A recommendation for improving the sense of orientation by enhancing visual communication on wayfinding systems: A case study of Minneapolis skyway system

by

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ABSTRACT

As the world becomes more complex and the population more mobile, people increasingly rely on wayfinding systems. The task for graphic designers, architects and other professionals who participate in building planning, is to design a sufficient and clear wayfinding system that will direct people in and out of the building, around the building, and to their destination effectively, comfortably, and confidently, without wasting any time or energy. The lack of orientation in an unfamiliar environment can lead to physical exhaustion, stress, anxiety, and frustration, all threaten their sense of well-being and limit one’s mobility. This study focuses on wayfinding challenges in the Minneapolis skyway system in Minnesota, a pedestrian skywalk system that currently connects various buildings in Downtown Minneapolis. Wayfinding and visual communication criteria used in evaluating the skyway were adopted from previous studies or concepts from wayfinding professionals. As would happen with any tunnel-based skywalk, one of the major wayfinding problems of this complex skyway system is that it lacks a sense of orientation. Many people, especially first time visitors, get lost without having any knowledge of where they are within the skyway system.

After studying this problem, design solutions were developed to improve existing wayfinding conditions of the Minneapolis skyway by enhancing the sense of orientation rather than relying only on signage-based solutions as a wayfinding aid. The design recommendations adopt Kevin Lynch’s elements of districts and landmarks, two of his five important elements necessary in forming mental maps as navigational aids to enhance wayfinding performance. These elements increase a person’s ability to see and remember patterns of an environmental space by creating one’s own mental map.
CHAPTER 1. INTRODUCTION

“Wayfinding is a fancy word for the series of things people know and do in order to get from one place to another, inside or outside.”


As the world becomes more complex and the population more mobile, reliance on wayfinding systems has increased (McCarthy 1998, 90-93). The issue of wayfinding difficulties is a relatively recent phenomenon brought on by the complexity of contemporary building and cities. The difficulties are with knowing where one is, where to go, and how to get there. Architect and city planner Kevin Lynch, author of *The Image of the City*, first used the term “wayfinding” in 1960 to describe the role of maps, street numbers, directional signs, and other wayfinding tools in cities. Wayfinding is the process of navigating through an unfamiliar environment. The ability to orient oneself and navigate through places is a basic human requirement (Griffin 2004, 227-228). Wayfinding requires knowledge about one’s current location, destination, and the spatial relationship between them. When people are in a new environment without such knowledge, they become disoriented, if not totally lost. Disorientation can have a serious effect on people. It can lead to physical exhaustion, stress, anxiety, and frustration, all of which threaten one’s sense of well-being and limit one’s mobility (Evans 1980, 259). It may also guide people to avoid or leave a place. However, easy wayfinding may provide positive feelings and a desire to visit. Ease of wayfinding is especially important for office

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1 Quote from Carpman and Grant as cited in Peter Morville, *Ambient Findability* (O’reilly Media, Inc, 2005), 17
buildings, hospitals, libraries, airports, colleges, museums, shopping malls, entertainment parks, transit stations, and zoos.

The Minneapolis skyway system in Minnesota, eight miles of pedestrian skywalk system, currently connects approximately 69 buildings in Downtown Minneapolis, enabling people to walk in a climate-controlled environment. This convenient skyway system makes it possible for users to live, eat, bank, work, and shop without going into the open air. However, one of the major wayfinding issues of this complex and unique skyway system is that it lacks a sense of orientation. When one navigates through the skyway system, he or she has a quite different wayfinding experience than occurs on the street level. Many people, especially first time visitors, get lost without having any knowledge of where they are within the skyway system. First time visitors might not know to what these skyway tunnels are connected, and which area of the tunnel they are currently in. It is also sometimes difficult to determine whether one is still on the skyway route or inside a building.

The purpose of this study was to analyze the challenges within the existing wayfinding system of the Minneapolis skyway, and to determine effective ways to improve users’ navigation and orientation throughout the system. Since the environment of the skyway system has different characteristics from the street level, the skyway system has unique wayfinding problems. For instance, unlike the street level, the skyway is like a maze. Once in the skyway system, one is unable to exit from the skyway system when desired. One can only exit from the nearest building within the system. While the street level has various ranges of memorable elements, such as landmarks and natural and built changes from one district or area to another that can assist people’s sense of orientation, the skyway system only provides a limited window view of these outside cues. This limits people’s understanding of how far they are from their destination. It also makes it more difficult for one to create a mental map or mental image of the skyway system, compare to the street level. According to Lynch, it is important to understand the layout of that
space within the city space. In order to understand the layout of the large-scale physical environment, people first create and form their own mental map. Lynch’s five elements—paths, edges, districts, nodes, and landmarks—increase a human’s ability to see and remember patterns of an environmental space by creating a mental map. If people have a legible and visible map in their mental space, they can easily navigate through a certain environment.

In addition, the existing directional signs on the skyway system are not as helpful as those encountered on the street level. Most of the directional signs are placed in random locations, and these signs do not efficiently guide people at every decision point in order to get to their destinations. Even if the signage was improved, existing literature states that although signage plays an important part in wayfinding, the process of wayfinding does not rely exclusively on signs (Muhlhausen 2000, 90). A wayfinding system is a system of navigation, while signage is the means of delivery for part, but not all, of that system.

A methodology was developed to analyze the navigation system of the Minneapolis skyway after a review of the existing literature. This author developed a range of wayfinding and visual communication criteria based on a literature review of previous studies or concepts from design professionals and from personal experiences. After assessing the system’s effectiveness, design recommendations for improving the sense of orientation were proposed, based on these criteria. This study relies heavily on Kevin Lynch’s idea of district and landmark, which are two of his five important elements necessary in forming mental maps as navigational aids to enhance wayfinding performance. Lynch believes that improving these elements—path, edges, districts, nodes, and landmarks—only then can a city become more legible, visible, and imageable (Lynch 1960, 46-90). He says, “a legible city would be one whose district or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern” (Kelly 2001, 30). The Minneapolis skyway system only provides path, node, and edge, but lacks any sense of districts or landmarks.
Several examples of wayfinding projects, which communicate the idea of districts, were also studied. For example, Rand Elliott’s work of Oklahoma City’s tunnel system in the underground clearly shows a distinction between different districts of the underground system. Elliott turned an old complex tunnel system that connected buildings in the center of Oklahoma City into a welcoming underground pedestrian system. As a navigation tool, he assigned different colors to the walls and lighting for each area of system. Elliott uses color-coding for each district effectively through the system. On the other hand, the Minneapolis skyway system lacks this clarity and consistency in providing wayfinding information to know where and which area of the skyway tunnel the navigator is currently. For example, there is no transition between financial and restaurant districts. These comparisons allowed the author to develop recommendations to assist people navigating through the system.

Improving a sense of orientation in the Minneapolis skyway will provide an effective wayfinding system and allow visitors to have positive experience as they navigate through the system. The findings and recommendations of this paper will also be relevant to many other skyways and to other transport systems that have a similar tunnel type: subway systems, underground pedestrian walkways, and even airport systems that are connected with tunnels. Today, there are many skyway systems in North American cities; Atlanta (GA), Cedar Rapids (IA), Cincinnati (OH), Des Moines (IA), Detroit (MI), Houston (TX), Oklahoma City (OK), Paradise (NV), Pittsburg (PA), Rochester (NY), Saint Paul (MN), Spokane (WA), and so forth. Also, many cities around the world have skyway systems, including Bangkok (Thailand), Hong Kong, Kuala Lumpur (Malaysia), Melbourne (Australia), Gatineau (Quebec), Plymouth (England), and so forth (Montgomery and Bean 1999, 403-437).
This first part of the thesis will demonstrate and discuss wayfinding and the importance of wayfinding systems. It also discusses the process of wayfinding, how poor and good wayfinding systems affect people when navigating, and why wayfinding is more than just signage. Once previous studies of wayfinding are reviewed, skyways and other pedestrian tunnels will be discussed. Finally, wayfinding and visual communication criteria will be developed, based on a literature review of previous studies or concepts from professionals.

2.1 History of Wayfinding

The term wayfinding may be unfamiliar to some people. Wayfinding is “a relatively new term which covers everything to do with how people find their way around environments” (Miller 1999, 11). The word ‘wayfinding’ cannot be found in standard English dictionaries. However, the increasing frequency of its appearance in the literature—environmental psychology, geography, environmental architecture, graphic design, and even in experimental psychology—suggests it could be a reasonable addition to the modern English dictionary (Golledge 1999, 46-48).

Historically, wayfinding refers to techniques used by travelers over land and sea to find relatively unmarked and often mislabeled routes. Urban planner Kevin Lynch first used the term “wayfinding” in 1960 to describe the role of maps, street numbers, directional signs, and other wayfinding tools in cities, although the process existed long before cities. Early humans made use of their observations of the surrounding ‘districts’ as a memory aid. The earliest signs were most likely real, physical hacks, e.g., marks on a tree’s bark, indicating a path through the woods. Most
of the written history of wayfinding concerns the invention or adoption of tools to support nautical exploration. The limited availability of landmarks and seamarks combined, meant a high probability of getting lost at sea. Early navigators on ocean voyage used natural signs such as sun, moon, stars, and planets to help orient themselves (Morville 2005, 21).

By the 1970s, research broadened and continued to reveal various levels of wayfinding. Expanded research pointed out that building symmetry, user expectations, language, signage, other people, and memory as examples of wayfinding indicators. Romedi Passini, an environmental psychologist, gave the designer a structure for describing what the demands of wayfinding systems (Arthur and Passini 1992, 6-19). Today, this term is commonly used in the vocabulary of architects, planners, graphic designers, and their clients.

2.2 Wayfinding Systems

“Every journey that we ever make is based on wayfinding” (Arthur and Passini 1992, 39). It is the process of navigating through an unfamiliar environment. The ability to orient oneself and navigate through places is a basic human requirement (Griffin 2004, 227-228). “In modern times, wayfinding is used in the context of architecture to refer to the user’s experience of orientation and choosing a path within the built environment, and it also refers to the set of architectural and design elements that aid orientation” (Arthur and Passini 1992, 5).

Wayfinding requires knowledge about one’s current location, destination, and the spatial relation between them. When people are in a new environment with a lack of such knowledge, they become disoriented, if not totally lost. This may guide people to avoid or leave a place. However, easy wayfinding may provide positive feelings and a desire to visit various areas. Easy wayfinding is especially important for office buildings, hospitals, libraries, airports, colleges, museums, shopping malls, entertainment parks, transit stations, and zoos, to name a few.
What is a Wayfinding system? According to designer Lance Wyman, a wayfinding system “incorporates branding, signs, maps and directional devices that tell us where we are, where we want to go and how to get there” (Wyman 2004). Wayfinding systems are designed to assist travelers or visitors in both decision-making (forming a plan for travel) and decision-execution (actively traveling) phases of their journeys. Travelers or visitors in a new environment need to know the location of their destination, their location relative to that destination, and an overall layout of that environment (Arthur and Passini 1992, 150-184). A facility layout, key architectural elements, directories, maps, brochures, signs and symbols, and directions given by staff are all considered part of the wayfinding system. An effective wayfinding system is designed by a multi-disciplinary team. Architects, graphic designers, interior designers, landscape architects, urban planners and environmental graphic designers might work as a team to develop a wayfinding system. Wayfinding problems occur for the lack of close collaboration between these disciplines at the beginning of the design process. There are many cases where graphic designers are brought in to design a signage system only after the building has been built. Without a clear and legible built environment, installing a signage system would not help to solve the wayfinding problems. While signage can help users find their way, it is more crucial for wayfinding to have clear and legible environmental features such as landmarks, paths, nodes, districts, edges, stairs, walls, entrances, and exits designed by architects. These can help users increase their sense of orientation. This is why graphic designers, architects, urban planners, and building managers should plan together in the beginning of the design process. This will save time, money and energy, and ensure a more successful wayfinding solution.

2.3 Wayfinding is More Than Signage

Many people think that wayfinding is all about making signage. Wayfinding is a behavior; it is more than a signage. In 2003, Romedi Passini said, “Wayfinding design is more than signage.
Signs have their use, but they cannot create what space planning has not done” (Passini 2003). Wayfinding is not just about focusing on signage. While many people think “wayfinding” is the same as “signage,” the two terms are not synonymous. A wayfinding system is a system of navigation, while signage is the means of delivery for one part, but not all of that system. Wayfinding is far more complex than signs, although they are one important tool of wayfinding. Although signage plays an important part in wayfinding (Figure 2.1), the process of wayfinding does not rely exclusively on signs (Muhlhausen 2000, 90). Wayfinding designer Chris Calori points:

Although the terms signage and wayfinding are often used interchangeably, it is very important to keep in mind this important distinction. Typically, the primary objective of a signage program is to help people find their way through an environment; whereas, effective wayfinding solutions often require more than signage alone (Calori 2007, 5).

