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**Environment Behavior Design for Improving the Urban Street Space in Vietnam
Metropolitan Area with Rapid Urbanization**

急速な都市化が進むベトナム都市圏における街路空間の改善に関する環境行動デザイン
研究

by

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ABSTRACT

Inevitably, the urbanization process exerts both positive and adverse impacts on urban areas. Metropolitan cities in Vietnam is facing a large rural population moving to such cities. This means the higher density of constructions in urban areas. As a consequence, fewer open space and public space are found in cities. Most activities of inhabitants are performed in street space which includes both sidewalks and roadways as defined. Indeed, streets are space for not only traffic but also other activities of residents. The municipal government undertakes street space-improving campaigns supporting residential use to alleviate the shortage of open public space.

Street space is improved by widening, adding small green zones or street furniture, improving quality of surface finishes and demarcation of parking. Also, some regulations were enforced to restrict trading activities to reduce conflicts between pedestrians and shop-owners. Newly renovated street space obviously brings lots of benefits to citizens; although typically designed in a sanitized manner that is unfamiliar to the residents. Meanwhile, in old streets, activities take place in a vivid way, and more importantly, featured cultures of locals remain.

Based on environment behavior study and architectural planning approaches, this study is to understand the characteristics of street space and relationship between street environment and users' activities in Da Nang Vietnam and to prefer solutions towards the street space improvements. A further aim is to examine the ways in which street space environment characteristics can affect urban residents' cognition, behaviors and concerns in the contemporary urban street. This study is among the first investigations of street space Vietnam that focuses on how the physical environment affects perceived usage of residents. This aims at developing a street space for everyone regardless of financial conditions and contributes the social justice.

This dissertation addresses:

Chapter One: History and current state of street space environment problems, including changes in street space that aim to promote users' behaviors. In addition, the research hypothesis, research questions, scope, structure, objective and significance of this study are explained in this section.

Chapter Two: Literature review related to open street space overseas and in Vietnam, including theoretical approaches, implementation, and trends; including theories of environment behavior study in relation to street space development.

Chapter Three: Definition and development of basic characteristics of street space on all; including the current improvement. Street space in major cities in Vietnam and discusses the various aspects related to challenges and specifically explores the management situation and the life along the street space in Da Nang.

Chapter Four: Describes the research methodologies including qualitation and quantitation; Questionnaires, Capture Evaluation Method survey, Visual Encounter Survey method, Behavior Mapping and some statistical analysis to understand the underlying information resulting from the investigation data.

Chapter Five: Residents concerns in the street space with emphasis on physical settings that attract users; findings show that people tend to frequently pay attention to 13 fundamental physical elements out of the 88 elements recorded; those factors which are most effected by development street space strategy and management are identified for prioritization in future developments.

Chapter Six: aims to understand users' behaviors on an unimproved street space and highlights the positive and negative impacts of the environment on users; revealing the different types of environmental behaviors that need to be considered in the improvement process focusing on influencing behaviors through the built environment.

Chapter Seven: Comparing the difference between improved and unimproved streets in various aspects including users' behaviors, users' cognition and the environment-behavior relationship within street and surrounding; Identifying 8

physical attributes needing consideration during the street development process. Improved and unimproved street shares 2 attributes e.g. (a) shop-house relationship and nature proximity, (b) sidewalk accessibility and permeability. And it differs in 6 attributes e.g. on improved street that consists of (f) degree of coverage and relaxation facilities, (g) degree of walking paths and related paths, (h) distribution of street stalls; on unimproved street that consists of (c) degree of openness, (d) degree of connections, (e) degree of tidiness. Whilst the findings on users' perception on each type of street indicated that both physical and socio-personal factors significantly contribute to street space usage in different income groups. The lower income people reporting significantly much access to the street space than their higher income counterparts and the number of lower income people slightly decreases when the quality of street space is enhanced.

Chapter Eight: Concludes with a discussion of the implications of this study in the street space development, suggestions, prospect works and improvement process. The street space improvement may be a proper and affordable solution to fill the gap in open public space in urban area in developing countries like Vietnam. Therefore, it is important to examine further steps toward street space development and identifying factors for consideration in street space design, planning, management and policy development. For doing that, three approaches have been proposed including street design and planning handbook, street management handbook, and various association and information systems. The specific design and planning principles, regulations and concepts of street component e.g. buffer and commercial zone were explained and illustrated in design and planning handbook. The second handbook contributes principles, usage management by street's elements, maintenance managements and suggesting a new policy for the enforcement forces and punishment form for violators. Finally, the associations related to street's users need to be established that play an important role in public education. Indeed, the street space development and improvement process in Vietnam currently neglects the role of

users' participation, while users' awareness and satisfying their needs may work as the key drive to promote regulation compliance and development design and development plan. City planning and street space planning and design may have closely linkage that lies on relationship between residence-commercial/ trading place. It is important to figure out the key stone in city planning that contributes to the liveable community and strong social coherence.

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Chapter 1 INTRODUCTION

1.1 Background

Not only does urbanization benefit the growth of economy, culture and society, but it also becomes a threat. It is predicted that by 2050, more than two thirds of population will have lived in urban areas[1]. While many benefits of well organized and efficient cities are comprehended, developing countries necessarily recognize that the rapid and unplanned urbanization unfortunately leads to social instability, critical infrastructure, water crises and the devastating spread of disease which results from the unprecedented transition from rural to urban areas.

Vietnam is one of the most densely populated countries in the world. During recent decades, cities in Vietnam became the engines of economic development and rapid urbanization has been the consequence. Since urbanization in Vietnam has been accelerating recently, a UN projection suggests that the urban population will exceed the rural population by 2040[2]. According to the Vietnam Construction Ministry, Vietnam is struggling with many challenges caused by its rapid urbanization, which is among the fastest in the region. There is a total of 800 urban areas across Vietnam with a current urbanization percentage of around 37%. This figure is predicted to increase by 50% by 2025[2-6]. The Global Risks 2015 Report looks at four areas that face particularly daunting challenges in the face of rapid and unplanned urbanization: infrastructure, health, climate change, and social instability[7].

Unlike other countries, urbanization in Vietnam is indeed different, which focuses on the urbanization of land, the lower population density in urban areas and the pressure on productivity gains. The urban development that is based on the conversion of the current land with industrial zones has occurred due to demands and prompted the urban expansion in a small scale and urban decentralization. The urbanization process of land is believed to be the culprit of

the devastation of the natural environment which brings benefits for human and animals. Most cities in Vietnam all achieved no effective standard in open/green space area [8]. In response to these mentioned above issues, such urban open space as parks, street spaces, plazas, malls, and community areas are developed to overcome the open space shortage. Drummond (2000) examined the uses of the terms of public space in context of Vietnamese urban life and confirmed that street space shows a resurgence rather than a death of street life and a convergence with it in the construction of other leisure spaces [9]. Most human activities take place in street space either in which either allows interaction and transportation activities to occur, or through which urban images are perceived [10-12]. A massive range of activities in street space brings cities to life, but also bringing service functions into conflicts. Streets and their pavements have been encroached upon for various purposes that affect traffic safety as pedestrians have to cross the hectic road always full of motor vehicles. The street environment is also impacted by litter. The chaotic and irregular use of sidewalks for various purposes distort the visual view of urban areas, affecting the streetscape and image of the city. To address mentioned problems, municipal authorities have upgraded street space by expanding road-widths, arranging street furniture, building up more pedestrian paths, increasing the quality and area of pavement, with the aim of making street space tidy and more orderly. Also, the campaign namely “Returning pavements to pedestrians” has been deployed to remove or curb/control private uses of street space and pavements (Figure 1.1).

1.2 Definition of the Problem of Street Improvements

In many cities of Vietnam, attempts of the municipality to upgrade and expand open street space are seen the most feasible for meeting demands of inhabitants when the scarcity of urban open space still exists. The most recent attempts to improve and manage street space by banning private and trading activities from

encroaching on pavements have been undertaken; also, the government expects to establish the Western-like, modern and neat urban space. This has become a matter of controversy among Vietnamese scholars. It is true that different users may perceive space in different ways [13]; to illustrate, for designers, visual quality is often the top priority in building open space, while this element is frequently underrated by users [14]. Besides, some research proposes to base experience of Western countries on the street space design, with the aim of building pedestrian-friendly place and promoting social interaction [15]; however, other studies put emphasis on respect and preservation of street activities in Vietnam as part of cultural value and accepting such multifunctional space as a feature of Vietnamese cities [9, 16]. An emerging question is whether the improvement gives an advantage to quality of life or not. Do Think (2018) stated that residents often express their concern over physical settings in dependent street space regardless of whether the street is improved or not [17]. Therefore various issues have been still occurring within street space due to the lack of detailed research on the nature of urban street space, its management and regulations applied to urban street space design.

