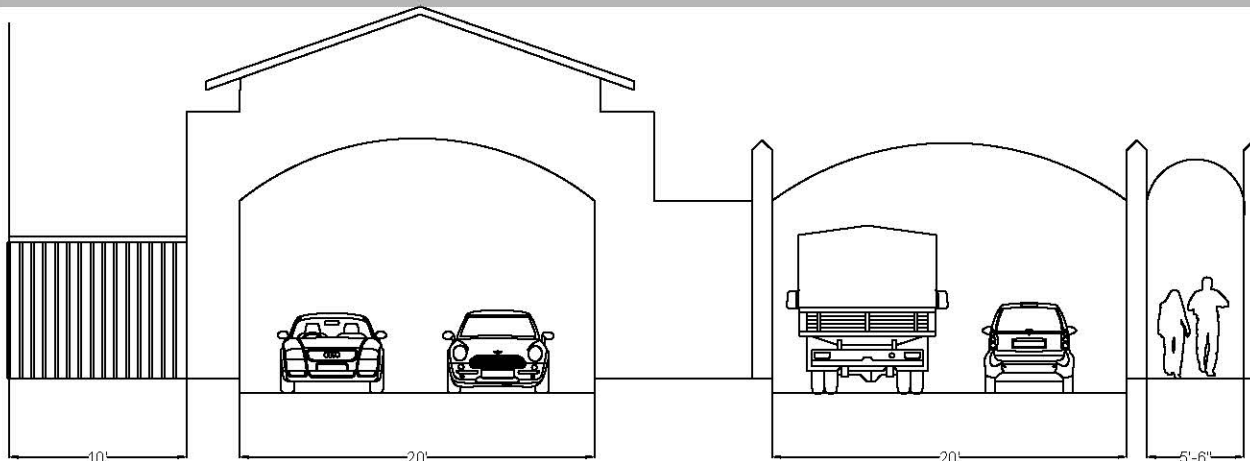
GREEN AREA WITH PLANTERS

2-WAY TRAFFIC AUTOMOBILE GATEWAY

PEDESTRIAN GATEWAY

Thoroughfare	Public Driveway
Pavement Width	30'
Movement	Slow / 2-Way
Design Speed	5 MPH
Traffic Lanes	2
Parking Lanes	N/A
Walkway Type	12'-8" Sidewalk
Planting Type	Grass or N/A
Landscape Type	Potted Plant

PENNSYLVANIA AVENUE GATE NORTH



PERMANENT FENCE

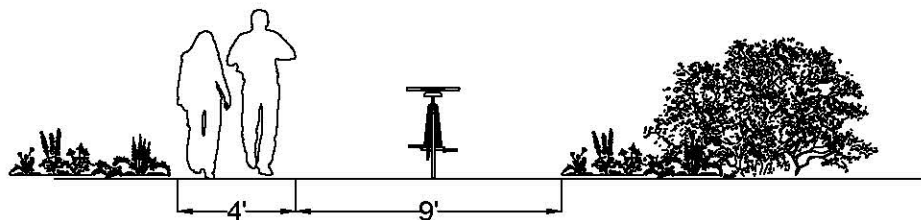
2-LANE/1-WAY AUTOMOBILE GATEWAY

2-LANE/1-WAY AUTOMOBILE GATEWAY

PEDESTRIAN GATEWAY

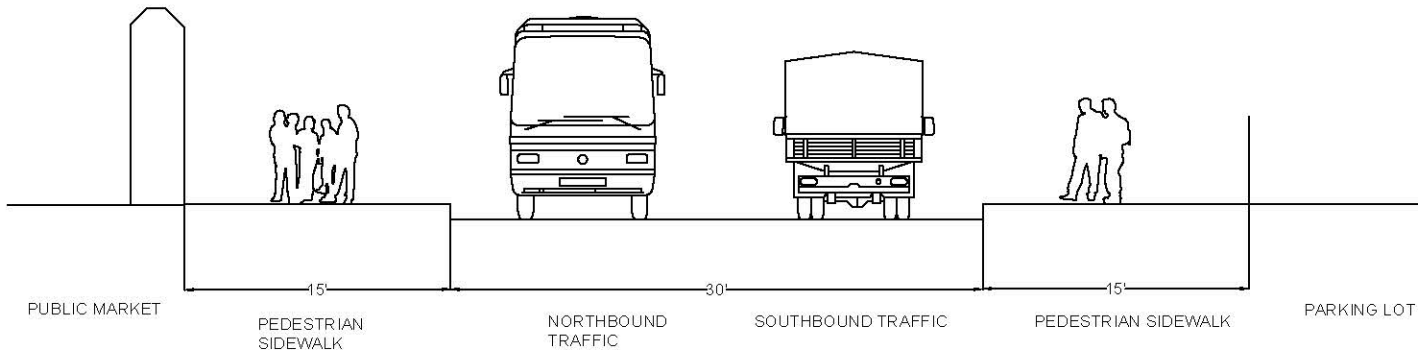
Thoroughfare	Public Driveway
Pavement Width	(2) 20'
Movement	Slow / 2-Way
Design Speed	5 MPH
Traffic Lanes	4
Parking Lanes	N/A
Walkway Type	5'-6" Sidewalk
Planting Type	N/A
Landscape Type	N/A