There is a general agreement in the existing literature that signage is just an important wayfinding design element, but it is not the only one. Signage is like a Band-Aid for a visitor’s natural wayfinding ability within a new environment (Griffin 2004, 228-230).

![Figure 2.1 Signage plays an important role within the broader realm of wayfinding cues](image)

Wayfinding is not just about installing signage in appropriate places. Elements of an effective wayfinding system include spaces visually distinctive from others, points of reference, a
building layout that is easy to remember and understand, memorable landmarks, signs, symbols, directories, and maps and staff who are well-trained in giving instructions (Gommel 1995, 391).

2.4 The Process of Wayfinding

Janet Carpman, an architectural sociologist, and Myron Grant, an innovative wayfinding system analyst and designer, considered that we should think of wayfinding as a five-step process: 2

1. Knowing where you are.
2. Knowing where your destination location.
3. Following the best routes to your destination.
4. Being able to recognize your destination.
5. Being able to reverse the whole process and find your way back to your starting point.

Arthur and Passini also identified seven distinctive wayfinding tasks crucial in the process of wayfinding (Arthur and Passini 1992, 39):

1. Learning a new route.
2. Returning to the point of origin (retracing one’s steps).
3. Linking known routes to new configurations.
4. Learning a route from a small display and making the journey.
5. Pointing to the directions of locations visited on a journey.
6. Learning a route from a nonaligned display.
7. Understanding the overall layout of a visit setting.

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2 Quote from Carpman and Grant as cited in Peter Morville, Ambient Findability (O’relly Media, Inc, 2005), 17


2.5 Good vs. Poor

A poor wayfinding system gives people difficulties or makes them unable to find their way to destinations in a new environment. It leads people to frustration, wasted time, and energy. For example, the location staff also faces loss of time and extra work in assisting them. It also gives people negative experiences and opinions of that site (Miller 1999, 22). Poor wayfinding can even become extremely dangerous. Many drivers on highways have become confused with poorly labeled traffic signs (Morville 2005, 31) (Figure 2.2). People in a building of fire may face trouble finding their way out of the building because of poorly placed or mislabeled fire exits in buildings or stations.

Figure 2.2 Confusing highway traffic signs

A good wayfinding system leads people to their destination without a waste of time, energy, money, and frustration. They should have a positive experience when reaching their destinations. Especially for health facilities such as hospitals, it is crucial to have a good wayfinding system, as most of the users are the patients. Patients are more likely to have physical or mental limitations. A good example of a wayfinding system for the hospital would be the Lankenau Hospital located in the suburbs of Philadelphia designed by AGS (Figure 2.3).
Figure 2.3  Lankenau Hospital wayfinding system designed by AGS

It has a very consistent, clear, and simple wayfinding system for a complex facility by identifying its zones alphabetically. Another good example is an airport wayfinding system of the Ottawa MacDonald-Cartier International Airport designed by Gottschalk + Ash International (Figure 2.4). Airports deal with many travelers and it can be very stressful if they get lost in the airport. It is important to provide a clearly designed wayfinding system at the airport.
Figure 2.4 Ottawa MacDonald-Cartier International Airport wayfinding system designed by Gottschalk + Ash International, Calgary, AB, Canada
The Ottawa Airport in Canada has aimed to create a wayfinding system to ease traveler’s stress “by creating humane spaces that reflect the nature of the region and make it easy to find one’s way” (SEGD 2004). As an international airport, it offers large and visible numbers that identify each gate, with natural lighting entering through a big window, an elegant choice of materials and layout, clarity of information, bilingual signs in French and English; it presents a consistent and unified wayfinding system. The Ottawa Airport uses standard international symbols and pictograms to communicate whenever possible (Berger 2005, 82). It also provides tactile and Braille for the visually impaired. “Brevity and clarity are the guiding principles for airport communication” (Berger 2005, 82). This Ottawa airport system is described as “a first class example of an everyday wayfinding program at its most accomplished and professional” (SEGD 2004). A good wayfinding system with clear and legible information would offer users a positive experience when navigating. When there is a good wayfinding design, it is not noticeable. According to Miller, “people do not tend to notice a good wayfinding system; they simply use it” (Miller 1999, 22).

2.6 Importance of Wayfinding

Wayfinding is an important aspect of environmental quality. It corresponds to reaching of destinations within acceptable limits of time and energy (Passini 1984, 158). Passini says:

Wayfinding is a very importance aspect of daily life and has been neglected for so long that we want to give it its rightful place on the drawing board…in the past, the built environment was relatively simple and clear, this is certainly not true of today’s mammoth building complexes (Arthur and Passini 1992, 42).

Today, it is crucial to provide an effective wayfinding system in our complex urban and building plans (Morville 2005, 26-28). When navigating, an effective wayfinding system assists users without having any trouble getting lost, becoming stressed, or wasting time and energy during
their exploration in a new environment. In other words, an effective wayfinding system can efficiently lead people to their destination and direct them back to their starting point.

2.7 Theories on How Wayfinding Occurs

Previous theories of wayfinding were studied and will be discussed here. First, Kevin Lynch’s imageability of city and five key environment elements is discussed. Second, Colette Miller’s three important factors that affect wayfinding, and the four senses that people use in wayfinding are reviewed. Finally, Paul Arthur and Romedi Passini’s three stages of problem solving process and the importance of cognitive maps are introduced.

2.7.1 Kevin Lynch: Imageability

In city space, it is important to understand the layout of that space. To understand the layout of the large-scale physical environment, people first create and form their own mental map. If people have a legible and visible map in their mental space, they can easily navigate through a certain environment.

In 1960, Kevin Lynch summarized five years of field study that was co-directed by him and under the direction of artist, Gyorgy Kepes, in his book, *Image of the City*. Lynch was a significant contributor to urban planning and urban design in the twentieth century. He has been also called the “leading environmental design theorist of our time” (Banerjee and Southworth 1995, 1). This is why a vast number of authors or researchers in the field of wayfinding mention or adopt the Lynch’s theory in their books or research. In his study, he uses three American cities: Los Angeles, Boston, and Jersey City as his case studies (Sundilson n.d.). His five-year study looks at how citizens perceive and organize their own cities as they navigate through them. According to Lynch, people create their own mental image of the city in order to understand its layout. Lynch asked them to draw maps of their city’s form according to their memory and did
verbal interviews. What he found out was that the people organized their images of their city by using a set of common features: paths, nodes, edges, landmarks, and districts. In his book, Lynch concentrates “especially on a particular visual quality: the apparent clarity or ‘legibility’ of the cityscape” (Lynch 1960, 2). If the city is legible we can print the image of city in our mental spaces as if it is printed on paper. Lynch asserts that image of a city should be visible, legible, and memorable. In Image of the City, he introduces the concept of imageability. Lynch defines imageability as (Lynch 1960, 5):

… that quality in a physical object which gives it a high probability of evoking a strong image in any given observer. It is that shape, color, or arrangement, which facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment. It might also be called legibility, or perhaps visibility in a heightened sense, where objects are not only able to be seen, but are presented sharply to their senses.

Imageability can be used as a guide for the building and rebuilding of cities. “A distinctive and legible environment not only offers security but also heightens the potential depth and intensity of human experience” (Lynch 1960, 5).

According to Lynch, “a clear comprehensive image of the entire metropolitan region is a fundamental requirement for the future” (Lynch 1960, 118-119). An environmental image of a city could play an important part in dealing with wayfinding tasks. Lynch analyzes an environmental image into three components: identity, structure and meaning. First, identity means identification of an object distinctive from other objects. It is the meaning of the object when recognized as a separate entity. Second, “the image must include the spatial or pattern relation of the object to the observer and to other observers.” This is called structure. Finally, the object should be practically or emotionally meaningful to the observer (Lynch 1960, 8). Lynch concentrated on the identity and structure of city images in his study of three cities and uses the
term *imageability* to describe the physical quality of identity and structure in one’s mental image of an environment. He uses the term *environmental image* instead of *cognitive map* in his book.

### 2.7.2 Kevin Lynch: Five Key Elements of the City Image

When humans are in a new and unfamiliar environment, they need a medium to solve their spatial problems, such as how to find a pathway from point A to point B. Lynch’s theory of the five key elements of the city image is the most well-known, and has greatly contributed and influenced the field of wayfinding design and environmental graphics. During his five years of case study of Los Angeles, Boston, and Jersey City, Lynch asked people to draw maps of their city’s form according to their memory, and did verbal interviews. What he found out was that the people organized their images of their city by using a set of common features: paths, nodes, edges, landmarks, and districts (Foltz 1998). According to Lynch, these are the five key elements of the city’s image:

- **Paths**: the channels that people move along in their journey customarily, occasionally, or potentially. For most people Lynch interviewed, paths are the predominant elements in their image. Paths can include streets, walkways, corridors, hallways, roads, and transit lines. “Paths are crucial to our sense of order and orientation inside buildings. It is while moving through them that projects are revealed” (Regnel 2003, 161). If the paths are clearly defined in complex buildings and sites, it helps people find their way more easily (Levine 2003, 55). An example of Rand Elliott’s map of Oklahoma City’s tunnel system used different lighting color to each path to show distinction between districts (Figure 2.5).
Figure 2.5 Example of paths and districts: A diagram that explains the Oklahoma City underground tunnel system designed by Rand Elliott.
• **Edges**: the linear elements not used or considered as path by people. They are usually the boundaries between two kinds of areas. Wayfinding edges determine where an area begins or ends. Edges include corridor, hallway, or even handrail. Edges provide “a boundary that people use to orient themselves in space and to keep themselves moving in space and to keep themselves moving in the right direction” (Levine 2003, 66-67). One such boundary could be a “continuous handrail system [that] provides a natural guide for people with visual impairments” (Levine 2003, 66-67).

• **Districts**: the medium-to large sections of the city recognizable as having some common, identifying characters. By breaking down the site into districts and zones, these help people to identify and distinguish different characters of each area. It is crucial to create visually strong identifiable characteristics for each district or zone to be memorable and unique in its context (Levine 2003, 59-60). According to Lynch, these things all occur in the natural environment as well. Each district could have identified center nodes. It is also useful to provide districts on orientation maps to assist people to understand their location. A map of *Walk! Philadelphia*, designed by Joel Katz Design, and LA Walks Map designed by Corbin Design with Hunt Design, show how these maps divide city centers into different districts with a distinct usage of colors, and symbols or icons for each district (Figure 2.6 & Figure 2.7). In both maps, color-coded symbols or icons represent key landmarks, significant cultural, and commercial areas of each district. On the Walk! Philadelphia maps. A “you are here” star indicates “the center of a 10-minute walking radius that helps users determine walking distance to destination” (Center City District). The main map breaks down into more detailed district maps. Rand Elliott’s map of Oklahoma City’s tunnel system also used color to give distinction between different districts (Figure 2.5).
Figure 2.6  Example of districts: Walk! Philadelphia map, showing one district (left) and a group of districts (right) designed by Joel Katz Design Associates
Figure 2.7  Example of districts: LA Walks map designed by Corbin Design with Hunt Design

- **Nodes**: the points or junctions, the strategic spots in a city where there is an intensive focus, or may be simply concentrations. People have to make navigation decisions at nodes. However, if there are too many nodes in a building, that may make people hard “to remember the spatial layout, especially if they all look alike” (Levine 2003, 59). Examples could be busy intersections or dominant features of the city. These nodes occur...
inside buildings as well. The Arizona Cardinals Stadium offers directional signs as a wayfinding tool at every decision point (Figure 2.8). It provides directional signs that hang from the ceiling to allow users to view signs from a distance and also from the busy traffic of people.

![Figure 2.8 Example of nodes: The Arizona Cardinals Stadium Wayfinding Signage System, designed by Pentagram Design & Etro Communication](image)

- **Landmarks**: a type of reference point. They are simply defined as a physical object: building, sign, store, mountain, or any other objects that help during the wayfinding process. They are frequently used as cues of identity and even of structure, and seem to be increasingly relied upon as a journey becomes more and more familiar. When navigating the urban environment, landmarks can also be effectively used to identify geographical districts or special locations (Berger 2005, 58). The Chiat/Day building in Santa Monica in Los Angeles can be a true landmark within the area (Figure 2.9).
Figure 2.9  Example of landmark: The Chiat/Day building in Santa Monica, Los Angeles designed by Frank Gehry

Theses five elements increase a human’s ability to see and remember patterns of a certain space when they are placed in a good form. Also, it is these patterns that make it easier to learn one’s own city as an image of the large-scale physical environment. These elements could also be the key to solving wayfinding problems. Lynch argues that visual accessibility and the prominence of these five elements are the design criteria for highly legible and imageable city environments (Arthur and Passini 1992, 22-24). Lynch asserts that all of these elements should work together. “Districts are structured with nodes, defined by edge, penetrated by paths, and sprinkled with landmarks” (Lynch 1960, 48-49). Lynch believes that improving these elements can make a city become more legible, visible, and imageable (Lynch 1960, 46-90). He says, “a legible city would be one whose district or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern” (Kelly 2001, 30).