By the approach of the architectural planning research and environment-behavior studies, this research investigates the current situation of urban street space and improves the basis of urban street space facilities, going further to propose the proper solution to overcome the problems of the urban street environment and the quality of life in Viet Nam. Therefore, it is important to examine its effect on human behavior, operation, regulation and potentials prior to making further stages to develop proper improving solutions, and make sure the proper arrangement/ improvement of urban street space facilities prior to the wide implementation (Figure 1.2).



Original street Unimproved street Improved street Improved street

Figure 1.1 Renovation situation of street space in Vietnam

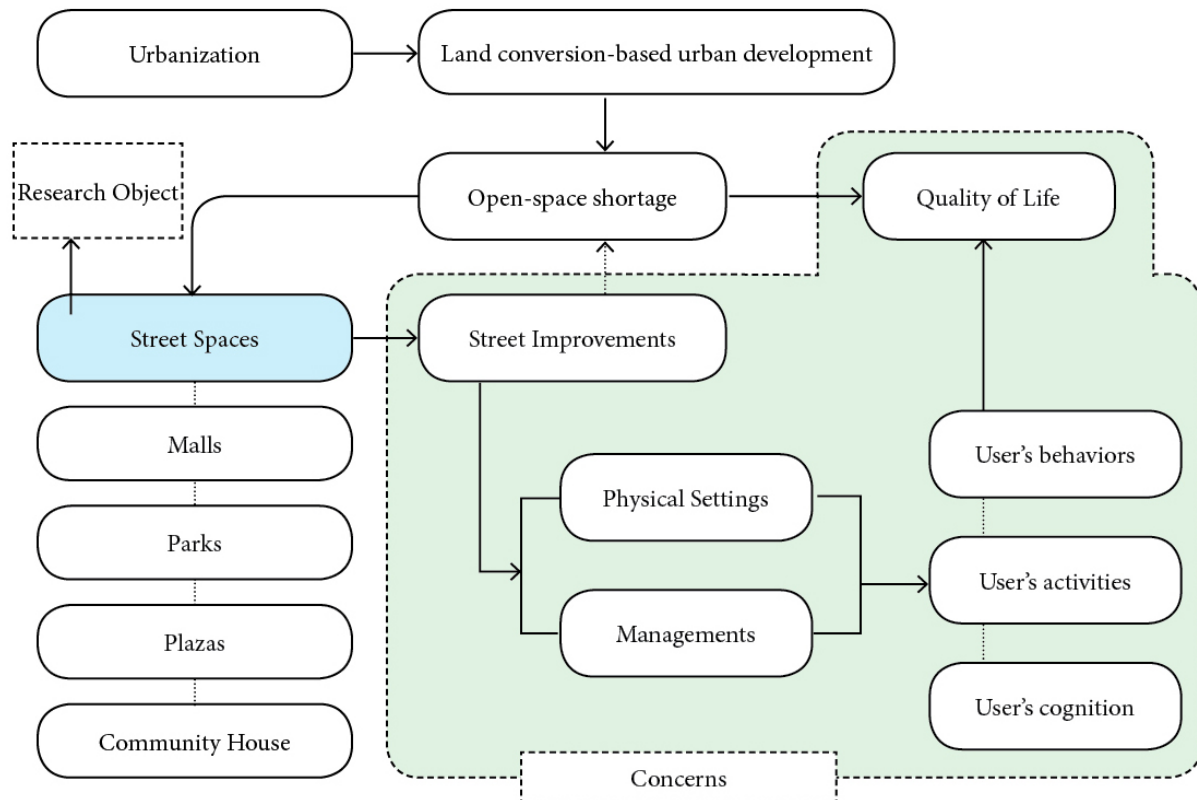


Figure 1.2 Main concerns and study object

1.3 The Linkage of Open Street Space to Quality of life

The term as “quality of life” has been used in various different fields, for example, from environmental science and health to social science owing to the impact of its complicated nature on human livelihood. This term gained popularity after the World War II in which the term referred to a “good life,” in respects of health, jobs, accommodation and visual art [18, 19]. The broad definition of the term stems from different definitions produced in different angles, as a result of

research by lots of scholars and its popularity. In term of social science, several variables (e.g leisure, wealth, security, employment, housing, education, family ties, cultural values, and community) are believed to closely relate to the quality of life [20]. In realm of health science, such issues as life expectancy, psychological wellbeing, prevalence of diseases, personal growth and access to healthcare are emphasized as relevant to the quality of life [21, 22]. Meanwhile, social science suggests pollution, waste management, and climate change as elements related to the quality of life [23-25].

Those distinct perspectives reveal the possibility that the quality of life is affected by different variables. Recently, it is admitted that green open space plays an environmental role in human life and studies on its relationship with the quality of life have made varied contributions to improving the quality of life [26-29]. Indeed, the quality of life is the outcome of the interaction of human and urban environment; also, how individuals satisfy with the environment is deemed one of indicators to measure the quality of life [30]. Public space is an important factor of urban environment, as its quality impacts on the quality of human life. Public open space that provides a place for many kinds of activities has a significant benefit to quality of life, especially in fulfilling inhabitants' needs in terms of health, relaxation and a good quality urban environment.

In addition to such features as greenery that brings recreational and restoration-related benefits, the public space facilitates many activities, which benefits the quality of life in terms of psychological and physical health, recreation and the fulfillment of the need for a pleasant urban environment [31]. The relationship between factors of public open space and quality of life was discovered by Chiesura (2003), Sugiyama et al (2010), Lynch (2007), Beck (2009), Quintas and Curado (2009) [32-35]. These studies were carried out in developed countries

which have a clear public-private space boundary. However, developing nations as Vietnam have the unclear boundary, especially in street public space.

When individuals use streets for regardless of trading activities to earn extra money, or non-motorized transportation like cycling and walking, or recreational activities such as having breakfast in pavement stalls, or even daily routine as dining and napping, it also builds up a vivid open space and promotes community connection and social interaction to make streets safer [36-38]. In this respect, this study aims to help urban planners, designers and authorities know how the street space improvements can support well-beings/ behavioral variables in active life style, social interaction and enhance quality of life.

1.4 Research Questions

How do added amenities into street space to support active life style, social interaction and quality of life?

Or How do improvements of urban street space support wellbeing in urban area e.g. active life style, social interaction and quality of life?

Above overarching research question are clarified in four sub-questions:

1/ What do people pay attention on street space ?

An investigation of the street space characteristics and users' concerns on urban street space was conducted. Before going further steps, clarifying the basic features of urban street space and understanding how people evaluate these spaces in order to filter out the risks and potentials for urban street space and to figure out different impact level of street environment factors to people attention behavior. The finding was published in Journal of Civil Engineering and Architecture 12 (2018).

2/ How do unimproved street space affect to people behaviors ?

A review on physical environment aspects, users' activities in unimproved street spaces (old streets) to understand its environmental behavior relationship. The

finding helps to clarify what should have been considered while developing the proper street space improvements solutions. This finding was published in Journal of Sustainability.

3/What difference in behavioral environment between two kinds of street (unimproved and improved street). This finding illustrates the changes of users' behavior according to street environment characteristics. Representative comparative study between unimproved and improved street spaces is conducted to reveal the influence of street modification on outdoor behaviors. The finding was published in Journal of Sustainability.

4/ Which type of street space environment including physical and non-physical affects users perceived accessibility/ usability?

Representative comparative study between unimproved and improved street spaces reveals the influence of street environment on users' cognition and their usage/ access. These will be learned through a crosswise comparison between unimproved and improve street space. And the findings will contribute to better improvements by extracting the good quality and correcting the bad side. This finding is expected to publish in Journal of Sustainability.

1.5 Purpose of The Study

The purpose of this study is to illustrate the basic characteristics of urban street space in Viet Nam and to propose proper solutions towards the improving urban street space. A further aim is to examine the ways in which street space environment characteristics can affected urban residents' behaviors and cognition in the contemporary urban street space of Da Nang. This study is among the first investigations on the street space in context of Vietnam and focuses on physical environment that affects perceived usage to street spaces. The first goal of this study is to identify users' attention behavior along the street space, and then focuses on investigating relationship between users' activities and street space

environment in old/ unimproved street space. Eventually, the study of the changes in behaviors and perceptions of residents about the current improved street spaces with widened road way; and/or higher quality of sidewalks; and provided street furniture/amenities (e.g. bench, greenery, walkpath, small trash bin and so on).

The research is conducted based on Environment-Behavior Research and Architectural Planning Research approaches that has long been a mechanism through environment, behaviors are influenced. Moreover, designs based on environment-behavior study can provide opportunities that contribute to, discourage various behaviors[39, 40].

Through mixture of qualitative and quantitative research methods, the data collected by using behavior mapping survey, visual encounter survey, capture evaluation method and questionnaires. Applying statistical analysis and studies can help to reveal the street space characteristics, the change of habitant behaviors and perceptions in corresponding to street space environments that can contribute for improvements and managements.