RAILROAD STREET GATEWAYS EAST



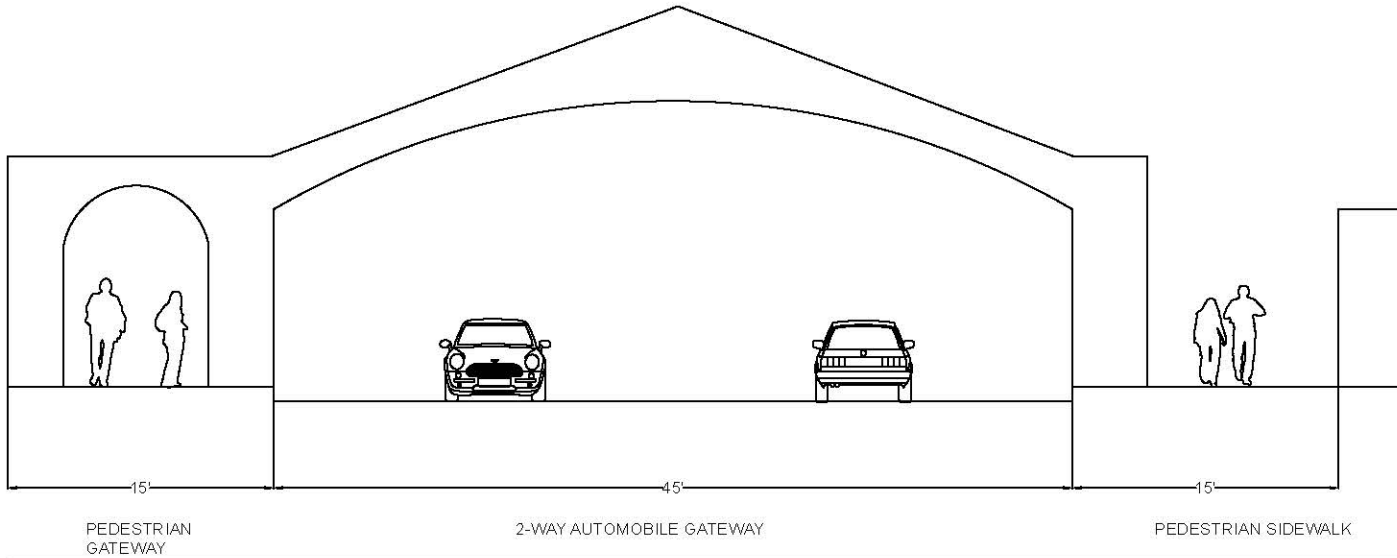
PEDESTRIAN / BICYCLE / TROLLEY BRIDGE OVER UNION STREET

Thoroughfare	Pedestrian Bridge
Pavement Width	13'
Movement	Slow / Walking Pace
Design Speed	N/A
Traffic Lanes	3 (2-Way Bicycle)
Parking Lanes	N/A
Walkway Type	Blacktop Sidewalk
Planting Type	Grass and Shrubs
Landscape Type	N/A



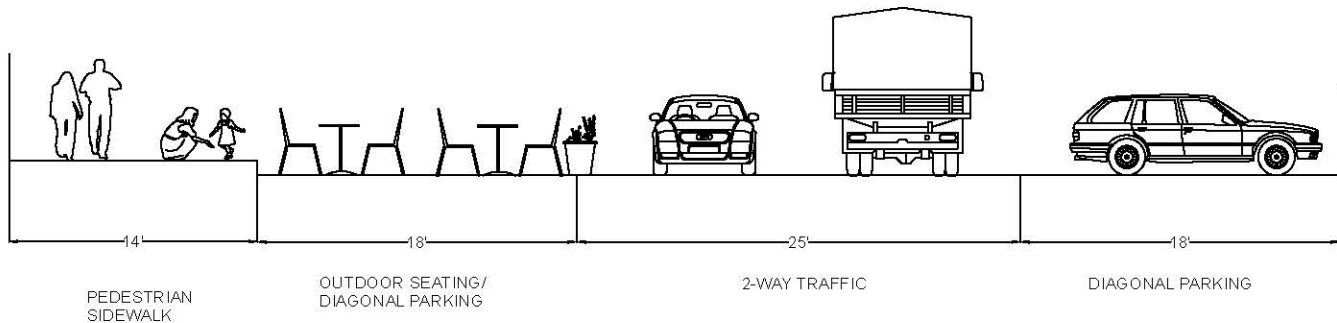
Thoroughfare	Street
Pavement Width	30'
Movement	Fast / 2-Way
Design Speed	30 MPH
Traffic Lanes	2
Parking Lanes	N/A
Walkway Type	(2) 15' Sidewalk
Planting Type	N/A
Landscape Type	N/A

UNION STREET
30MPH



Thoroughfare	Public Driveway
Pavement Width	45'
Movement	Slow / 2- Way
Design Speed	5 MPH
Traffic Lanes	Up to 3
Parking Lanes	N/A
Walkway Type	(2) 15' Sidewalk
Planting Type	N/A
Landscape Type	N/A

UNION STREET GATE



Thoroughfare	Public Plaza
Pavement Width	25'
Movement	Slow / 2-Way
Design Speed	5 MPH
Traffic Lanes	2
Parking Lanes	Up to 2
Walkway Type	14' Sidewalk / 18' Seating
Planting Type	Potted Plants @ 5'
Landscape Type	N/A

EAST SECTION FROM UNION STREET GATE

A long-exposure photograph of a city skyline at night, reflected in a body of water. In the foreground, a bridge or highway has light trails from moving vehicles. The sky is dark, and the city lights are bright and colorful.

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