He points that a clear and comprehensive image of the city is an essential requirement for the future. This simply means that we need an environment with good imageability, which would
allow people to feel quickly at home in new surroundings (Lynch 1960, 111). Today we call this image of the city a mental or cognitive map.

Later, Arthur and Passini adopted Lynch’s method and applied it to his study of Bonaventure, a commercial center in Downtown Montréal (Passini 1984, 35-45). His findings from this study were much like those found for Lynch’s city: images of paths, edges, districts, nodes, and landmarks inside a complex building, that can also be remembered as a mental or cognitive map. As previously discussed, Lynch has been called the “leading environmental design theorist of our time” (Banerjee and Southworth 1995, 1). This is the reason why, like Passini, many other authors or researchers in the field of wayfinding adopt Lynch’s theory as a basis in their own research.

2.7.3 Colette Miller: Factors that Affect Wayfinding

According to Miller, there are many factors that influence how people find their way to their desired destinations without having difficulty. Miller insists that not only do these factors affect people’s ability to find their way to their destinations, but also these factors affect their ability to know they have arrived at their destinations. She suggests these factors can be grouped into three different types of categories: people factors, environmental factors, and informational factors (Miller 1999, 16-17). First, people factors—experience, knowledge, and ability of each individual during one’s journey—affect the kind of decisions each person will make in order to easily find the way. People factors such as a prior knowledge or familiarity of the environment, emotional state, ability to read signs and understand site maps, a sense of direction, ability to remember and create a sufficient mental image of the site layout, and ability to understand the language used on signs can all influence the decisions people make during their journeys in physical space.
Second, *environmental* factors—distinctive features or characteristics of the environment—affect how easily people can find their way by making the right decisions during their journeys. Environmental factors that affect the decisions people make during their journey include: complexity of site, routes, and interiors of the building; reconcilability and memorability of the site; difference in areas and buildings in color, size, architectural style etc. at the site; visibility of entering the building entrance; number of changes in direction along each route; and prominent or noticeable landmarks for people to remember and recognize, internally and externally.

Third, *information* factors are a range of information that people receive, see, and look for during their journey. “Clarity, clarity, clarity. You can’t draw well unless you respect the reader … good visual communications work is like good writing. Clarity in design and complexity in information are what count—just the opposite of the modern world,”3 It is important to have clarity, accuracy, and legibility of information at the site. It is crucial that the kind of information people perceive matches with what they can see in the actual environment. Miller suggests there are four types of information that help people to successfully complete their entire task of their journey (Figure 2.10): pre-visit information (site map sent with pre-visit letters, written or spoken directions), en-route information (road signs, entrance signs, environmental information), on-site information (signs, directories, site maps located at the site) and locational information. Miller asserts that locational information includes information that allows people to know their arrival at the destination. People know they have arrived at their destination by seeing information such as distinguishable environmental features; for example, a reception desk with locational sign, etc.

All of these three factors can influence people’s ability to find a way to their destination more efficiently and easily.

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2.7.4 Colette Miller: Wayfinding is a Multi-Sensory Task

When people navigate through a space, sight is not the only sense used for wayfinding. Other senses include sound, touch, and smell. These four senses are also used when people find their way to their destinations. Miller explains, “wayfinding is a multi-sensory task” (Miller 1999, 18). She insists that incorporating these four senses in the site can increase the effectiveness of wayfinding system.

Sight is the most useful sense that people use when wayfinding. It can be used to see things both near and far. It is the most reliable sense that people can use to navigate. However, sight might not be the dominant sense for people with low vision.

People sometimes use or follow sound or noise to find their way in a physical environment. For instance, when people cannot find an elevator inside the building, the bell sound (which
means the elevator is on that floor and the door is open) coming from a distance could help them
find the location of the elevator. People can hear and follow the music sounds coming from a
nearby record store. A sound of busy footsteps, people talking, cars honking, and mixed noise
inform people they are getting closer to a busy street or center area. However, sound may not be
useful for people with hearing problems.

Figure 2.11  Braille and Audio Handrail System & Floor Markings by Coco Raynes Associates

The sense of touch can be a useful wayfinding aid to people, especially for those visually
impaired who rely on tactile signs as their wayfinding aids. Coco Raynes Associates, an award-
winning environmental graphic design firm, created the Braille and Audio Handrail System
(Figure 2.11) for the Charles De Gaulle Airport in Paris. It was created for visitors with visual
impairments as a wayfinding aid, and received international recognition for its contribution to
universal design.\footnote{Braille is a tactile code that was developed by Louis Braille. It is used to represent letters of the alphabet, which is used by people with visual impairments.} The Braille and audio messages on the handrail provides information of
direction, describes open areas, traffic patterns, stairs, and warns of ramps. They also designed
dotted floor markings, slightly raised from the floor, along the circulation path of the airport. These dots can be followed visually or by foot; the dots also make a sound when tapped with a cane (Berger 2005, 50-51). This kind of wayfinding aid assists users to find their way more efficiently.

Miller points out that not only tactile signs, but also “environmental factors, such as changes in internal floor and external pathway texture to delineate between different areas,” are useful wayfinding aids to all users which involve the sense of touch (Miller 1999, 18).

People also use a sense of smell to “identify and remember places” (Miller 1999, 18). For instance, people can identify that a restaurant is nearby if they can smell food on the street. Also, Miller suggests that smell can “affect people’s emotional state in either a positive or negative way,” so it is important to consider smell when designing a wayfinding system (Miller 1999, 18). However, smell is not usually “specific enough to enable people to literally follow their nose” (Miller 1999, 18).

2.7.5 Arthur and Passini: Wayfinding is a Problem-Solving Process

According to Arthur and Passini, wayfinding is a problem-solving process. Paul Arthur and Romedi Passini define wayfinding as, “the term introduced to describe the process of reaching a destination, whether in a familiar or unfamiliar environment. Wayfinding is best defined as spatial problem solving” (Arthur and Passini 1992, 25). When humans are in a new and unfamiliar environment, they need a medium to solve their spatial problem, such as how to find a pathway from point A to point B. It is better to predict wayfinding problems early in the design process. This could avoid costly remodeling and make better buildings. In order to do this, architects, urban planners and graphic designers should work together when they plan or design a building at the beginning of the process. To have a good and clear wayfinding system is important in buildings (Yehuda 1992, 367-368). According to Arthur and Passini, designing a successful
wayfinding system can be complex. It is helpful to have a few guidelines to follow to make the design process less complex. First, it is important to design a clear communication for the first-time visitor. Second, continuity in a wayfinding system is also of utmost importance. For example, incorporating common design elements, colors and the same materials are important considerations in designing wayfinding systems. Architects, designers, and any other professionals who participate in building planning should design a sufficient and clear wayfinding system that will direct people in and out of the building, around the building, and to their destination effectively, comfortably, and confidently without wasting any time or energy.

According to Arthur and Passini, wayfinding is composed of three interrelated processes (Figure 2.13). The first process is decision-making and development of a plan of action. The second process, decision-executing, transforms the plan into action and behaviors at the right place and time. The third process is information gathering and treatment, which sustains the two decision-related processes.

Figure 2.13 Three Key Processes in terms of spatial problem solving, adopted from Arthur and Passini
Process One: Decision Making

As we navigate through a space, we have to make a series of decisions in order to reach our destination. When making wayfinding decisions, it is very crucial to have information available at decision points where we have to determine how to proceed with our journey in a physical environment. According to Arthur and Passini, once we make general decisions to go somewhere or to reach our destination, we need to make additional and further decisions (Arthur and Passini 1992, 29). Decisions made during the wayfinding process should be hierarchically structured into a plan. Arthur and Passini developed a diagram of a hierarchically structured plan (Figure 2.14), which shows that “most general decisions are on the left and the decisions leading indirectly to spatial behavior are on the right. The vertical axis represents the chronology of the events” (Arthur and Passini 1992, 30).

Figure 2.14  Diagram of a Hierarchically Structured Decision Plan by Arthur and Passini
Arthur and Passini assert “this type of problem solving leads to highly structured plans which can also be easily remembered”(Arthur and Passini 1992, 30). To access the skyway from the street level, for example, one may need first to decide to go to the nearest building and determine the location, then go to the second or third floor, and proceed to find the entrance to the skyway system. Every step of these decisions can be further broken down into more detailed decisions. For instance, to go to the nearest building, one may have to walk along the pathway to the corner, turn left and walk straight.

**Process Two: Decision Executing**

Once people have a decision plan on how to reach a destination, then the next step is to put the plan into an action by setting out on the journey. In other words, each step of decisions must first be executed and transformed into the right behavior at the right place (Miller 1999, 14). Arthur and Passini suggest that it is not just about turning left or right, but making a correct turn at the correct intersection. And, as people move and navigate through the space, they will look for information to create a mental image or map of the route and layout of the site (Arthur and Passini 1992, 31). According to Arthur and Passini, decision execution is composed of two important parts (Arthur and Passini 1992, 31):

1. A behavior such as turning right and left, going up or looking for information.
2. An environmental entity such as the intersection, the stairs, or the billboard.

When people execute a decision, what they recognize in the environment must match a mental image or map they created previously. Wayfinding problems occur when one cannot execute the wayfinding decision. Arthur and Passini suggests that (Arthur and Passini 1992, 31):

Because we cannot execute the decision, we have to develop a plan to solve this problem. A wayfinding problem is a wayfinding decision that cannot be directly executed and therefore requires further planning and decision-making.
Process Three: Information Processing

Information processing is the process of obtaining information through all available senses. In order to do this, people need to understand the information, including spatial information, and be able to manipulate information in context (Arthur and Passini 1992, 33). According to Arthur and Passini, there are two components of information processing: perception and cognition. Perception is the process of obtaining information through human senses such as vision, sound, and tactile. Cognition is understanding and being able to manipulate spatial information (Arthur and Passini 1992, 33). When people are in an environment, they tend to perceive surroundings through different sensory modalities.

Arthur and Passini assert that environmental perception is the most crucial and efficient way to gain information from our environment during the wayfinding task. Environmental perception is “based on a process of scanning and glancing” (Arthur and Passini 1992, 33). While people move or navigate through a space, their eyes tend to scan whatever appears visually interesting in a short period of time. Then, these images add into one’s short-term memory until they are translated into memory of a longer period. Vision works “both for distance and for close up views” (Arthur and Passini 1992, 34). Arthur and Passini explain the perception of distant cues:

It allows people to perceive and direct themselves towards a distant destination which otherwise would require intermediary points of reference. The perception of distant cues simplifies a great many wayfinding tasks.

They suggest that the level of light affects vision, and it is crucial to have an adequate light level. Hearing is the second important sense that can be used in environmental perception. People with low vision can use sounds as their wayfinding cues. They also introduced perception of tactile cues. Examples of these are tactile letters or symbols such as Braille and raised letters signs. “Tactile maps have been shown to be useful to blind travelers” (Arthur and Passini 1992, 35-36).

*Environmental cognition* means knowing and understanding the environment and also
remembering certain spatial characteristics of settings. There are two aspects of environmental
cognition that can be distinguished. First, it is “the knowledge that people have about the given
components of a setting, such as the buildings they remember in a city. Second, the understanding
of the spatial characteristics of a physical setting” (Arthur and Passini 1992, 37). Arthur and
Passini suggest that it is important for planners to build and design the physical and non-physical
characteristics of buildings to be memorable (Arthur and Passini 1992, 37). They refer to the
work of psychologists Evans, Smith and Pezdek, which says there are four factors that increase

1. Form of the building: its size, contours, shape and uniqueness of architectural style.
2. Visibility and access: pedestrian access and the possibility of moving around the building.
3. Use: if a building has an important function and is used often, it is also well remembered.
4. Symbolic significance: elderly people were especially aware of historical and cultural
   meanings associated with buildings.

2.7.6 Arthur and Passini: Cognitive Map

People create a mental image or mental map, which simplifies a complex environment and the
routes through it, based on accessible information. When people arrive at the site or continue
along the route, then they try to match their mental or cognitive map to the actual environment
(Arthur and Passini 1992, 23-25, 32). This mental image or mental map is called a ‘cognitive
map.’ The term ‘cognitive map’ was first coined by Tolman in his article, Cognitive Maps in
Animals and Man, written in 1948. A cognitive map is an image of information about a space that
people store or add into their brains. An example can be a cognitive map of the Iowa State
University campus that was drawn by a current student (Figure 2.15). He drew a map of campus
according to his memory. Another example can be a cognitive map of part of the Minneapolis
skyway system drawn by the author (Figure 2.16). After visiting the Minneapolis skyway system, she drew everything she remembered from that site.