1.6 Scope of The Study

This research aims to examine open street space in Vietnam, and Da Nang city is selected as the site for case study. This city was chosen because the city was planned and developed with a mixture of various urban configurations that consist of Anglo-American ideas and Vietnamese contemporary urban development. Currently, this city still remains various streets originated from old design standards with original residences. Moreover, the street improvement campaign has just begun and some streets in the metropolitan area were completed the improvement processes. In addition, because it is the third-largest city located in the centre area of Vietnam and one of the fastest-growing cities with high flexibility in urban development policy and strategy, hence, choosing this city as a case study will have great potential of enforcement that may become a pilot for

other cities in Vietnam. These mentioned characteristics provide the positive outlook for the research to understand the mechanism of habitant’s behaviors changes responding to street environment modification.

Due to the large amount of street space, along with many intricate features, a semi-structured questionnaire was designed to sort out the candidate street spaces within six districts of Da Nang city. Based on the results of the survey and analysis using conceptual definition of street and statistical analysis, a total of 33 streets which high ratings were selected and classified into two groups of improved and unimproved street space based on current situation of upgrading street space policy of local municipality, and eventually, 8 street spaces were chosen for research survey (Figure 1.3)

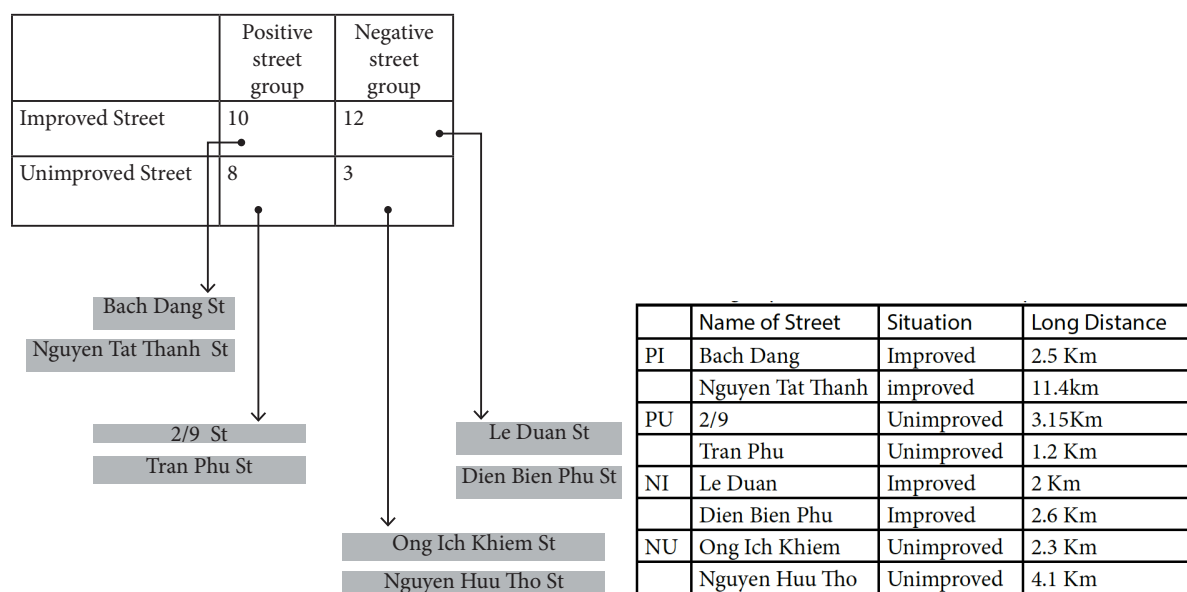


Figure 1.3 Street space was chosen after applying semi-structured questionnaires survey, extreme value analysis and sampling strategies.

On the first case study, 8 street spaces have been candidates for revealing people’s attention behavior/ concerns along the street spaces in both positive and negative sides regardless of different kind of streets.

On the second case study, 2 unimproved street spaces which consisted of Tran Phu St and Ong Ich Khiem St are chosen for revealing different type of behavior

setting and further understanding the relationship between physical environment and user's behaviors

On the third case study, because the purpose of the study is to reveal the change in behavior setting and people cognition between unimproved and improved street spaces, therefore, 2 kinds of street spaces are selected including Ong Ich Khiem St and Le Duan St.

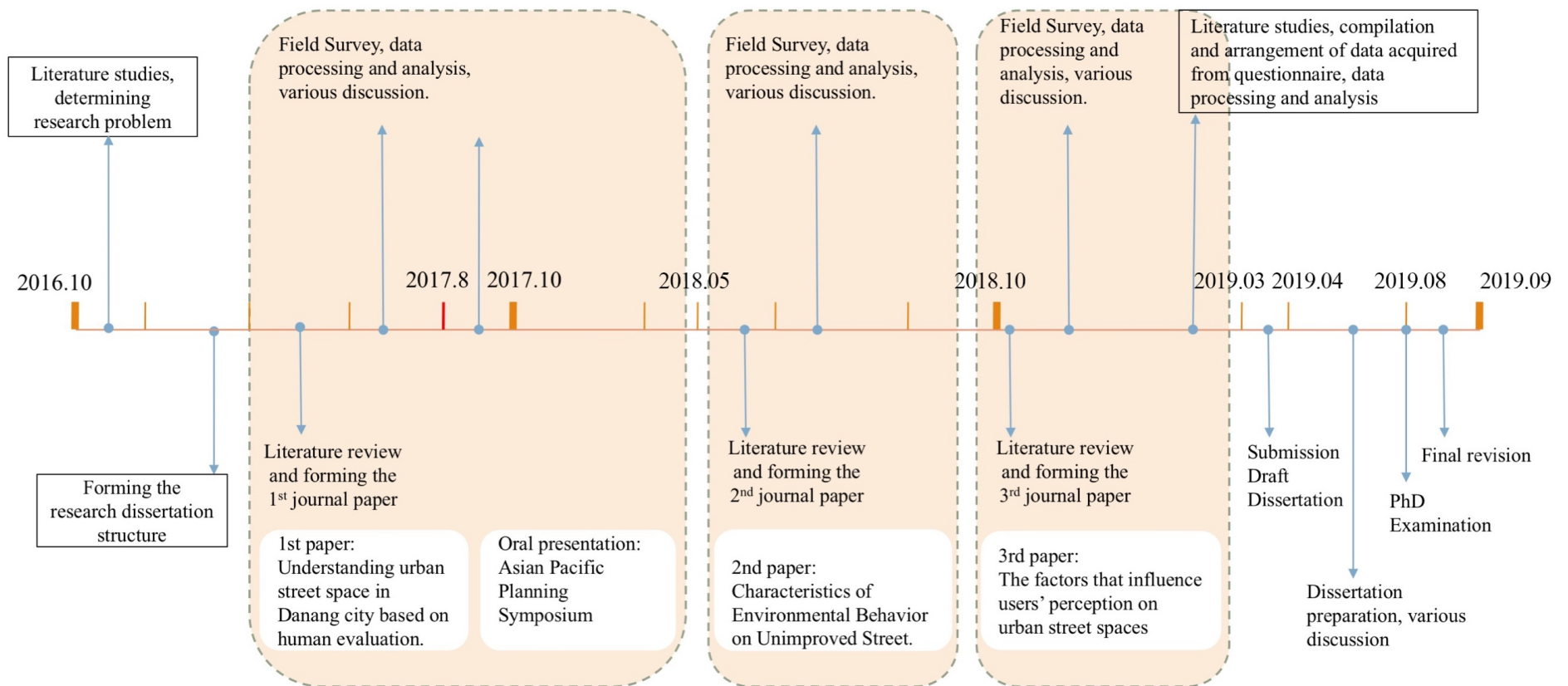
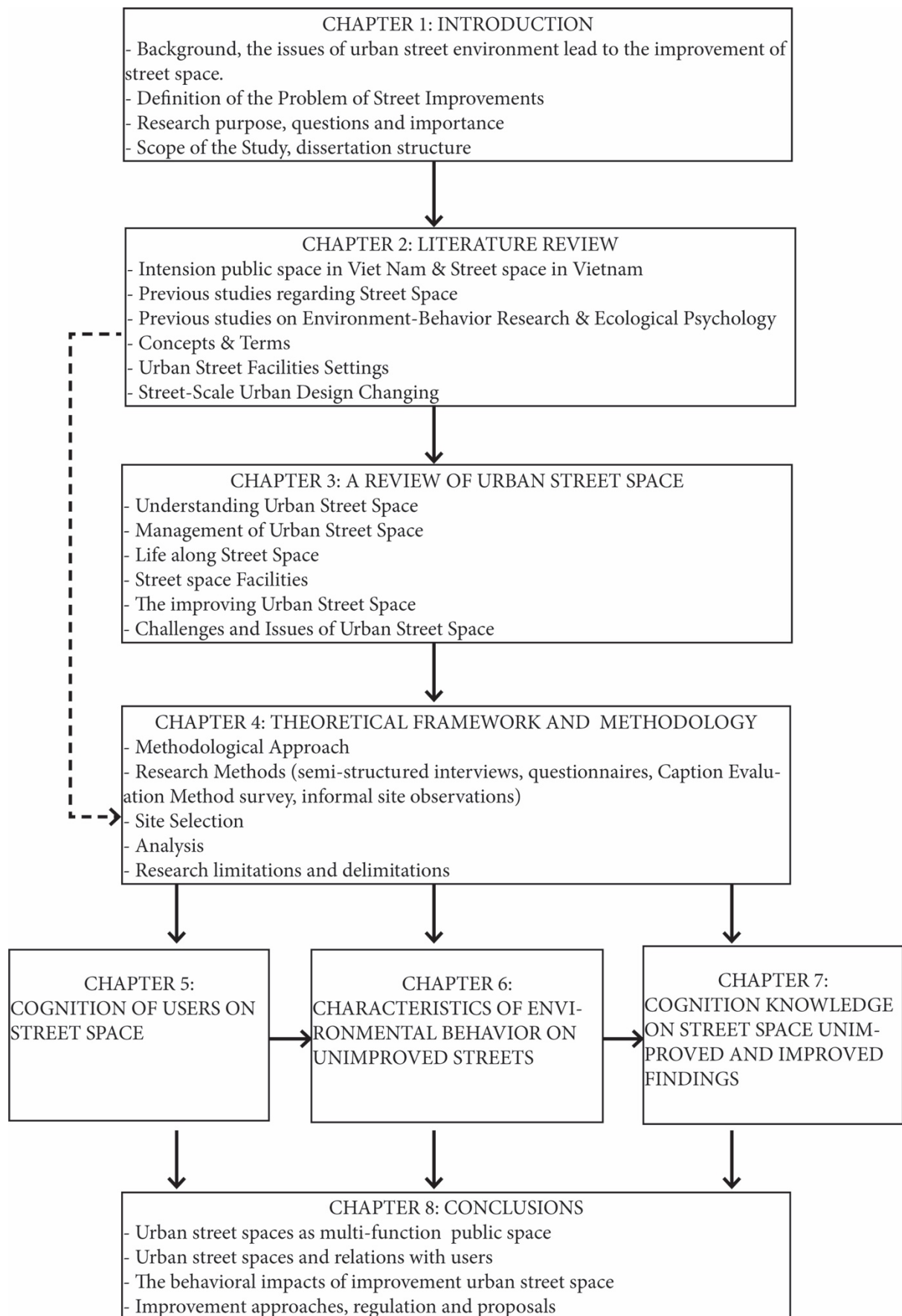


Figure 1.4 Research Timeline

1.7 Structure of Dissertation



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Chapter 2 LITERATURE REVIEW

2.1 Public Open Space in Urban Area of Vietnam

2.1.1 Public Open Space Situation in Vietnam

Public open space is defined as an open piece of land including both undeveloped or developed that is generally open and accessible. It is generally described as land or space set aside for the purpose of public relaxation and protection of unique, environmental, social and cultural values for existing and future generations.

Indeed, public open space is one of indicators that affect inhabitants' satisfaction of quality of life, especially in fulfilling their needs for health, recreation and a good quality urban environment [1, 2].

Viet Nam is one of Asian countries that have a high urbanization rate. In 2017, the statistics show that urban population in Vietnam constituted for nearly 35% [3]. The total population of Vietnam is estimated to reach 112.7 million in 2050 and urban residents account for a half of total [4]. It is agreed that urbanization will undoubtedly change the city and bring various potential benefits, if it has a good management; also, it can reach the higher productivity and growth by positive agglomeration effects such as larger or more efficient labor markets, lower transaction costs and easier spreading of knowledge. However, unlike other countries, Vietnam mostly focused on the urbanization of land, reduced urban population and suppressed productivity gains. The urban development that was based on the conversion from the current land into industrial zones happened ahead of demands and resulted in an increasing expansion of small-scale, fragmented cities. The urbanization process of land was believed to be the culprit of the devastation of the natural environment which brings benefits for human beings and animals. Indeed, after the 1980s, when the “opening up” policy was launched, cities in Vietnam developed rapidly; as a result, environmental

problems arose and led to the shortage of green open space in the metropolitan area [5].

Effectively, featured cultures and private economic models of Vietnamese people created a different urban form from that in western countries. Citizens prefer owning land lots that mostly lie adjacent to streets to facilitate the opening of shophouses to get profits. Along with the high population density in urban regions, the row houses are available in all parts of the city to meet residential needs, leading to the scarcity of green open space in urban areas [6]. According to statistics of the Department of Infrastructure and Ministry of Construction, the current greenery rate per capita in urban areas of Vietnam is one-tenth lower than that of the world. The inconsistent construction and planning of a city is one of the triggers that prevent urban open space from expansion. Also, lands for public space are increasingly scarce and always occupied for other profitable purposes. Current parks and public space are often encroached and exploited for wrong purposes and public services.

Previously, Vietnam has little history of public space; that is, the social context of that time was always influenced by the political power of feudal empires and only few public spaces à la Western style truly developed [7]. In recent years, recognizing the meaning and significance of open public space in Vietnam to the quality of life, authorities pay attention to increase the area of open green space in the city. Open public space in Vietnam can be developed and classified into two major groups on its service purpose in terms of sociological/political approaches[8, 9] (Table 2.1).

Table 2.1 A typology of urban open spaces¹

Public Open Space Categories		Examples	Functions
Sociological	Official level	Park, waterfronts, neighbourhood parks, sports field	Space for physical, relaxation or social activities
	Local level	alleys, playgrounds, local/street markets, pagodas, temples, and communal houses, streets, neighbourhood open spaces, plazas, found spaces	Space for social activities, relaxation and worship of the locality
Political	Official level	Square, monuments	Space of assembly for the community
	Local level	Public culture house	Space of assembly for the village community

The origin of open space, in the Western perspective, is associated with the concept of access to and exclusion from such space. In democratic social models, the state should make equality-driven space in which individuals all have access to any social status or economic condition. Such space is really shared by all people. Different social institutions in different historical periods would make such “access” to open public space be restricted and regulated in different ways and levels: particularly who are allowed to get in, which time and what they are permitted to do in such space. Open space, thus, is separately designed with different functions, purposes and access management. Squares in which large-scale political or social events with standard, major ceremonial often take place are the typical example of this formal open public space. Parks are also seen as formal open public space, yet still respect human rights of relaxation, exposure to nature and social interactions [9, 10].

2.1.2 Legal Bases on Open Public Space Planning, Design and Management in Vietnam

¹ Initialled from Urban Open Space (Mark Francis) - Advances in Environment, Behaviors, And Design, Vol 1, (1987)

In respect of state management, open public space has yet to be officially defined, mentioned or specified in constitutions or laws generally and technical regulations on architecture planning particularly.

In chapter II, section 2.3.1 in the Construction Planning Standards of 2008 (being currently modified), such functional areas as open public space are not directly mentioned, yet the part indirectly refers to “Construction sites for urban parks and flower gardens,” which are one of “functional areas” in a city [11]. This alludes to the natural open public space (parks or flower gardens) rather than political ones.

In section 2.4 of residential unit planning, section 2.4.1 requires “Residential unit planning should guarantee the provision of housing and daily essential services (preschool education, secondary education, information cultures, markets, commercial services, sporting activities, space for walking and relaxing, etc.) to residents within the walking radius of 500 meters to encourage the use of public transportation and walking.” In the part, open public space is only indirectly referred as “space for walking and relaxing” [11].

Section 2.4.2 regulates that “Houses should be decorated with flower gardens or playgrounds in the serving radius (calculated according to the nearest actual approach path) of under 300 meters” and “The public greenery area in housing units should be 2m² per person at least, each of which has the minimal greenery area of 1m² per person” [11].

In section 2.5 on the planning of urban service works, open public space is excluded in the list of open public space (including main groups as education, medical services, sports, cultural and commercial activities). There is no specific regulation, therefore, on the area of open public space at different levels.

However, in section 2.6 on Urban greenery planning, section 2.6.1 on urban greenery system combines green vegetation in squares, parks, flower gardens, walking gardens, etc. into a group of “Public greenery” whose targeted area per

capita is regulated specifically for each urban type: more than 7m²/ person in special urban area and more than 4m² in Type V urban area (Table 2.2)[11].

Table 2.2 The public greenery area outside residential units in urban area (Source: (QCXDVN 2008))

City Category	Standard Area (m ² /person)
Special (population ≥1.500.000)	≥7
I and II (1.500.000 ≥ population ≥ 250.000)	≥6
III and IV (250.000 ≥ population ≥ 50.000)	≥5
V (50.000 ≥ population ≥ 4.000)	≥4

Thus, the official planning system of Vietnam has yet to frame the concept of public open space; especially, there is no specific affirmation or presentation on planning or development principles for the official open public space that is deemed as political infrastructure, although political squares, in practice, have been still planned and built.