Figure 2.15  Cognitive map of the Iowa State University campus
According to Paul Arthur and Romedi Passini, a cognitive map “is an overall mental image or representation of the spaces and the layout of a setting” that is visible and legible…[it] is the psychological concept that underlies the notion of spatial orientation”(Arthur and Passini 1992, 23). Spatial orientation is a person’s ability to determine his or her location in a spatial setting, and is based on the ability to form a cognitive map. Arthur and Passini assert that one can be considered as ‘spatially oriented’ when one has a sufficient cognitive map of the surrounding setting and is able to situate oneself within that representation (Arthur and Passini 1992, 23). If the city has a pattern within itself, we can hold our image of the city in our head, like mapping in our own mental space. This is called, cognitive mapping. Cognitive mapping is the “mental structuring process leading to the creation of a cognitive map”(Arthur and Passini 1992, 23).
When people are denied the ability to do any of the following, they cannot form cognitive maps of the environment (Arthur and Passini 1992, 25):

- Unable to determine their location within the setting.
- Unable to determine their destination within the setting.
- Unable to form a plan of action that will take them from their location to their destination.

Cognitive mapping is affected by the patterns of the circulation system (Arthur and Passini 1992, 105). As a cartographic map designer needs to collect data on spatial environments in a defined manner (Klippel et al. 2002), we need to form our own mental imagery or draw a sketch map in our own minds of the physical environment around us. Passini and Arthur assert that during the wayfinding process, “both decision-making and decision-execution are based on information generated by cognitive mapping” (Arthur and Passini 1992, 46). The crucial role of a cognitive map is that its function supports situating the decision in physical space. It would be difficult to navigate a space without a mental or cognitive map.

### 2.8 Skyways and Other Tunnel Based Systems

#### 2.8.1 Skyways

What is a skyway? Skyway systems are increasingly used by cities in North America as a solution to protect pedestrians from climate, traffic, and vehicles (Lassar 1988, 2-6). These climate controlled systems allow pedestrians to move from one building to another without any interference from the street level. Most of the skyway tunnels have transparent windows either on both or one side. “At the beginning, in the 60s and 70s, the cities that were putting in the skywalks were the cold weather cities—Minneapolis, St. Paul, Winnipeg…Now all the activity is

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5 Skyways are also called skywalks. As Minneapolis uses the term skyway system, the word skyway is used in this thesis.
in the warm weather cities—Dallas, Charlotte, NC, even some in Los Angeles” (Belkin 1988). In 1982, the skyway systems helped reduce the number of accidents, and improved traffic and pedestrian flows in the central business district at Des Moines, IA (Heglund 1982, 5-7). In a survey conducted in 1988, 97 percent of skyway users, workers, visitors, and shoppers, said they would like to have more skyway tunnels in their downtown area (Robertson 1988, 457-484). Another survey found that 89 percent of the city’s residents in Saint Paul prefer shopping on the skyway level to shopping on the ground level. For this reason, many retail business in the downtown area are now on the skyway level (Belkin 1988).

However, there are negative impacts about the skyway system. Most of the pedestrians are up on the skyway and there is a loss of street level activity. For example, in downtown Minneapolis, since most of the people are in the skyway system, it is difficult to see human activity on the street level. This would also cause the loss of retail stores and restaurants on the street level that are not connected within the skyway system. Robertson quoted that “skyways may represent harbingers of the twenty-first century downtown, which is likely to become increasingly indoor-oriented and less dependent on the street level for its vitality” (Robertson 1988, 457-484). William H. Whyte Jr., who studies pedestrians on street corners on behalf of the American Conservation Association, says, “If you remove all the people from the sidewalks of downtown, do you really have a downtown anymore? The basic question here is, What exactly is a city?” People say that skyway systems foster a two-class society “with the poorer people outside, on the ground level, and the wealthier people inside and insulated” (Belkin 1988).

Another problem is that in some cities, skyway systems are owned entirely by private businesses rather than the city. Therefore, there is inconsistency in the visual look of the skyway tunnels. There is also an issue that skyways have no direct access from the street level. Dr. Robertson said, “Often you have to go into the lobby of that building to enter the system, and that may be an intimidating experience for people who feel they don't belong. I see that as a problem. Of course,
some people like it that way” (Belkin 1988). It has been stated that from the street level, it is difficult to locate the entrances to the skyway system (Pandey 1992, 6-8).

There are wayfinding issues unique to the skyway systems. One of the major wayfinding issues of these complex systems is that they lack the sense of orientation. When one navigates through the skyway system, he or she has quite a different wayfinding experience than the experience on the street level. First time visitors experience difficulties, since they do not have a coherent cognitive map of the system. They tend to depend more on spatial information to make wayfinding decisions (Parab 1991, 63).

Even though there are many pros and cons about the skyway systems, today many North American cities have them (Belkin 1988). Since the Minneapolis skyway system—the nation’s first modern skyway—was opened to the public in 1962, pedestrian systems have been constructed in many downtown areas of North American cities like Atlanta (GA), Cedar Rapids (IA), Cincinnati (OH), Des Moines (IA), Detroit (MI), Houston (TX), Oklahoma City (OK), Paradise (NV), Pittsburg (PA), Rochester (NY), Saint Paul (MN), Spokane (WA), and so forth. Also, many cities around the world have skyway systems, including Bangkok (Thailand), Hong Kong, Kuala Lumpur (Malaysia), Melbourne (Australia), Gatineau (Quebec), and Plymouth (England) (Montgomery and Bean 1999, 403-437).

2.8.2 Other Tunnel Based Systems

Underground tunnels have similar characteristics as skyway systems. These tunnels are different from the pathways on street level, and people can only access these tunnels from the street level. An example of a tunnel based system could be London’s underground. London has an efficient wayfinding system for its underground. In 1933, Harry Beck simplified the complex London underground into a map. His map was a groundbreaking step in visual orientation. Since then, designers have been inspired by Beck’s underground map and used similar notations to
convey information simply and effectively on transit systems around the world (Berger 2005, 28). The London underground continues to be efficient for navigating. A graphic designer, Jason Santa Maria says (Maria 2007):

I am proud to say I didn’t get lost once in London, not because I am a fantastic navigator, but because of the London Underground’s wonderful wayfinding system. Whether you are buying a ticket, descending the stairs, or getting on or off the trains, your entire experience is clearly plotted; you always know where you are, where you are headed, and where all of your possible connections may be made. Systems like that seem like common sense when they are done well, but leave us wandering around filled with confused aggression when they are not.

Like skyway systems, most underground pedestrian systems are also climate controlled pedestrian systems that allow people to walk from one building to another without any interference from the street level. Rand Elliott turned an old complex tunnel system connecting buildings in the center of Oklahoma City into welcoming underground pedestrian tunnels with a simplified wayfinding system. These examples will be discussed more specifically in ‘Color Coding.’ (page 45).

2.9 Criteria for a Successful Wayfinding System

Information presented thus far provides a general framework to analyze the effectiveness of any existing navigation system. Through this framework, this author has categorized the most important criteria for creating a successful wayfinding system. These include universal design, human factors, multi-sensory factors, ease of navigation, memorability, color coding, legibility of information and spaces, consistency, architecture, safety, and comfort.
2.9.1 Universal Design

As the usage of the term universal design increases, it is crucial to understand what exactly it means. Universal design specialists, Dr. Arvid E. Osterberg and Donna J. Kain, state, “Design should work well for all people, regardless of variations in ability” (Osterberg and Kain 2005, 5). Some people may consider that universal design is only used to assist people with mental or physical disabilities. However, universal design is not only for people with mental or physical disabilities, but also for the people “who are not necessarily classified as having a disability or aged, but who routinely encounter functional obstacles in their daily lives” (Levine 2003, 9). For example, first time visitors in an unfamiliar environment may have difficulty in finding their way to destinations. We can say these people are having functional obstacles in wayfinding by not being able to know where they are and find their way. The center for Universal Design of North Carolina State University states that “universal design is the design of all products and environments to be usable by everyone regardless of age, ability, or situation, to the greatest extent possible, without the need for adoption or specialized design” (Connell et al. 1997, 2).

Universal design provides accessibility of information and physical environments, and tries to optimize safety as well as comfort. It is crucial to consider the accessibility issue when designing a wayfinding system. Not all universal design is required by law. However, there are well-known accessibility laws in the United States, such as the ADA (Americans with Disabilities Act) regulations which regulate signage design especially for people with vision impairments. An environmental graphic design organization, SEGD (The Society for Environmental Graphic Design) has written extensive interpretations of the ADA regulations. In 1977, a group of experts, architects, product designers, engineers, and environmental graphic design researchers, at North Carolina State University developed the “Principles of Universal Design.” Use of these seven principles “leads to a design approach that does not discriminate and provides increased usability
These principles that make designs usable for all people are (Connell et al. 1997):

1. **Equitable Use**: The design is useful and marketable to people with diverse abilities, and provides the same means of use for all users.

2. **Flexibility in Use**: The design accommodates a wide range of individual preferences and abilities, and provides adaptability to the user’s pace.

3. **Simple and Intuitive Use**: Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.

4. **Perceptible Information**: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities. He uses different modes (pictorial, verbal, tactile) for redundant presentation of essential information. Also, it provides compatibility with a variety of techniques or devices used by people with sensory limitations.

5. **Tolerance for Error**: The design minimizes hazards and adverse consequences of accidental or unintended actions. It provides warnings of hazard and errors.

6. **Low Physical Effort**: The design can be used efficiently and comfortably, and with a minimum of fatigue.

7. **Size and Space for Approach and Use**: Appropriate size and space are provided for approach, reach, manipulation, and use regardless of user’s body size, posture, or mobility.

### 2.9.1.1 Human Factors

It is not clear when this term was first coined (The Australian Council for Safety and Quality in Health Care 2004, 7). However, the term ‘human factors’ is now used widely in America. Human factors deals with psychological, social, physical, biological and safety characteristics of
a user and the system the user is in. The term human factors “is often used synonymously with ergonomics” (Fleet and Bates 1995). The two terms can be used interchangeably. However, ergonomics can also be one of the several categories of human factors (Malven 2008).

Academically, ‘human factors’ are those characteristics that define the human organism. Functionally speaking, ‘human factors’ is the study of human and environment relationships. The latter is the definition of ‘human factors’ as applied to design. Human factors is:

concerned with the application of what we know about people, their abilities, characteristics, and limitations to the design of equipment they use, environments in which they function, and jobs they perform (Human Factors and Ergonomics Society).

Studies of human factors allow designers to consider people when designing a physical environment. There are eight major categories of human factors related to design (Malven 2008):

1. **Health, Safety and Welfare issues**: Factors relating to the protection of individuals from threats of significant injury, disease or discomfort.

2. **Anthropometrics issues**: “anthro” referring to human and “metrics” denoting application of statistics or mathematical analysis. Anthropometrics is the measurement of human characteristics, human dimensions, spatial requirements, inter-element relationships, physical adjuncts and environmental elements; color and temperature. It can be divided into four categories—child, adult, elderly and handicapped.

3. **Ergonomic issues**: “ergo” refers to work and “omics” refers to a body knowledge or principles; the pseudo-science of human work and working conditions.

4. **Psycho-Behavioral issues**: The emotional or behavioral response of users of the built environment, and the physical variables that affect them.

5. **Bio-Physical issues**: Human sensory, anatomical, and other biological or physical characteristics, and their interaction with elements of the built environment, such as perceptual and sensory issues.
6. **Contextual issues**: Ethnic, political, economic, geographical, ecological, aesthetic, stylistic, and other unique variables of human user(s) and the specific setting(s) in which they operate.

7. **Ecological issues**: Costs/benefits and impacts, both positive and negative, of various design decisions on the sustainability and quality of the human and natural environment.

8. **Enabling Issues**: Factors influencing the degree and quality of user access to building features and functions, including, but not limited to, “accessibility” and “universal design” and ADA (American with Disabilities Act).

The study of human factors allows us to understand the interaction between the human and environment, and helps to create more efficient working and living spaces.

### 2.9.1.2 Multi-Sensory

To design a wayfinding system for all people, we need to consider both people without disabilities and with disabilities. It is crucial to “provide compatibility with a variety of techniques or devices used by people with sensory limitations” (Connell et al. 1997). As the author has previously discussed, when people navigate through a space, sight is not the only sense used for wayfinding. Sight might not be the dominant sense for those people with low vision. Other senses include sound, touch, and smell. These four senses (sight, sound, touch, and smell) are used when people find their way to their destinations. Wayfinding is a multi-sensory task. Arthur and Passini state that when people are in an environment, they tend to perceive surroundings through different sensory modalities. Miller asserts that by installing all of these four senses into the site we can increase the effectiveness of a wayfinding system.
2.9.2 Ease of Navigation

Wayfinding is the process of navigating through an unfamiliar environment. A well-designed wayfinding system allows users to have an ease of navigation within that space. Well-designed wayfinding helps people to navigate without getting lost, becoming frustrated, or wasting time and energy during their exploration in a new environment. In other words, an effective wayfinding system can efficiently lead people to their destinations and direct them back to their starting points.

2.9.2.1 Sense of Orientation

“A sense of orientation is usually equated with a sense of direction” (Passini 1984, 27).

According to Passini, a sense of orientation is (Passini 1984, 27-28):

…an ability to maintain a direction while moving, or to point to a direction independently of one’s location in space and independently of cues originating from the environment.