Open public space that is seen as social infrastructure is also mentioned as space for greenery with some sketchy requirements. That might be a reason why such space is often used to grow plants wherever possible. Such open public space on a planning map is often green space, then properly turns to grass beds, flower gardens or greenery areas in reality; those places, at some angle, are built in a very mechanical and short-sighted way which reduces the space use efficiency as it serves no daily activities of residents, rather setting up scenery and producing visual effects.

2.1.3 Public Policy on Open Public Space Planning and Management in Vietnam's Cities

Policy documents on open public space planning and management are primarily issued by the Government and Ministries (i.e. Ministry of Natural Resources and Environment, or Ministry of Construction) although municipal authorities in

Vietnam also introduce separate policies on open public space development and management. Collected policy documents on public space planning, development and management showed some positive and major changes in policies as to open public space in Vietnam. However, those changes can exert really positive impacts on urban development of Vietnam if they are seriously made. Also, coercive mechanism is required to ensure the implement of such positive policy changes in urban areas.

- (1)Policies have been more specific in respect of terms and contents;
- (2)Vietnam’s planning models have automatically approached the public space planning;
- (3)Policy makers recognize that urban areas and city dwellers need public space;
- (4)The quality of public space has paid more attention;
- (5)It is acknowledged that protecting such space from being degraded and encroached is necessary.

Vietnam’s policy framework for public space still has some limitations. Recent policies have more specific solutions for the public space planning, but too many different concepts of public space that coexist in official documents lead to no official definition of such space in urban areas of Vietnam. In addition, various old, two-sided and functionalism-driven planning methods that are based on indicators and targets are still popular despite many attempts to the more systematic introduction of public space planning and management methods. Finally, the policy framework took urban design into account yet, apart from the aesthetic dimension of public space, still considering other aspects of such space. This would help build a lively open space which is accessible to as many residents as possible, effectively used and safe for even the most vulnerable individuals [12].

2.1.4 Profiles of Different Types of Open Spaces

Urban open space is defined as publicly accessible open places designed and made for human activity and relaxation that is widely accepted. This definition is initiled from the work of Lynch (1981) who reckons that open space is open when it is accessible[13, 14].

The concept that public space is deemed as social places is not new in Vietnam’s urban planning. As shown by research of Stephanie Geertman and Julie Ann and her colleagues [15], the definition was introduced in Vietnam during French colonial period and has then become a part of architecture and design from that time until the socialist period now. However, in fact, both professionals and Vietnamese citizens often base the separate, more direct name of such places as parks, flower gardens, squares, lakes, pavement or markets on their functions, rather than using the common tag “public space”. Yet in general, public space is understandably distinguished from private space in respect of space owners. However, in Vietnam, boundaries between public and private space are pretty blurred, as the former has been deliberately privatized by users who often do daily activities there. In this way, public space is occupied for private activities that negatively affect the necessary activities of the community e.g. on the street, shop-owners occupied the sidewalks for their business that affects the pedestrian. Consequently, social, cultural and even business activities invade such official public space as pavement, streets, parks and monuments in different ways – thus building a city with boldly public nuance [16].

The term “public space” is officially defined as works or sites that are owned by the Government on behalf of citizens, and include such space accessible to all residents as public streets, pavements, parks or public library. Also, “public space” is commonly defined as wherever residents can gather, including private-owned places like shopping malls. Many of the above works are truly open space to serve the development of social life in urban areas, yet some restrict personal freedom [17]. Urban public space is meant to hold common activities of community, or denominated as space for community communication. Professor

M. Douglass [18] prioritized the use of the phrase “citizen space” to refer to wherever citizens can freely gather, community groups become visible and all people can exercise their citizenship. It is where social activities take place in a more open and accessible way, including public space inside and outside.

In short, public space could be categorized based on four following approaches: (1) Classification by scale in cities, including urban region scale, residence scale and building scale; (2) Classification by legal basis, including government- and private-owned public space; (3) Classification by the use level² including public, semi-public, and private space; (4) Classification by the legal level, including formal and informal space.

On the table 2.3, various kinds of open space in the urban area have been categorized and summarized.

Table 2.3 Open space classification matrix

		Outdoor	Indoor
Sociological	Official level	Park, waterfronts, neighbourhood parks, sports field	Commercial park, plazas
	Local level	Alleys, playgrounds, local/street markets, streets, walking street	Pagodas, temples, communal houses, church
Political	Official level	Square, monuments	
	Local level		Culture house

² As classified by [19] O. Newman, *Defensible space*: Macmillan New York, 1972., it still depends on the use level of a whole community or any certain individual.



Figure 2.1 Various kinds of open space in Vietnam.

2.2 Previous Studies regarding Street Space

2.2.1 Developing Street Space

The evolution of public space and the spatializing theory of Henri Lefebvre³, public space is constantly evolving into varied types with different standards and new design to meet the development need of society [20]. In Vietnam, public space can evolve from such basic forms as markets, streets or squares to others like parks, playgrounds, flower gardens, shopping malls, walking streets, sky gardens, riverside paths and so on. However, public space has been incomplete to satisfy the need of residents. Furthermore, there is no spatial linkage, and reasonable or suitable distribution for urban structures and development. Public space is not considered an open space system that is uniformly planned and constructed open space to serve common activities of a city; most of which still

³ Spatializing theory of Henri Lefebvre, a French Marxist philosopher, is highly regarded as an inevitable theory to explain the evolution (expansion and change) process of public space and interactions between society and public space.

take place in street space [7, 9, 21]. Owing to the urban land scarcity, using street space as urban open one is an affordable solution. Taking advantage of this merit, authorities have upgraded and improved street space in order to attract human activities and alleviated the shortage of urban open space. Moreover, the renovation of street space aims to create friendly space for pedestrians and encourage physically active lifestyles. The action is performed through new construction or several stages of upgrading in different areas. Having said that, the effectiveness of the project is still an unanswered question.

2.2.2 Previous Studies

Until now, quite a lot of research as to street space originates from developing countries. Particularly, just some of which investigates street space in Southeast Asian nations.

Ming Shih Chen (2016) discussed factors along streets in Taiwan that had attracted residents and tourists. The findings showed that the rules for public and private realm should be established based on the concept of co-existence in order to create regional characteristics, attract tourists and enhance the potential of revisiting. Moreover, this research drew out four main points that needed to be considered; they included local activities, public facilities, street landscape, and various types of stores[22]. In addition, Lee (2015) explored how pedestrians got store-related information when walking on commercial streets. This article proposes the proper methodology for sequential analysis to describe the characteristics of a commercial street by examining the relationship between the business type of store and street that is the most influential determinant of the ambience on a commercial street[23]. By another approach, Lee (2013) studied the impact of ubiquitous street furniture on users' behaviors. The findings showed that the demand for ubiquitous street furniture like media poles was increasing, and the visual aspect and functions had the most distinctive impact on user's

behaviors [24]. Another study of Tsai (2016) aimed at walking space and living path of elders along the street. The findings also showed that different groups of elders required different features of street environments. Thus, the setting and improving of various urban resources in social, optional, and essential terms can satisfy different clusters of elders[25].

Much research explored variables that affect human attention to street space and exist in such typical streets as tourist and commercial streets; or focused on the impact of particular elements on street space to find out the interplay between human beings and physical environment around streets. Meanwhile, research on common street space that serves all activities in Vietnam has not been conducted. When it comes to this issue, Espina (2018) revealed the relationship of user's behaviors with street environment. The findings showed that the street could be classified into distinct zones, and even shared by flexibly accommodate both behavior settings and vehicular traffic at different times [26].

It was discovered that a variety of activities that took place in typical street space in developing countries were distributed to different areas and classified into varied behavior settings. This is also a scientific basis to consider how to adapt the development of street space for use characteristics of each nation and local area.

Lemya Kacha (2015) explored users' cognition towards streetscape in different cultures that keep different perspectives in environments [27]. Rahman (2015) examined the factors that encouraged people to use urban streets. The findings showed that various factors such as attractions, activities and reasons for using streets, proximity, familiarity, congestion, greenery, public amenities, maintenance, the distance to public space and freedom of action affected the street use of residents. Moreover, the attributes of each factor were different in varied contexts [28]. Another study of Iderlina (2007) discussed street space design and management in Asian countries that encouraged the automobile use without sufficiently considering other street users. Moreover, this study analysed the

relationship between Asian society and cultures in using streets that contributes to sustainable development of street space [29].

These studies show the importance of cultures and social context when it comes to their impacts on human activities in the space. Having said that, developing countries, with the same socio-economic context, differently use street space. In addition, distinct modes of transportation and urban forms also affect human behaviors and activities.

Meanwhile, research on street space is still limited. Drummond (2000) described the boundary between public and private space of streets, which keep Vietnam's streets lively while other developing countries are in attempt to find this precious value [7]. Vietnamese scholars have just paid attention to street space and pavement in recent years, and their research is already limited to framing the concept of all urban open space and having the general orientation for the street space development. Thus, street space in new urban areas only looks newer, but not more appealing, convenient, effectively exploited or safer than old one [30]. Also, there is not a full awareness of the importance of streets and pavements; design standards are fairly old; design approaches are stuck in a rut and seem unrealistic; similarly, there are not appropriate models for political, cultural and socio-economic context of Vietnam.

2.3 Environmental Behavior Research

2.3.1 Architectural Planning Research and Environmental Behavior Study

The ever-built environment that involves architectural planning is naturally deemed as a mechanism through which human behaviors are affected [31]. In accordance with environment design and planning, some certain types of

behaviors can be promoted, discouraged or even inhibited, yet still associated with people's activities [32].

In-depth research on “Architectural planning,” or commonly known as “kenchiku keikaku” in Japanese has drawn much more attention from architecture experts in Japan. The groundwork for “Architectural Planning Research” (APR) is mostly limited to the academic scope of the Architectural Institute of Japan (AIJ). Rather than entailing art and design as in Western countries, the focus of the architecture field in Japan is on engineering; in other words, the definition of architecture and its relevant research also cover technological aspects [33]. Obviously, the high frequency of natural catastrophes in this country requires architecture designers and planners to look at both aesthetic and technological issues about how buildings withstand such disasters. That is why architects have to take all necessary technologies during construction into consideration [34]. Three main domains are included in APR as follows: (1) production technology (e.g. design methods, construction planning and management); (2) life and space related studies categorized by different types of architecture based on a science-impacted mixture of economics, sociology and ergonomics; and (3) fundamental issues of any building (e.g. design-related theories, human behaviors, security and safety). Nevertheless, instead of addressing architecture-involved problems, the concentration of most studies is chiefly on the “plan's” configuration as many academics in different societies change their interests; for instance, AIJ attempts to deal with sociocultural issues rather than undertaking multidisciplinary research [33].

The purpose of Environmental Behavior Studies (EBS) is to understand the relationship between human beings and their surroundings; also, EBS mentions a wide range of such environment-related concepts as natural environment, social settings, and already built environments. This field focuses more on values and problems yet its research still prioritizes solutions to environmental issues by considering individual's well-beings in his society. In accordance with the

developed model of people-environment communications, environment-related conditions in which human behaviors will take place are predicted; additionally, they can help to anticipate results of decisions as to design, development and improvement, concurrently determine conditions and related issues. EBS's multidisciplinary features have drawn much attention from psychologists, economists, geographers, educators, architects and even policy makers. Each field will make different contributions to the growth of EBS through relevant studies on relationships between environment and behaviors, between human and environment, and on eco-psychology, or known as "environment psychology".

Architecture Planning Science has long developed since the late 1920s and achieved certain success. Later, Fujii and Yokoyama commenced their large-scale work on "the anthropometric nature of the human body" after being profoundly influenced by temporary architecture styles in Western areas, especially from Klein (1972) [35] [36].

Furthermore, another perspective of Yasumi Yoshitake on architectural planning showed that research was seen as a direct way to judge design. Yasumi also used various scientific methods and chose public institutes (e.g. hospitals, schools and libraries) as research subjects. His research methodology, which focuses on the purposes of the space, highlighted the significance of understanding what it is currently used for by conducting field survey to explore the balance point between the researched space and participants. Accordingly, if the imbalance occurred, it meant the appearance of difficulties faced by users when they used such space [37]. By 1950s, Adachi, who primarily based his research on the architectural philosophy strengthened by research on human race and social science, pioneered studies in attempt to understand basic qualities of human from a psychological angle. Moreover, his studies were conducted in terms of social

science, yet unsuccessfully further developed until the EBS introduced in Japan in 1970 rendered his research more attended [33].

Environmental Behavior Studies (EBS) aims at discovering how environments are linked to human behaviors, and showed interactions of human beings with surroundings and demands. For this case, EBS would be applied to architectural planning or design, particularly relevant knowledge were used during the design process. Apart from measurable issues and functions, EBS in architecture also looks at users' psychology, social interactions, types and meanings of buildings/space, aesthetics and technology. In fact, function is linked with human needs and behaviors; aesthetics is related to their perspectives, interests and experiences; and technology can deal with concerns about perspectives of structural expression [33].

As described in Table 2.4, Funahashi explained how Environmental Behavior Studies (EBS) differed from Architectural Planning Research (APR) [33, 36]. According to the traditional APR, design projects are environment or architecture oriented, and they regard physical parts of settings as elements to exert intended effects on people's behaviors [38, 39]. The transactional perspective explains that design can be deemed as planning a whole system which even covers people's daily life. Meanwhile, the environment-based design should become a vehicle to improve people's awareness.

Rather than giving direct resolutions to design, EBS often bases directions and principles on attempts to understand the human-environment relation, and focuses more on enhancing the living quality through improving the environment. For this case, EBS examines this relationship in the transactional term, which means EBS aims at active participation and interruption of human beings and in respects of physical features, functions and the way environments are perceived [33].

Table 2.4 Differences in characteristics of Architectural Planning Research and Environmental Behavior Study

	Architectural Planning Research	Environmental Behavior Study
Usage assessment	Usage purpose: Generality oriented, tolerant indirect intervention.	Post occupancy evaluation: Facility-oriented, Toward problem improvement
Concept	The concept of life: Based on the functional aspects, focused mainly on the everyday activities among types	The concept of behavior: Involving functional aspects, and psychology, subcultural difference, meaning and symbolism of environment
Environment	Architectural Environment including physical/ spatial factors i.e. form, shape, dimension, architectural/ spatial components	The entire environments consist of physical and social-culture aspects.
Human environment relationship	Deterministic/ interactional	Transactional

2.4 Improvement Streets and its Emerging Trends

The road network of Vietnam has been designed and developed over decades, with its reasonable distribution by region. Until now, it has a length of 256,684km in total, including: National highways with the length of 17,228km (equivalent to 6.72%); provincial roads with 23,520km (9.04%); urban roads with 8,492km (3.31%); district roads with 49,823km (19.4%); service roads with 6,434km and commune roads with more than 150,187km (the rural road network with 201,010km, equivalent to 78.38%). The road density to the country's land area is 0.78km/km² and to the population is 3.09km/1000 people; both of which were recorded fairly high compared to other countries in the same region. However, if only national highways and provincial roads were counted, the rate would be still very low [40]. Effectively the road network has yet to meet requirements of the socio-economic development, for example, roads are still narrow and of low quality; a number of personal vehicles increase too significantly while they are hard to control and still a main means to travel in all Vietnam's urban areas. So

most streets are still designed solely as conduits for traffic, while other dimensions of human behavior are ignored [41]. The lack of opportunities to support activities of all users has spawned a growing movement across Vietnam to reclaim, redesign, and expand the functionality of streets [40]. It is commonly known as the ‘street improvement’ movement [40].

In fact, the street renovation in Vietnam has not been officially regulated, concurrently the concept of a “complete street” has yet to be specifically and officially mentioned or defined. The street improvement takes place based mainly on foreign ideas or regulations. According to the US National Complete Streets Coalition (2011), a complete street typically includes sidewalks, bicycle lanes, shared use path, designated bus lanes, safe and accessible transit stops, and frequent and safe crossings for pedestrians, which consist of median islands, accessible pedestrian signals, and curb extensions [42, 43]. A complete street in a rural setting may look quite different from one in an urban or suburban setting. For example, the former may involve providing wide shoulders or a separate multiuse path instead of sidewalks. The common element is balancing safety and convenience for everyone using the road [44]. However, due to financial constraints as well as differences in traffic and urban forms, the urban street renovation in Vietnam just met some criteria of a ‘complete street’ which are applicable, affordable and suitable for the current situation. Meanwhile, other street spaces simply operate as a place for traffic with narrow or no pavements. The general requirement for the street improvement is providing street space and related infrastructure to address such problems of traffic participants as congestions, sidewalk encroachments, safety, low quality of pavements, and unattractive space. Each complete street has to be customized to characteristics of the street area it serves [43].

Apart from standards issued by such agencies as the Ministry of Transport and the Ministry of Construction to regulate the development and planning of urban street space, related departments at the local/ city level in Ha Noi capital or Da

Nang city also collaborate with international organizations like JICA (Japan) to research and put forward some urban planning and developing solutions which tend to support the ‘street improvement’ movement and provide more transportation choice [45, 46]. These agencies support existing communities through transit-oriented, mixed-use development and land recycling, and value communities by investing in healthy, safe, and walkable neighborhoods.

When taken simultaneously, these solutions and proposals provide alternatives to the motorized transportations and promote more multifunctional, pedestrian-friendly street networks. Pedestrian-friendly networks would increase opportunities for active/non-motorized transportation and social interaction. By offering these opportunities, streets can be used to enhance the quality of life in terms of psychological and physical health, recreation and the fulfillment of all street user’s demands for a pleasant urban environment as well as reduce cardiovascular diseases, and certain cancers and improve psychological well being [47, 48].