A person’s ability to determine his or her location in a spatial setting is called spatial orientation. Spatial orientation is the ability of knowing where one is located, and is based on the ability to form a cognitive map. According to Passini, he states that spatial orientation could be described as (Passini 1984, 35):

A person’s ability to mentally determine his position within a representation of the environment made possible by cognitive maps.

As previously mentioned, a cognitive map “is an overall mental image or representation of the spaces and the layout of a setting,” that is visible and legible (Arthur and Passini 1992, 23).

Having a good sense of orientation is having an ability to effortlessly navigate through the space without having any wayfinding problems. However, not many people have this confidence in their ability when they are in a new or unfamiliar environment. When people are in a new environment with a lack of such knowledge, they become disoriented, if not totally lost. “People
tend to feel disoriented when they cannot situate themselves within a spatial representation and when, at the same time, they do not have, or cannot develop, a plan to reach their destination” (Passini 1984, 25). Disorientation can have a serious effect on people. Being disoriented in an unfamiliar environment can lead to physical exhaustion, stress, anxiety, and frustration, all which threaten their sense of well-being and limit their mobility (Evans 1980, 88).

To reinforce the ability to orient oneself and be able to create one’s own mental map within a new environment, the wayfinding system must provide cues—signs, landmarks, maps and etc.

2.9.2.2 Memorability

While people move or navigate through a space, their eyes tend to scan whatever appears visually interesting for a short period of time. Then, these images add into the short-term memory until they are translated into memory of a longer period. Environmental perception is not just limited to vision. However, vision is the most efficient way to identify information from our environment during the wayfinding process. Lynch’s five key elements of a city’s image are defined as a network of path, edges, districts, nodes, and landmarks. These elements increase human ability to see and remember patterns of a certain space when they are placed in a good form. These memorable mental images of a space assist people in wayfinding. Distinctive landmarks, paths, or districts can easily be recognizable and memorable for people when navigating through the space. By creating a distinctive identity at each district grouped by its common attributes, the designer can increase memorability (Foltz 1998). This also helps users create their own mental images of that site. As Miller explains, environmental factors are the distinctive features or characteristics of the environment that affect how easily people can find their way by making the right decisions during their journey (Miller 1999, 16-17). Environmental factors such as the difference between areas or districts in color, size, architectural style, etc. at the site may be memorable to people. Prominent or noticeable landmarks for people to remember
and recognize, internally and externally, may also help people remember and increase their memorability of the site during the wayfinding process.

2.9.2.2.1 Color-Coding

The usage of color can play an important role as a wayfinding aid. “Color and graphics are used throughout to create easy-to-identify pathways and to highlight key points of service” in an environment (Regnel 2003, 161). Color-coding is the “use of a limited number of nameable colors for the purpose of visual orientation or direction” in wayfinding (Arthur and Passini 1992, 223). Paul Mijksenaar, a designer of visual information and a principle of the internationally known office Bureau Mijksenaar, says that in visual culture, coding means “that you communicate through means like symbols, forms, colors or verbal messages (like jargon) by the sake of mutual agreement. As a ‘sender’ you must be sure that your ‘receiver’ has learned or be able to learn this ‘code’ before starting to communicate” (Mijksenaar 2006). Mijksenaar is convinced that the purpose of color-coding for wayfinding can be only used “as a redundant element to emphasize a category of messages or to make signs conspicuous tools in their environment” (Mijksenaar 2006). Arthur and Passini state that people are likely to suggest color coding as the first suggestion to solve wayfinding problems. Color-coding by different parts or areas of a site can be useful wayfinding advice (Mollerup 2005, 167). It enables people to distinguish between different areas within the environment. If a map is used, it is important to have a simple color-coding system that coordinates with the map (Salm 2005, 4). For example, Harry Beck, a graphic designer, designed a map of the London underground system by using colors as code. He is best known for creating this map in 1933. This was the first map of a subway system that simplified the complexity of the underground system. He used a color-coding strategy to his underground tunnel system to enable people to create their own mental maps of the system. In this map, color-coding allows users to distinguish one route from another and also
allow users to remember each subway line by its color. This lets users know which station or line they are currently on and also which color of subway line they should take in order to get to their destination (Figure 2.17). Even though this map was designed in 1933, Beck’s innovative design is “still in use and has served as a prototype for most subways around the world” (Passini 1984, 132-133), including that of Boston, which has the oldest subway system in the United States (Swift). An important component about the Boston subway system is that every route spreads or goes out from the center point, Park Street/Downtown Crossing (Figure 2.18).

Figure 2.17 Color-coded map of the London Underground map system, originally designed in 1933 by Harry Beck
Another good example is Elliot’s wayfinding system of the underground Oklahoma City tunnel system. As a navigation tool, he assigned different colors to the wall and lighting for each area of the gallery. He used color “green to the tunnels connecting banks, blue to the federal buildings, red to the county buildings, magenta to hotels, and so forth” (Cohen 2007, 194-203). This assists users to distinguish between different galleries and enables easy navigation. It also makes the experience visually enjoyable as users navigate through the space (Figure 2.19).
The Massachusetts General Hospital had wayfinding problems for its complex and confusing layout of 18 public hospital buildings (Figure 2.20). A new wayfinding system for the hospital was designed by Two Twelve Associates to improve its navigating system. Like a subway system, the new wayfinding system was based on routes and stops rather than the names of each building (Figure 2.21). For example, they divided the ground floor into five different sections and color-coded each section. They named each route and elevator as a stop for each route (SEGD 1998). This allows users to identify where they are and find their way better.
Figure 2.20  Original Map of Massachusetts General Hospital

Figure 2.21  Revised Floor Map of Massachusetts General Hospital designed by Two Twelve Associates
Miller states, “color-coding is an appropriate method for simplifying, dividing, or explaining a site layout, internally and/or externally”(Miller 1999, 28). In order to design an effective color-coding system, Miller suggests it has to be:

- appropriate for the site,
- used extensively and consistently on all wayfinding information (signs, maps directories) and also on architectural features,
- identifiable as a color-coding system rather than simply a decorative use of color.
- noticeable and understandable for first-time visitors.

Color-coding is often used as a tool to solve wayfinding problems at a site that has a complex layout. It helps to simplify the layout of the environment. It also helps people remember a complex layout of the environment by its color code and to create their own mental image of that site. However, it is important to not use too many colors, especially on signs. In general, color-coding should “use not more than six colors”(Berger 2005, 58) to avoid causing confusion for people. Also, there are many people who have “color perception problems and cannot distinguish between certain colors”(Calori 2007, 130). This is the reason why color can only be used as a redundant feature when designing a wayfinding system.

2.9.2.3 Legibility

It is crucial to have a clear and legible wayfinding design in urban and building plans (Morville 2005, 26-28). Legibility is defined as the ability to be read. Information on signs or maps should be readily legible. Also, the layout of the site should have a high degree of ‘legibility’, which aids in the formation of a clear mental image of the space to be recalled later so that we can locationally visualize ourselves (Malnar and Vodvarka 2004, 124).
2.9.2.3.1 Legibility of Information

It is important to have clarity, accuracy, and legibility of information at the site. It is crucial that the kind of information people perceive matches what they can see in the actual environment in order for people to easily find their way (Miller 1999, 16-17). Legibility or visibility is the key aspect of signage (Berger 2005, 73). When people navigate through the physical environment, information on signage or other wayfinding elements must stand out and be easily recognizable or legible from a distance. Especially for health facilities, where they mostly deal with patients or visitors with various degrees of physical or mental abilities, it is important to consider legibility and accessibility issues when designing a wayfinding system.

In order to make information easy to read, “legible typography is essential for clear communication” (Calori 2007, 107). ADA recommendations prescribe that characters and symbols contrast with their background by a minimum of 70 percent. ADA also recommends there should be a minimum of eight inches of headroom for overhanging ceiling signage, with a minimum of a 3-inch cap height for characters (Osterberg and Kain 2005, 121). Characters must be used in a combination of upper and lower case, sans serif or simple serif (SEGD 2006).

2.9.2.3.2 Legibility of Spaces

According to Carpman and Grant, “successful wayfinding depends on reading the physical environment as well as on reading signs” (Carpman and Grant 1993, 83). If the site is legible, we can print the image of the site in our mental spaces as if it is printed on paper. An environmental image of a site could play an important part in dealing with wayfinding tasks.

As previously discussed, Lynch asserts that the image of the city should be visible, legible and memorable. In Image of the City, Lynch uses the term ‘imageability’ which could also be called legibility. Lynch argues that visual accessibility and the prominence of five elements (paths, edges, districts, nodes, and landmarks) are the design criteria for highly legible and
imageable city environments (Lynch 1960, 46). Lynch believes that we need an environment with good imageability, which will allow people to feel quickly at home in new surroundings (Lynch 1960, 111). By improving legibility of the environment images, people can have a clear mental image that will help them find their way.

### 2.9.2.4 Consistency

It is crucial to have consistency in a wayfinding system; it is the key to effective wayfinding. Consistency helps reduce complexity and confusion in wayfinding. In order to have consistency in a wayfinding system, it is important to consider the use of font, materials, location, color, and so forth. An example of consistency would be the Lankenau Hospital located in the suburbs of Philadelphia designed by AGS shown on page 11. It has a very consistent wayfinding system for a complex facility by identifying its zones alphabetically and using the same design layout of the sign throughout the system. A consistent wayfinding design provides users with a positive experience during the wayfinding process. “A high and consistent quality of sign system is a necessary prerequisite of a trusted wayfinding support” (Arthur and Passini 1992, 107). As previously discussed, color-coding can contribute to consistency. In addition to the sign system, a consistent layout of architectural elements can also help users to navigate space efficiently; this will be discussed more in the next chapter.

### 2.9.3 Architecture

An architectural setting plays a crucial role when people navigate through an environment. If the building has clarity of its structure, then that building may not need to rely exclusively on signage. Passini suggests that in consideration of wayfinding, the setting of architectural elements should not be ignored. He states, “architecture elements like stairs, corridors, walls, the space
defined, and the relationships among spaces provide the user with information just as signs and maps do” (Passini 1984, 186). People pick up circulation information not only from the environment in general, but also from architectural elements. These elements can provide a great variety of wayfinding cues when users navigate a space. In order to make people effectively find their way, they must understand circulation systems. People tend to pick up circulation information during wayfinding through the use of architectural elements or features (Arthur and Passini 1992, 116).

Architectural settings or elements (such as Lynch’s paths, edges, districts, nodes and landmarks) affect people when they create cognitive maps. Legibility of these elements is a “prerequisite to understand the spatial organization” (Arthur and Passini 1992, 52). If spatial organization is clear, it helps users to understand the setting of their environment and create cognitive maps. While Lynch’s study was done at the city scale, Passini insists, “there is no reason to assume that these elements do not apply to the architectural scales as well” (Passini 1984, 120). For example, Passini states that (Arthur and Passini 1992, 129):

The articulation of paths is a fundamental aspect of wayfinding communication. Proper articulation not only indicates the direction of movement and facilitates an understanding of the circulation system, it also gives users an indication of the importance of the destination and whether or not they have access to it.

Also, when designing, a method of grouping by similar architectural settings into different zones can also be “an act of classification that helps the designer gain an initial understanding of the setting to be planned” (Berger and Elss 2002, 30-34).

2.9.4 Safety and Comfort

Wayfinding is not just about assisting people from point A to point B, but also bringing them back from point B to point A. When navigating through the space, people might face an
emergency situation where they need to exit from the building or facility. Being able to have a
mental image and knowing where they are at the site is important because in an emergency
situation, they need to know their current location relatively to the space. Arthur and Passini say
(Arthur and Passini 1992, 10):

People who get into buildings also have to get out of them—sometimes fast. As settings grow
larger and more complex, emergency evacuation becomes a key problem, and wayfinding
becomes a matter of life and death.

An ineffective wayfinding system can become extremely dangerous. People die because of poorly
placed or labeled fire exits in buildings or stations; as a result, “Requirements for exit routes are
regulated by national fire codes”(Arthur and Passini 1992, 10). People with disabilities may even
face more difficulty and need to feel more safety and comfort while navigating. To reduce these
kind of problems, information such as emergency exit, signs must be clearly presented to the
site’s users. Emphasizing an exit using architectural expressions and the use of light can help

Wayfinding affects people’s emotional states when it lacks safety and comfort. People feel
safer if they clearly understand the layout of the site and can easily navigate through the space.
People also feel comfortable if they know where they are without being disoriented. Arthur and
Passini state, “Movement towards the familiar is psychologically comforting and sometimes even
CHAPTER 3. METHODOLOGY

This author has completed a site analysis, including data collection and photo-documentation in the skyway system of Minneapolis, Minnesota. Data collection included the author’s personal observations and wayfinding experiences of the site. A methodology was developed to analyze the navigation issues of the Minneapolis skyway system using a range of wayfinding and visual communication criteria. These criteria were based on the literature review of previous studies or concepts from professionals as well as the author’s personal knowledge gained from previous wayfinding research projects. While the analysis is limited to the Minneapolis skyway system, the methodology can also be applied to all other skyways and transport systems that have similar tunnel types: subway systems, underground pedestrian walkways, and even airport systems connected with tunnels.