Street improvement campaigns are rapidly increasing across the nation for adapting to the urbanization and high population. Currently, this policy has been mostly implemented by local authorities in such metropolitan cities as Ha Noi, Da Nang and Ho Chi Minh city to improve street space. Any street improvement solution or strategy is all drawn up for different urban contexts, concurrently, the management methods of street and pavement space are also proposed and devised. In 2007, a campaign, often known as ‘taking pavements back to pedestrians’, was organized in Ho Chi Minh city, followed by Ha Noi, Da Nang and Nha Trang; particularly, it aimed to impose a ban on encroaching activities of street vendors which restrict social activities and movement of pedestrians on pavements. However, it failed due to a wide range of pavement-related factors as explained by domestic scholars that this use of street pavements was part of the living habit; the so-called “pavement culture” of Vietnamese people is closely tied to the concept of “economic pavement”, both of which make a distinctive

characteristic of Vietnam's cities [49, 50]. The increasing number of cities and jurisdictions effecting the street improvement adds growing requirements to empirical research on how improvements of urban street space support behavioral variables, social interaction and wellbeings.

2.4.1 Previous Study of Street Improvements

Inevitably, street improvements have affected active transportation, the possibilities of waking and pedaling, and social interaction. Some empirical research as follows discussed urban design on street scale which determined impacts of street features on behaviors of pedestrians and cyclists.

Research of Appleyard (1981) on three residential streets in San Francisco aimed at examining how traffic, air and noise pollution influenced on human behaviors in social, environmental and psychological terms. The purpose of interviews and observations was to determine five following issues: (1) traffic-related problems, (2) strain due to air and noise pollution, (3) neighboring and visiting, (4) a sense of territory and privacy, and (5) self-realization of environments [51]. Based on research findings, traffic levels and speeds could separate areas within a city, make neighbors less socialize, and weaken street functions for non-motorized activities. Accordingly, street design should be considered in many aspects, while traffic calming mechanisms potentially encouraged pedestrians and bicyclists to use streets and improved the living quality of inhabitants which inevitably involved social capital. Lower traffic levels can enhance the living quality and vice versa [51].

A pre-post study undertaken by Painter (1996) in Metropolitan London investigated street lighting improvements in three different spots and a pedestrian-only path within six weeks to examine how they affected a number of users in those areas at night. To assess this, attitude and behavior based solutions that were proposed by before-and-after surveys on pedestrians were applied [52].

Those investigations were conducted on streets six weeks prior to and after improvements. This surveying time was short enough to diminish effects of such environmental variables as climate conditions on behaviors. A group of researchers from different governmental agencies carried out light improvement in crime- and danger-prone areas to encourage more users to walk at night. Results showed how successfully the improved lighting systems dealt with dangers and criminal activities, with an increase of more than 50% of pedestrians in such zones.

This came to an obvious conclusion that reforming lighting systems on streets can fortify more individuals to walk at night [52]. The addition or upgrade of physical objects (e.g. lighting systems) on streets could increase affordances of residents who in turn used streets more. Accordingly, what this study found can support actions of encouraging self-propelled modes of transport and social interaction at night by improving streets. Yet the investigation that was carried out six weeks after street improvements pointed out unusual features of this activity. Also, different interviewees were chosen before and after those improvements, and their responses could depend on different factors.

Social behaviors and the living quality are also influenced by physical factors of streets. In 2009, research of Mehta on three surrounding commercial streets in Cambridge, Massachusetts used behavior mapping method, observations and perceptions of interviewees to identify influences of street's physical factors on social interaction [53]. Accordingly, such elements as seats, pavements, tree cover, facades and permeability of buildings were all important. Street space settings which have a certain level of liveliness, or in other words, attract human activities, often receive more attentions from users. A street's liveliness is frequently used to assess the quality of life [51, 54]. Also, individuals and societies differently define "the quality of life" which yet involves social interaction and milieus, especially regarding streets [55][54]. Jones (2012) researched how behaviors influenced on urban street improvements (e.g. in such

physical terms as cycle paths, zebra crossings, shelters and road diet) in the United States [56].

As shown by mentioned findings, physical factors of a street possibly give a pleasant and important space to users of commercial streets. Small-scale properties of a street space can be put together to form patterns of human activities which are precondition for the street's "liveliness" to increase the street use of pedestrians. Despite such small-scale physical features of streets, the research of Mehta involved no physical factors of improved streets in Vietnam's context of socio-culture, politics and economy.

The impact of environmental convenience and aesthetics on physical and mental health was also studied by Ball, Bauman, Leslie and Owen (2001). From data collected from 3,392 randomly chosen Australians in a telephone survey, this cross-sectional research was carried out and entailed such variables as "A park or beach is within a walking distance" or "A cycle path is accessible." Approximately 40% of survey participants lowly appreciated the space's convenience or aesthetics and less did exercise than ones who highly rated those factors [57]. According to Booth, Owen, Bauman, Clavisi and Leslie (2000), over 60-year-old Australians gave high ratings for suitable places for exercise and entertainment as they facilitated their walking, cycling and provided positive space for more social interactions [58]. Concurrently, research findings showed that neighborhood security and approach to local amenities were vital indicators for the increase in human activities; Weinstein, Feigley, Pullen, Mann and Redman (1999), Hovell, Hofstetter, Sallis, Raul, nad Barrington (1992), and Hunt and Abraham (2007) proved this as well [59-61].

In general, such urban design modifications in a street scale are prerequisites for follow-up studies on small-scale physical characters of street space that have profound impacts on behaviors. Based on above findings, this research will

examine behavioral elements of active lifestyles, social interaction and the living quality supported by facilities or modifications of urban streets.

2.5 Danang Urban Street System

Vietnam's urban areas have begun to upgrade and renovate street space. Streets were actually built up in accordance with old standards in French or American colonial periods, in order to serve Vietnam wars and mainly function as a means to commute. This previous intent of use did not meet demands of modern cities with the high population density and high use of motorized vehicles. Cities previously had the lower population density; moreover, citizens at that time rode bicycles and walked, so roads were narrow without any street furnitures and simple pavements. The upgrading of Vietnam's street spaces included two main steps. The first stage is embellishing streets by such installation of common amenities elsewhere in the world as paving sidewalks, arranging signs, traffic lights, and street lights, and drawing parking lines with pedestrian crossing. This stage is mostly complete for urban streets of Vietnam. However, the second stage focuses on expanding streets, pavements, enhancing pavement quality by using higher quality surfaces finishes, growing trees, arranging visual objects, benches, putting trash bins, decorating with greeneries, drawing parking areas/ lines and banning or managing vending/ traditional trading/ private activities; those actions have gained growing popularity and then some achievements in certain locations. Da Nang city was originally a colonial urban area, then becoming a military center during the Vietnam war, yet being less developed in the subsequent period. After the 1980s, the "opening up" policy was launched, and cities in Vietnam developed strongly; and Da Nang was no exception. After 1997, Da Nang became one of the major cities of the country and the planning booming really left a significant impression. This period was divided into two stages: the first one focused on splitting plots to exploit property, and the other one paid more

attention to urban landscape and amenities; it means that the rapid decline and significance of natural areas, as well as effects of the urban sprawl have been unprecedented [6, 62]. With the potential economic development, the population is predicted to double to about two million by 2030[63]. Attempts to accommodate a growing population led to environmental problems that resulted in the shortage of green space in the metropolitan area[64]. Therefore, the city government launched a campaign to improve the public space by expanding and upgrading roads and street space; setting up such physical elements on the road as planting more trees, imposing parking rules, making seat arrangement, setting small trash bins, bus shelters, providing small green public space, footpaths on sidewalks, decorative art objects, and decorative lights, etc. instead of the former street space that was merely for the traffic function.

There are many different definitions and classifications of streets; many of which have different meanings, and are inconsistently applied. The most notable is Rykwert's theory that was based on classification of three different street groups[65]. Meanwhile, Moughtin defined street as a place to allow movements to destination, the circulation of commuters and goods by motorized vehicles, animal traction or by walking, fast moving or heavy mechanics with all its technical requirements, and it is a relatively wide road in the town or village but different from a lane or alley [66].

Several authors have defined the boundaries between the built environment and the public realm, such as Lynch (1994), Eisner (1993) and Gallion (1963), but the hierarchical classification of a street that divides it into four levels of complexity is widely accepted. Those four levels are: minor streets (loops or cul-de-sacs), collector streets, major arterials and freeways/highway.

Except for freeways/highway, the other three groups of roads support traffic-free pedestrian streets which have the greatest potential to support human activities and social interaction. These types of streets may also be named according to their

function as the roads of residential areas, riverside street, tourist street etc. to form a strict hierarchy of streets with the great importance in street design and analysis.