3.1 The Minneapolis Skyway System

Before discussing the criteria, it is crucial to introduce the Minneapolis skyway System.

The nation’s first modern skyway system was introduced in Minneapolis in 1962. “The Minneapolis skyway system is a pedestrian skywalk system that connects various buildings in Downtown Minneapolis, enabling people to walk in a climate-controlled environment. Almost the entire downtown area can be accessed through this system without leaving the comfortable climate controlled pedestrian system (Millet 2007, 32-33).” The extensive system is renowned, “alongside the underground cities of Canadian cold weather cities Toronto and Montreal (Blumenthal 2007).” Leslie Park, president of Baker Properties, is the man who invented the idea
of the skyway system, which was built and opened to the public in 1962 (Daniels 2005, 8). Downtown Minneapolis began losing its retail shoppers to shopping malls in the suburbs during the late 1950s. Leslie Park, and, his partner, Edward Baker, an architect, “led an effort to draw shoppers back downtown by conceiving of a network in the skyway (Daniels 2005, 8).” The new skyway system improved retail sales downtown:

…studies show that the average city worker now spends more than twice as much money in the financial district as they did prior to the building of the skyways. Corporations such as AT&T, Pillsbury, and Wells Fargo, as well as large city entities such as the Minneapolis Convention Center, have linked skyway corridors to lavish, welcoming guest lobbies (Daniels 2005, 8).

These skyways have developed through private corporations and parking ramps. The connected buildings are privately owned. Today, this convenient skyway system makes it possible for users to live, eat, bank, work, and shop without going into the open air. These eight miles of skyways connect 69 buildings in downtown Minneapolis (Figure 3.1).

Figure 3.1 Typical examples of the skyway system in Minneapolis, MN (left: interior space of the skyway system from the Accenture building, right: exterior of the skyway system)
According to the daily users interviewed, the IDS Tower is the center point where people gather and has the busiest traffic within the skyway system. The IDS Tower also is a landmark on the street level—it is the tallest building in downtown Minneapolis. However, unlike the street level, skyway users cannot view and follow the tallest building inside the skyway tunnels. Even though users can see the outside view from some part of the skyway tunnels, it is difficult for them to follow landmarks, as they are unable to walk across one route to another. Once users are on the skyway route, they must follow the same route until they get to the node where they can make decisions to take a different route or continue the same route to get to their destination. On the street level, people can make frequent adjustments to their route. This is one of the disadvantages of being on the skyway system when navigating. On the street level, people may create better mental or cognitive maps, since there are many memorable key features. For example, in people’s mental maps, they may have the IDS Tower as the central point of the downtown area. As they get closer to the IDS Tower, they know they are getting closer to the center of the downtown because the landmark gets bigger and more distinct. Other than the IDS Tower, the Target Center, the Minneapolis Convention Center, and the Hubert H. Humphrey Metrodome are key landmarks on the street level of downtown Minneapolis (Figure 3.2). Unlike the skyway, the street level has four identified sub-districts—riverfront (south), warehouse (west), Loring Park (south), and Elliot Park (south) districts.\(^6\) Other than these districts, there are no officially identified sub districts.\(^7\) However, these districts are not connected with the skyway system, except some part of the warehouse district. Thus, the main downtown section, covered by the skyway, has no identified sub-districts.

\(^6\) Casey Kluver, personal phone call from a staff of Minneapolis Convention & Visitors Association: Meet Minneapolis, 13 March 2008, 2:41p.m.
\(^7\) Sherri Macko, personal e-mail to receptionist of Minneapolis Downtown Council, 12 March 2008
Figure 3.2  A map of Downtown Minneapolis and the skyway system
3.2 Scope of Project

This author has studied a portion of the Minneapolis skyway in order to analyze its existing wayfinding system. This author did not observe the entire system, as the minor and major paths, and nodes within the selected area seemed to represent the types of issues that occur throughout the system. All kinds of systems were evident in the area observed. The selected area was from the Accenture Building to the IDS Center (Figure 3.3). Since there were two different routes possible to get to the IDS Center from the Accenture Building, both routes were observed.
Figure 3.3  The scope of the study area: A map of the Minneapolis skyway system: Orange boxes and yellow dotted areas show the area the author studied.
3.3 Criteria Used for Critique of the System

When designing a wayfinding system, it is important for designers to provide a system that helps users navigate through an unfamiliar environment without becoming lost. As previously discussed, being lost or disoriented in a new environment can lead people to have physical and emotional stress. Wayfinding systems must provide users with knowledge about their location, destination, and also the spatial relationship between users and environment. In order to solve wayfinding problems in a complex environment, people need to create their own mental or cognitive maps of that space. In previous literature, it appears that Lynch’s five key architectural elements (edges, nodes, districts, paths, and landmarks) help people create mental or cognitive maps of their environment when these elements are in good form. Solving a wayfinding problem is not just about installing signage, but also providing architectural settings or elements to help create these mental maps.

In order to critique existing wayfinding issues for the Minneapolis skyway system, a qualitative method was used. The following wayfinding and visual communication criteria were based on a literature review of previous studies or concepts from professionals and the author’s personal experiences. Before going into the actual critique of the wayfinding system for the Minneapolis skyway system using these following criteria, it is important to explain each criteria.

3.3.1 Universal Design

Some questions important for consideration in this study include:

1. Designing for all people is very critical, both with and without disabilities. Is the skyway system accessible for all people? Does the wayfinding system consider both people with and without disabilities?
2. As previously discussed, wayfinding is a multi-sensory task. When people navigate through the space, sight is not the only sense used for wayfinding. Does the wayfinding system apply senses other than visual, such as sound, touch, and smell?

**Human Factors**

Human factors are another consideration. However, issues of human factors are related to and embedded in all other criteria. It is best to critique these issues in the context of other criteria.

### 3.3.2 Ease of Navigation

Questions addressing navigation include:

1. Is it easy for the user to navigate throughout the system?
2. Are the existing signs useful to users when navigating?
3. Does the wayfinding system effectively lead users to their destinations and direct them back to their starting points?

**Sense of Orientation**

Sense of orientation is concerned with the following questions:

1. Does the wayfinding system enable users to gain knowledge of where they are located? Which tunnel they are navigating? Which part of the skyway they are currently in? How far they are away from their destinations?
2. Is there any distinction or differentiation between building lobbies or plazas and the skyway tunnel? Is it easily identifiable? Is it easy to return to the skyway route when one is in a building’s lobby or plaza?
Memorability

As discussed previously, while people navigate through the space, their eyes tend to scan whatever appears visually interesting in a short period of time. Lynch’s five key elements of the city image are defined as a network of paths, edges, districts, nodes, and landmarks. When they are placed in a good form, these elements increase human ability to see and remember patterns of a certain space.

1. Are there any memorable key architectural features or elements for users to remember in the skyway system?
2. Do the architectural elements enable users to create their own mental or cognitive maps of the skyway system?
3. Is color-coding used for the wayfinding system or in any architecture setting or elements?
4. As previously discussed (page 44), creating a distinctive identity at each district, grouped by common attributes, can increase memorability. Is the skyway system divided into districts that are distinct and recognizable?

Legibility

Questions addressing legibility include:

1. Are there any legibility problems?
2. Is information on the signage legible to viewers? Are size and contrast levels appropriate for the viewing distance?
3. Is the orientation map legible to users?
4. As previously discussed (page 52), if the site is clearly visible and legible, we can imprint the image of the site in our mental spaces. Lynch argues that visual accessibility and the prominence of five architectural elements (paths, edges, districts, nodes, and landmarks)
are the design criteria for highly legible and imageable city environments. Are the architectural settings or elements legible to users in skyways?

**Consistency**

Consistency is concerned with the following questions:

1. Does the wayfinding signage system have consistency throughout the entire system (placement of directional signs and orientation map, a kind of information on signs)?

2. Do architectural settings or elements have consistency in the sections (for example, carpeting, lighting, shape of windows, colors of handrails, and so forth)?

**3.3.3 Architecture**

Most of the architecture issues will be discussed in the criteria of memorability. These issues are mostly related with ‘memorability’ (on page 63).

**3.3.4 Safety and Comfort**

Questions addressing safety and comfort include:

1. Can users easily exit directly from the skyway tunnel? Can they find exit signs easily in the skyways?

2. Can users find restrooms easily in the skyway system?

**3.4 On-site Observation**

This author has completed a site analysis by collecting photo-documentation data in the Minneapolis skyway system, Minnesota, from March 13, 2007 to December 21, 2007. Between these dates, the author visited four times.
On-site experience of the Minneapolis skyway System identified severe wayfinding problems. Navigating from one skyway tunnel to another is visually chaotic and disorienting to users. As a first time visitor, one becomes disoriented and then totally lost. The user is unable to know where these tunnels are connected and which tunnel he/she is located. Also, it is difficult to have knowledge of how far one is from a destination.

This severely complicated system is like a maze; the navigator understands how a mouse must feel in a maze, while trying to find the desirable destination. If one is especially observant, it is possible to determine some uniqueness — a smell of food coming from restaurants somewhere within the skyway system; certain skyway tunnels playing jazz music. If there is a wide window on both sides of the skyway’s corridor, the temperature becomes sufficiently hot for people to just wear light clothing, even though it may be the middle of a cold winter.

In the window areas, the user can become oriented by looking outside through windows located on both sides of the corridor. The user finally gets to know where he/she is when there is signage naming the building and street. Although the skyway system has signage, there are legibility issues and inconsistencies in color, design, use of materials, and locations. In addition, existing signage is not always placed at the decision points (nodes) where users must determine where to go in order to proceed on their journey to their destinations. According to the author’s observation of this skyway system, there were many empty walls or ceilings that could be used for wayfinding elements.

3.5 Critique of the Minneapolis Skyway System

The author’s goal is to analyze the challenge within the existing wayfinding system of the Minneapolis skyway system in order to determine effective ways to improve users’ navigations and orientations through the system. The on-site observations relies heavily on Kevin Lynch’s five important elements for forming mental maps as navigational aids to enhance wayfinding
performance within this unique system. Once the criteria are established, it is necessary to analyze each criterion during the on-site observation process.

3.5.1 Universal Design

Wayfinding is a multi-sensory task, especially for the disabled (page 25). Within the Minneapolis skyway system, it was clear that the wayfinding system was not designed for all people. It was more difficult for blind or visually impaired to navigate throughout this system than people with strong vision. While the author was navigating through this unique system, she could not find any clear wayfinding elements that would lead blind or visually impaired people effectively through this space. It is especially difficult to navigate through the corridors when they come to the decision points (where one must choose which way to go). At some decision points, people with strong vision can use directional signs as a wayfinding tool. However, for people who do not have strong vision, there is no alternative for them other than directional signs. There were no tactile signs (touch), sound, or smell that clearly inform them where they are and which way they should go to reach their destinations. Although there were wayfinding issues, other aspects of accessibility were successful. Every entrance in the skyway system had automatic doors that were accessible for people with wheel chair or walkers. The width of most pathways was wide enough for wheelchairs to pass through. The skyway also provided handrails in most of the skyway tunnels (Figures 3.4).
3.5.2 Ease of Navigation

When navigating in the skyway system, it was difficult to make a choice of which way to go in order to get to one’s destination. The only wayfinding cue was directional signs, randomly hanging on the ceiling (Figure 3.5), and periodically a wall mounted orientation map (Figure 3.6). Most of the orientation maps were in the buildings, but not in the actual skyways. Randomly located orientation maps and directional signs were not very helpful when navigating. Some directional signs provided the street name of the skyway he or she was currently located, which can be helpful for users to know where they are at a certain point in the system (Figure 3.7). However, it was not always helpful as this information was not on every directional signs. Another wayfinding cue was the outside view of the wide windows. However, it was sometimes confusing to see outside, as one cannot change the route as easily as on the street level. Other than these cues, it was difficult for users to navigate through the space, especially for a first time user having no mental or cognitive map in the mind.
Figure 3.5 Directional signs in skyway tunnel

Figure 3.6 ‘You Are Here’ orientation map of the skyway system

Figure 3.7 Street information on directional signs of the skyway system
3.5.2.1 Sense of Orientation

It is difficult to know where one is and how far he or she is from a destination within the skyway system. When navigating through the skyway route, there was no information either on directional signs or an orientation map about how far one is from a destination (Figure 3.8).

![Directional sign in the Campbell Tower](image)

Figure 3.8 Directional sign in the Campbell Tower

Most of the directional signs within the skyway route tell users the name of the building ahead of them at the last minute, rather than providing all other possible major destinations like the IDS Center. This makes users wonder how much further they have to proceed on their journeys in order to arrive at their destinations. For example, when the author was in the Campbell Tower, a directional sign indicated the ‘IDS Center’, but she had no sense of how far she was from the IDS Center. From the Campbell Tower, she had to walk about 0.2 miles (three skyway tunnels) to arrive at the IDS Center. By comparison, road signs provide drivers with a sense of how far they are from a destination and where they need to exit (Figure 3.9). This avoids drivers wondering how much further they need to drive.
Another example is restroom signs in a subway system of Seoul, Korea (Figure 3.10). These ceiling mounted directional signs provide information of how far users are from a restroom. These signs also avoid people wondering how much more they must walk in order to get to the restroom. As discussed previously, being disoriented in an unfamiliar place may lead people to becoming stressed and frustrated (page 44).
Also, there is a problem in the sense of orientation. An example is when a user goes from a skyway path to a building’s lobby or plaza and then returns to a path in the skyway. This problem usually occurs in an open plaza or center area such as the U.S. Bank Plaza (Figure 3.11), One Financial Plaza (Figure 3.12), and the IDS Center (Figure 3.13). In these open areas, one loses the sense of direction and wonders, “which direction should I go in order to return to the skyway route?”

Figure 3.11 Open area of U.S. Bank Plaza
Open areas or plazas are used by individual buildings’ visitors for different purposes than those of the skyway users. These visitors use these spaces in a way other than navigating. This is part of the reason users become more confused when they are in these open spaces of the building. These areas work as nodes (page 20), where people must make decisions. There were no
wayfinding cues available at these nodes and some open areas had too many decision choices available.

Another significant problem of the skyway system is there is no obvious distinction between the different districts shown to people on the orientation map (Figure 3.14) or in an architectural setting of the skyway system.

Figure 3.14  An orientation map of the skyway system: No distinction between districts or areas
As mentioned previously, the current skyway system is not divided into sub-districts (page 57), so it does not have a clear distinction between different areas of the system. When navigating, it is challenging to know which area of the skyway system one is in because it has no differentiation in architectural settings between different districts or areas (Figure 3.15). There are no differences in the architectural setting of the skyway between the U.S. Bank Plaza (which could be called the financial district) or Campbell Tower (which could be called the financial district) and
Government Center (which could be called the government district). These conditions cause users to be disoriented without knowing which area of the skyway tunnel or route they are in.

### 3.5.2.2 Memorability

To enhance memorability, a color-coding method may help people remember the complex layout of the environment by its color code, allowing people to create their own mental images of that particular site. It also enhances memorability (page 50). However, the skyway system does not provide any color-coding treatment to its wayfinding system. For example, there is no color treatment used to distinguish between different areas on the orientation map (Figure 3.16). All skyway routes have the same color on the map. Since no districts have been identified, the different areas are not color-coded.

![Figure 3.16](image-url):

No color-coding shown on the orientation map of the skyway system.
As previously discussed (page 54), architectural settings or elements affect how easily people create cognitive maps. Architectural settings of most of the skyway tunnels are not memorable and are dull looking (Figure 3.17). There are no unique identifiable architectural features or memorable treatment of colors.

Figure 3.17  Dull architectural features as shown in the skyway tunnel to the Accenture Building (top left), to the Rand Tower (top right), to the Government Center (bottom)
However, a few of the skyway tunnels have unique architectural elements, and this helps users remember and create a mental cognitive map. A skyway tunnel to the City Center has a unique diamond shape of windows and ceiling, bluish lighting, and use of metal (Figure 3.18). Another memorable skyway tunnel leads to the Wells Fargo Center (Figure 3.19). It has a unique window shape in the middle of the pathways, on the ceiling, and floor. It also has a unique flooring. These skyway tunnels are so unique and distinctive from other skyway tunnels that they enhance memorability for the user. These memorable features help navigators know where they are in the system.
3.5.2.3 Legibility

In the skyway system, there were problems of legibility in both the wayfinding signage system and architectural settings or elements. The existing orientation map of the system is too complex for the user to understand because it has too much information (Figure 3.20). Without any distinction or hierarchy, this orientation map makes it challenging for the user to find the information they want in a short period of time.
Information on signage must be legible and easily recognizable. However, the existing directional signs are not legible. The cap-height of these characters is about two inches, which does not meet the ADA recommendation of a minimum of 3-inch cap height for characters for overhanging signage (page 51). It was quite challenging for users to read some of the signs from a distance, due to their use of small type sizes (Figure 3.21). There are many empty spaces on these signs that can be used to make these characters bigger.
There are legibility issues on some of existing directional signs hanging from the ceiling. These directional signs have a water image, which this author assumes represents the lakes between the Twin Cities, on their background with white serif type (Figure 3.22). These interfering images make it difficult for the user to read these signs from a distance and even from directly below the sign. There is not enough contrast between the background color—light blue—and the white characters. This provides difficulties for users when reading these signs.
In addition to the signs in the skyway system, there is also an issue of legibility in the architectural elements. As discussed previously (page 52), Lynch’s five key architectural elements (paths, edges, districts, nodes, landmarks) help people create mental or cognitive maps when these are highly legible and visible. Legibility of these elements is a requirement to understand spatial organization (page 54). The skyway system has no memorable or highly legible paths with nodes and edges (Figure 3.23), although they do have those elements. However, the system does not have any identified legible districts or landmarks within the system. Absence of identifiable districts and landmarks makes the skyway system lacking in legibility.

![Figure 3.23 Lack of legibility in the path with edge (left) and node (right) of the skyway](image)

### 3.5.2.4 Consistency

It has been previously discussed that consistency can help reduce complexity and confusion in wayfinding (page 52). The skyway systems are owned entirely by private corporations rather than the city. Thus, there is inconsistency in the visual look of the skyway tunnels (page 36). Even within the same area or district, there are different architectural features and no similarity or unity in any wayfinding signage system. This confuses people as to whether they are walking through the same district or have crossed into a different district. For example, there was no unity
in what could be considered as the financial district area, such as the skyway tunnel to the U.S. Bank Plaza, to the Wells Fargo Center, to the TCF (Figure 3.24).

Figure 3.24  Different architectural features of the same district area: (from top to bottom) skyway tunnel to the U.S. Bank Plaza, to the Wells Fargo Center, and from the Baker to the TCF
They all had different architectural features (flooring, lighting, shape of windows, colors, materials, and so forth). Users cannot find any unity in these skyway tunnels.

Figure 3.25  Inconsistency in the sign systems of the skyway

There is no consistency or strategy in signage systems within the skyways (Figure 3.25). As previously discussed (on page 36), the skyways and buildings owned by many private owners and
there are many different kinds of signs placed by the owners in the skyway system. These signs have different materials, and are even inconsistent in the use of colors, sizes, types, and kind of information provided. In some locations, there are two different types of directional signs, making it difficult to determine which one to follow (Figure 3.26). Even though these two signs provide different information, it is unnecessary to have two different types of signs in the same location.

Figure 3.26 Two different kinds of directional signs in the skyway system providing different information

The skyway system also provides two different styles of orientation maps, which confuse users when navigating (Figure 3.27). These maps provide different kinds of information. The map on the right shows symbols and a close-up view map of the skyway system. When one map is vertical and the other map is horizontal, these two maps challenge users to learn two different maps.
3.5.3 Safety and Comfort

In terms of safety, there is a problem with where EXIT signs are located. Most of the EXIT signs are placed inside buildings rather than within the skyway system. In case of an emergency, it might cause difficulty for users to locate these EXIT signs, since they are only placed inside the building rather than on skyways, too (Figure 3.28).
When navigating through the space, people might face an emergency situation where they need to exit directly from the skyway route. Having a mental image and knowing where the signs are located within the site is important. In an emergency situation, visitors need to know their current location relative to the space and the EXIT (page 54). However, one cannot exit directly from the skyway. To exit from the skyway, one always must find the nearest building and exit to the street level from that point. There were no exit signs in most of the skyways. When navigating, some users may not feel comfortable being in tunnels and not knowing how far they are from exits or where to leave the building. Only one skyway tunnel (which has longer pathways than the others) has a direct exit from the skyway. The skyway tunnel to Thrivent Financial has a direct exit where one can exit to the street level from a skyway (Figure 3.29). There is also no direct entrance from the street level to the skyway.

![Direct exit from the skyway tunnel: Tunnel to Thrivent Financial](image)

Figure 3.29   Direct exit from the skyway tunnel: Tunnel to Thrivent Financial

When navigating, an issue of comfort was that this author was unable to find any restroom within the skyway system. She could not even find one inside any building. According to other users who have used this skyway system before, they too had a difficult time finding restrooms
and thought there was no restroom within the skyway system. Even though there were public restrooms within the system, it was not evident to the user. This may affect a user’s emotional state.

3.6 Findings

In summary, the skyway system has several major wayfinding issues that should be addressed. One of these major wayfinding issues of this complex and unique system is that it lacks a sense of orientation. One way to improve this sense of orientation is to enhance the memorability of the skyway system.

Possibly the most significant problem of the skyway system is that it lacks memorability of its architectural settings. While the street level has various ranges of memorable elements, such as landmarks and natural and built changes from one district or area to another that can assist people’s sense of orientation, the skyway system only provides a limited occasional window view of these outside cues, and offers little consistency or distinction in architectural settings. This makes it more difficult for one to create a mental or cognitive map of the skyway system than that at the street level.

A third issue is the system does not provide legible, memorable, and consistent architectural settings throughout the system that enables first time visitors create their own mental or cognitive maps of the system. With the absence of districts, it is difficult for users to understand or remember the layout of the site. There was no differentiation in architectural settings by different districts currently found in the skyway system; it is not divided into districts. The visual appearance of the pathways for different districts is often similar. Also, what can be considered as the same district may have no consistency in its signage system or architectural settings. In other words, there is no unity or consistency throughout the entire system. This is a reason why the
Minneapolis skyway system lacks a sense of orientation. Users cannot understand the layout of the entire system.

3.7 Recommendations

Design recommendations for improving the sense of orientation are proposed, based on these critical observations, as well as Lynch’s idea of district and landmark. As discussed above, one of the major wayfinding issues of the Minneapolis skyway system is that it lacks a sense of orientation due to its lack of memorability in architectural elements. The Minneapolis skyway system only provides paths, nodes, and edges, but lacks any sense of districts or landmarks. This makes it difficult for first time users to create mental or cognitive maps of the complex skyway system. As previously discussed, Lynch believes that improving these elements—path, edges, districts, nodes, and landmarks—can make a city become more legible, visible, and imageable (Lynch 1960, 46-90). He says, “a legible city would be one whose district or landmarks or pathways are easily identifiable and are easily grouped into an over-all pattern” (Kelly 2001, 30). Enhancing memorability of Lynch’s five key elements, especially districts and landmarks, will improve a sense of orientation within the Minneapolis skyway system. This would provide an effective wayfinding system and allow visitors to have positive experiences as they navigate through the system. To improve the sense of orientation in the wayfinding system of the Minneapolis skyway, the author recommends focusing on improving memorability of districts and landmarks in the site, rather than relying only on improving the existing signage system. Although landmarks are often useful as memory aids, these recommendations focus instead on other ways to enhance memorability, since landmarks may prove less successful in this situation.
Memorability: Grouping by Districts

To reduce complexity of the current system and enhance memorability, it is crucial to break the system down into sub-districts. As previously discussed (on page 18), by breaking down the site into districts and zones, these help people to identify and distinguish different characters of each area. It is also useful to provide districts on orientation maps to assist people to understand their location. It is logical to divide downtown spaces into districts by similar functional characteristics: financial, shopping, government, residential, and warehouse districts. Once the skyway system is divided into sub-districts, color-coding each district is necessary to enhance memorability (as discussed on page 50). Color-coding each district provides consistency and unity throughout the system. These colors can be used differently in each district to allow users to distinguish between these districts. Color should be used in:

1. Orientation maps: to reduce complexity of the system and enhance memorability.
2. Lighting: different color lighting of each district.

Simplified orientation maps color coded by districts will enhance legibility and memorability of users in wayfinding. In addition to the color-coding, each district will be coded by different shapes that identify each district. These shapes represent the different shape or pattern of windows that would be added in each district:

Triangle – Financial District
Diamond – Shopping District
Octagon – Government District
Circle – Hotel District
Square – Warehouse District

This will also enhance memorability when navigating. A comparison of the original orientation map (Figure 3.30) with the revised orientation map (Figure 3.31) shows how the revised map would enhance legibility and memorability.
Using different color lighting in each district will allow users to be able to distinguish between them when they are at the open plaza areas or inside buildings (at nodes); the color lighting coming from the skyway tunnels will help them find their way back to the skyway to continue their journey (Figure 3.32). Ceilings in each district may need to reflect the color as well.

Figure 3.30  Original Orientation Map of the Minneapolis skyway system
Figure 3.31 Revised orientation map of the Minneapolis skyway system
Memorability: Using Same Architectural Settings in Each District – Consistency and Unity

As previously discussed (on page 50), color should not be the only wayfinding tool that distinguishes districts. There are many people who have “color perception problems and cannot distinguish between certain colors.” (Calori 2007, 130) Each skyway pathway of the districts should also have differentiation in architectural features such as the shape or pattern of the windows. Previous findings prove that skyway tunnels with unique shapes or patterns of the window were more memorable to users than the visually dull looking skyway tunnels (page 77). For this reason, each district will have different shapes, creating different patterns for the windows (Figure 3.32). When navigating, these shapes will allow users to have knowledge of where they are by identifying which district of the skyway tunnel they are currently located. Using the same color and patterns within each district will provide unity within the district.
Figure 3.32  Different shapes for windows, and different color lighting of skyway tunnels of five districts
In addition, to inform users of their distance from a center point (IDS Center), the shape or pattern of windows in the skyway tunnels should get denser as they get closer to the center point. It will become sparse as they move further from the center point of skyway system (Figure 3.33-3.37). Users will learn to identify their location and have knowledge of how far away they are from the IDS Center, since these changes in pattern density will occur on every path. By implementing these recommendations, there will be an increase in memorability, and also an improved sense of orientation in the wayfinding system of the skyway system.

Figure 3.33  Showing changes in pattern density in the financial district when approaching the center point (IDS Center) of the skyway: Farthest away from the center point is sparse, closest is dense
Figure 3.34  Showing changes in pattern density in the shopping district when approaching the center point (IDS Center) of the skyway: Farthest away from the center point is sparse, closest is dense
Figure 3.35  Showing changes in pattern density in the government district when approaching the center point (IDS Center) of the skyway: Farthest away from the center point is sparse, closest is dense
Figure 3.36  Showing changes in pattern density in the hotel district when approaching the center point (IDS Center) of the skyway: Farthest away from the center point is sparse, closest is dense
Figure 3.37  Showing changes in pattern density in the warehouse district when approaching the center point (IDS Center) of the skyway: Farthest away from the center point is sparse, closest is dense


**Signage Recommendations**

While not the focus of the recommendations, there are some simple changes to the sign system that could contribute to improved wayfinding, as well as to support the enhanced sense of orientation. Signs and orientation maps should be placed in the same location with the same quality or kind of information throughout the entire system to be consistent. Directional signs will also provide information on how far one is from certain destinations (Figure 3.38).

![Figure 3.38 Information on distance: proposed improvements to directional sign](image)

### 3.8 Limitations of the Methodology

User surveys were not conducted, since the author’s knowledge and expertise gained from studying wayfinding and her review of the existing literature and theories were sufficient to observe the general wayfinding problems of Minneapolis skyway system, while doing the on-site observation. Conducting surveys from skyway users would very unlikely provide any knowledgeable opinions about what is missing. Users also may not know what is missing in terms of wayfinding. When they get lost in skyway system without knowing where they are, they may just think *something* is missing but not know specifically *what is* missing. According to this
author’s knowledge, it was clear that the Minneapolis skyway system lacks a sense of orientation, and conducting surveys would not expand on this obvious fact.
CHAPTER 4. CONCLUSIONS

Wayfinding has become very crucial in the built environment, and our reliance on it has increased, due to the complexity of contemporary buildings and cities. When people are in an unfamiliar or complex environment, they may face many wayfinding challenges. Most wayfinding systems have challenges, and there are some unique problems that happen in the tunnel systems. Tunnel systems do not provide the varied wayfinding cues or aids that are visible on the street level. Therefore, people face greater challenges when navigating in these systems. When a wayfinding system is effectively designed, people will feel comfortable and welcomed within the environment. An effective wayfinding system will also show users a clearer understanding of the layout of the site and how to easily navigate through the space without being disoriented.

A wayfinding system is designed by a multi-disciplinary team. In order to create an effective wayfinding system, architects, graphic designers, architects, urban planners, and building managers should plan the system together from the beginning of the designing process. This will save time, money, and energy, and ensure a cohesive system.

This study analyzed the unique wayfinding challenges within the existing wayfinding system of the Minneapolis skyway system, and determined effective ways to improve users’ navigation and orientation throughout the system. The study relied heavily on Kevin Lynch’s key elements of districts and landmarks, which are two of his five important elements necessary to form mental or cognitive maps as navigational aids to enhance wayfinding performance. Improvement of the wayfinding system of the Minneapolis skyway would enhance comfort and well-being. By
improving this wayfinding system, it will not only help skyway users get from point A to point B, but also allow users to enjoy traversing the skyways without getting lost when navigating. The findings and recommendations of this paper will also be relevant to many other skyways and to other transport systems that have a similar tunnel type—subway systems, underground pedestrian walkways, and even airport systems connected with tunnels.

This author notes several possible areas for future study and development of this proposal. For example, should additional district identifiers be deemed necessary, it is recommended that supportive elements such as banners, floor tiles, or wall graphics be implemented that repeat the district's color and shape. If the recommended geometric shapes are deemed too difficult to remember, the author suggests an investigation into other, more recognizable iconic references (possibly related to the district's nature) as a possible substitute for the abstract shapes. Additional developments might also include an investigation of ways to inform the users of the shape/color identifiers, to ensure they are looking for them while in the skyway.

The methodology and recommendations present other implications for future study. For instance, Colette Miller, wayfinding consultant, states that wayfinding is a multi-sensory task (Miller 1999, 18-19), so recommendations might also be developed regarding other ways that multi-sensory wayfinding could enhance the skyway system. This could enhance people’s sense of orientation more effectively and also help people without strong a visual ability.

It would be interesting if these design proposals were to be prototyped, allowing a more in-depth study of their effectiveness in practice. It is hoped these hypothetical recommendations could be considered at the early planning stages of future skyway systems.
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Figure 2.1  Signage plays an important role within the broader realm of wayfinding cues [Source: Chris Calori, *Signage and Wayfinding Design* (John Wiley & Sons, Inc., 2007), 5]


Figure 2.3  Lankenau Hospital wayfinding system, designed by AGS [Source: Marisa Bartolucci, *Honor Award: Bookending the Hospital Experience* (SEGD Design, no.14, 2006), 30-33]

Figure 2.4  Ottawa MacDonald-Cartier International Airport wayfinding system, designed by Gottschalk + Ash International, Calgary, AB, Canada [Craig M. Berger, *Wayfinding: Designing and Implementing Graphic Navigational Systems* (Rotovision, 2005), 79-82]

Figure 2.5  Example of paths and districts: A diagram that explains the Oklahoma City underground tunnel system designed by Rand Elliott [Source: *The Way Forward* (Interior Design, August 2007), 194-203]

Figure 2.6  Example of districts: Walk! Philadelphia map, showing one district (left) and a group of districts (right) designed by Joel Katz Design Associates [Source: Craig M. Berger, *Wayfinding: Designing and Implementing Graphic Navigational Systems* (Rotovision, 2005), 33-34]

Figure 2.7  Example of districts: LA Walks map designed by Corbin Design with Hunt Design [Source: Craig M. Berger, *Wayfinding: Designing and Implementing Graphic Navigational Systems* (Rotovision, 2005), 59]
Figure 2.8  Example of nodes: The Arizona Cardinals Stadium Wayfinding Signage System, designed by Pentagram Design & Etro Communication [Source: Marisa Bartolucci, *A Winning Stadium* (SEGD Design, no.15, 2007), 29]

Figure 2.9  Example of landmark: The Chiat/Day building in Santa Monica, Los Angeles, designed by Frank Gehry [Source: Per Mollerup, *Wayshowing: A Guide to Environmental Signage Principles and Practices* (Lars Muller Publisher, 2005), 17]

Figure 2.10 Four types of Information that enable people to complete all stages of their journey successfully. Illustration by Colette Miller [Source: Colette Miller, *Wayfinding: Effective Wayfinding and Signing System: Guidance for Healthcare Facilities* (NHS Estates, 1999), 17]

Figure 2.11 Braille and Audio Handrail System & Floor Markings by Coco Raynes Associates [Source: Craig M. Berger, *Wayfinding: Designing and Implementing Graphic Navigational Systems* (Rotovision, 2005), 50]

Figure 2.13 Three Key Processes in terms of spatial problem solving, adopted from Arthur and Passini [Source: Colette Miller, *Wayfinding: Effective Wayfinding and Signing System: Guidance for Healthcare Facilities* (NHS Estates, 1999), 14]


Figure 2.15 Cognitive Map of the Iowa State University campus [Source: A drawing provided by a current student]

Figure 2.16 Cognitive Map of Minneapolis Skyway System (from Accenture building to TCF Bank) [Source: Author’s drawing]

Figure 2.17 Color-coded map of the *London Underground* map system designed in 1933 by Harry Beck [Source: Craig M. Berger, *Wayfinding: Designing and Implementing Graphic Navigational Systems* (Rotovision, 2005), 14]

Figure 2.18 Color-coded map of Boston subway system [Source: *Subway Map* (Massachusetts Bay Transportation Authority), (cited 8 March 2008); available from http://www.mbta.com/schedules_and_maps/subway/]

Figure 2.19 Color-coded map of the Oklahoma City Tunnel System designed by Rand Elliott [Source: Edie Cohen, *The Way Forward* (Interior Design, August 2007), 194-203]
Figure 2.20 Original Map of Massachusetts General Hospital [Source: Two Twelve Associates]

Figure 2.21 Revised Floor Map of Massachusetts General Hospital designed by Two Twelve Associates [Source: Two Twelve Associates]

Figure 3.1 Typical examples of the skyway system in Minneapolis, MN (left: interior space of the skyway system from the Accenture building, right: exterior of the skyway system) [photos by the author]

Figure 3.2 A map of Downtown Minneapolis and the skyway system [Source: Minneapolis Downtown Council (cited 11 March, 2008); available from http://www.downtownmpls.com(directions.php)]

Figure 3.3 The scope of the study area: A map of the Minneapolis skyway system: Orange boxes and yellow dotted areas show the area the author studied [Source: Mapformation (cited 18 March, 2008); available from http://www.mapformation.com]

Figure 3.4 Automatic door button (left)/wide pathways with handrails (right) [photos by the author]

Figure 3.5 Directional signs in skyway tunnel [photo by the author]

Figure 3.6 ‘You Are Here’ orientation map of the skyway system [photo by the author]

Figure 3.7 Street information on directional signs of the skyway system [photo by the author]

Figure 3.8 Directional sign in the Campbell Tower [photo by the author]

Figure 3.9 Road signs with an indication of distance [Source: Craig M. Berger, Wayfinding: Designing and Implementing Graphic Navigational Systems (Rotovision, 2005), 38]

Figure 3.10 Restroom sign with an indication of distance, Seoul Korea [Source: images provided by Somin Kim]

Figure 3.11 Open area of U.S. Bank Plaza [photos by the author]

Figure 3.12 Open area of One Financial Plaza [photo by the author]

Figure 3.13 Open area of IDS Center [photo by the author]

Figure 3.14 An orientation map of the skyway system: No distinction between districts or areas [photo by the author]

Figure 3.15 Different districts with similar architectural settings: Photos from various areas of the systems, yet showing no differentiation [photos by the author]
Figure 3.16  No color-coding shown on the orientation map of the skyway system [photo by the author]
Figure 3.17  Dull architectural features as shown in the skyway tunnel to the Accenture Building (top left), to the Rand Tower (top right), to the Government Center (bottom) [photos by the author]
Figure 3.18  Unique memorable architectural features of skyway tunnel to the City Center [photos by the author]
Figure 3.19  Unique memorable architectural features of the skyway tunnel to the Wells Fargo Center [photos by the author]
Figure 3.20  An orientation map of the skyway system: Too much information without distinction [photo by the author]
Figure 3.21  Small type on directional signs: Illegible from a distance [photo by the author]
Figure 3.22  Directional signs with water background image [photo by the author]
Figure 3.23  Lack of legibility in the path with edge (left) and node (right) of the skyway [photos by the author]
Figure 3.24  Different architectural features of the same district area: (from top to bottom) skyway tunnel to the U.S. Bank Plaza, to the Wells Fargo Center, and from the Baker to the TCF [photos by the author]
Figure 3.25  Inconsistency in the sign systems of the skyway [photos by the author]
Figure 3.26  Two different kinds of directional signs in the skyway system providing different information [photos by the author]
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Figure 3.38  Information on distance: proposed improvements to directional sign [designed by the author]
NOTES

1 Quote from Carpman and Grant as cited in Peter Morville, Ambience Findability (O’Reilly Media, Inc, 2005), 17
2 Quotes from Edward Tufte as cited in Richard Saul Wurman, Information Anxiety (Doubleday, 1989), 269
3 Braille is a tactile code that was developed by Louis Braille. It is used to represent letters of the alphabet, which is used by people with visual impairments.
4 Skyways are also called skywalks. As Minneapolis uses the term skyway system, the word skyway is used in this thesis.
6 Casey Kluver, personal phone call from a staff of Minneapolis Convention & Visitors Association: Meet Minneapolis, 13 March 2008, 2:41p.m.
7 Sherri Macko, personal e-mail to receptionist of Minneapolis Downtown Council, 12 March 2008