2.6 Theoretical Framework of The Study

A built environment theory asserts that the form and content of the built environment significantly affect human behaviors [67]. The effects on behaviors provided by the built environment are seen as affordances of its environmental attributes [67]. The proxemics is the understanding of space in the holistic sense, as well as the cultural association people place upon space[68].

A review of existing literature on street design and behaviors indicated that streetscape characteristics can influence behaviors by affecting opportunities for active transportation, social interaction, and the quality of life [32, 51, 54, 69]. The influences of three theories constitute the main focus of this study: (1) Behavior setting theory [67], which addresses standing patterns of behaviors in physical settings; (2) Concept of Affordance developed by Gibson [70], which explains how humans (agents) respond to opportunities afforded by the physical environment; (3) And the proxemics theory of Hall studies how an environment, at the interactive and interpretive level, is bestowed with meaning by people in daily life [68].

The aim of this study is to investigate how behaviors changed in the behavior setting of an urban street in response to improvements to the street environment, which improved various activities and non-motorized transportation and reduced negative driving behaviors. Modifications included walk path, pedestrian crosswalks and the widening of a street and its sidewalks, amenities setting and so on. Figure 2.2 depicts the conceptual framework of the study. This study aims to determine behavior settings and variables of improvements on users (perception and use). Improved affordances for all users help create a more

walkable and livable street space. Streetscape modification variables and street users are defined as the independent variables. Active transportation, social interaction, public health, and quality of life variables are defined as the dependent variables (outcomes).

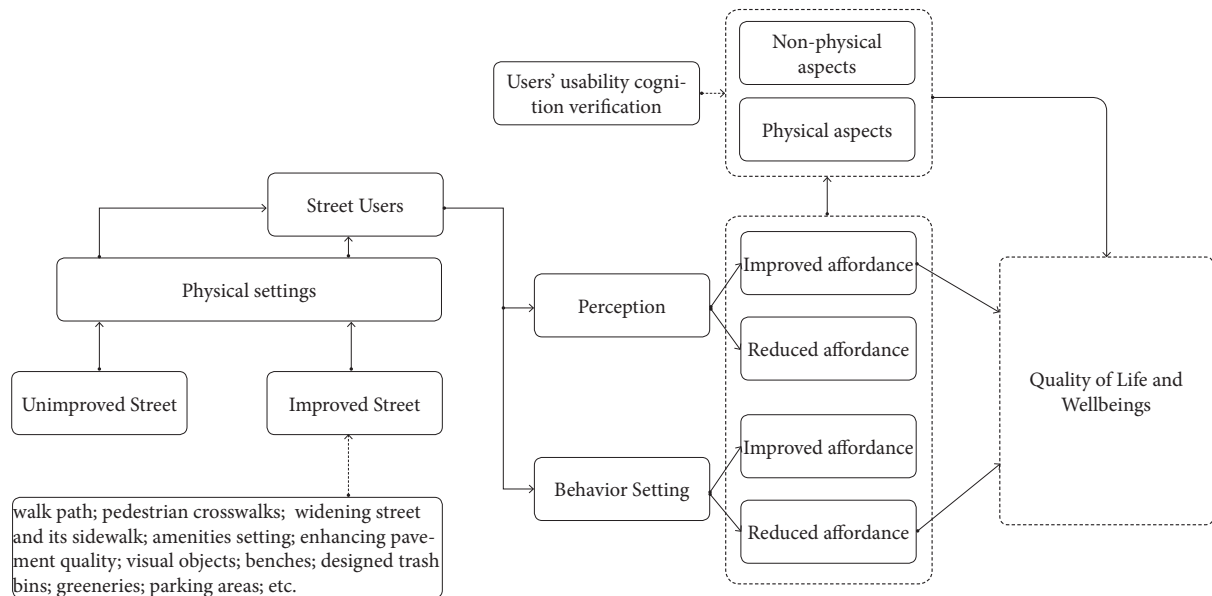


Figure 2.2 Conceptual/ theoretical framework of the research

2.6.1 Behavior Setting and Behavior Studies in Street Space

Based on the concept of behavior settings by Barker (1968), the existence of an observable environment is not tied to psychological processes of a particular individual [67]. Accordingly, a behavior setting is seen as “a standing pattern of behavior synomorphic and circumjacent to the milieu.” In other words, a behavior setting includes the standing pattern of a behavior related to a certain place at frequent intervals [71]. It is easy to observe and recognize those behaviors as normal events in a person’s life [71].

A behavior setting exists independent of neighboring behaviors and context [71]. Human is a setting’s variable that can be replaced and changed; it means that who participates in streets is not more essential than whether or not each important zone in the setting is set up[71], for example, how individuals worship at a church

or children perform in schools. Such patterns are established by space where people stay. Particularly, the church is an objective, perceptible place that is unaffected by any psychological significance of parishioners [71]. This also applies for schools. A school is an objective facility free of perspectives of any students [71]. Both students and parishioners react to objective factors of two given places. Despite different actions of each person in given settings, common behaviors to environments still occur [72]. Accordingly, the synomorphic relation indicates the compatibility of the behaviors and objects [72].

A theory of behavior settings in the realm of ecological psychology demonstrates various impacts of the geographical and physical space on human behaviors. In behavior settings, “focal points” – the most visited places by the greatest number of individuals in all kinds – are used [72]. A behavioral focal point will provide a necessary condition to turn a geographical unit to a community; in other words, a community is only formed when residents have a place to gather and meet in person every day. Those focal points often lie on the centre and allow high visual access [71].

Behavior settings are immediate surroundings which allow people’s behaviors and offer users instant inputs [73]. They are active, self-controlling systems which involve participants and objects in them doing sets of activities [73]. In some cases, behavior settings just last a short term; for example, when some facilities turn degraded over time, their corresponding functions also become worse. The physical space, however, has profound impacts on people’s behaviors [73].

Streets can be seen as a behavior setting. In Mehta’s research in 2010, three surrounding commercial streets were used as behavior settings to investigate which design properties of such urban streets reinforced naturally social activities that were stationary and sustained [54]. Accordingly, some physical characteristics found to encourage social activities were trees for shading, benches and a wide range of land uses, and concurrently, streets could be perfect places to increase community social capital. The research aims at determining

how changes in street user's behaviors influence physical improvements. More particularly, the study wants to find out impacts of building more cycle paths, zebra crossings, shelters and road diet on user behavior changes, especially ones as to social communication and active transportation in term of the living quality. Recent research has indicated influences of a street's physical factors on human behaviors [51, 54, 69, 74]. Also, street design encourages active transportation and social communication of users [75-78].

Modifications to the physical space can be deemed effective in encouraging more active transportation, especially in pre-improved environments (1) which design is not appropriate for active transportation and life of neighbors, and (2) which do not have such qualified, maintained and safe amenities as pavements [51, 79]. If interventions cover some urban design characteristics (e.g. land use, density, street connectivity, street scale and aesthetic), they play a vital role in affecting how residents use active transportation [80]. In comparison, other actions like watching other do exercise, stunning scenery, traffic and shade prove to encourage social and physical activities, especially as to strolling around commercial surroundings [81].

2.6.2 Concept of Affordance

The theory of affordance is involved in behavior settings. This term shows how people are aware of their surroundings [70]. According to the definition of Gibson, affordances are what the environment provides or furnishes users [70]. Affordances can be positive (promises) or negative (threats), in which objects in the environment are commonly characterized compared to organisms [82]. Also, affordance refers to complementary relationships between users and the environment [82].

Affordances are not influenced by whether or how users can perceive them (in direct or indirect way) [82]. The change in needs of an observer does not affect

affordances of an object [70]. This object will show its functions due to its distinct nature. Although affordances of the environment can be altered, they still exist and are hardly separated from environmental features of the context [70].

2.6.3 Affordances and User's Behavior

The term “Affordance” is used to explain which options are available to a user, or in other words how a situation is used [70]. More exactly, affordances are deemed as prerequisites for people's activities. However, the appearance of an affordance in some activities does not guarantee the occurrence of those activities, but only implying how likely they are to happen [83]. Whether or not the arrangement of certain affordances takes place may stimulate or curb particular human activities [83]. In an instance, the absence of pavements or cycle paths along a crowded street with high traffic speeds can limit a user's perceived options for active means of transportation. Additionally, the appearance of pavements or cycle paths can allow or afford some acts of walking or pedaling. Several affordances focus on such obvious things as walking along a paved section of a crowded thoroughfare versus walking along a pavement, while other affordances focus on such opportunistic things as choosing to walk or drive on a crowded thoroughfare due to the sense of safety brought by the appearance of a pavement [84].

With the aim of ensuring the safety of participants in physical and social activities on street space, such space should provide opportunities that are unavailable on an unimproved street [69, 85, 86]. However, different street space, albeit improved or unimproved ones, obviously has distinct meanings and impacts on people's life and activities in Vietnam. Some physical settings or features of improved street space are widening streets, building more walkpaths, improving pavements' quality, setting up visual objects and benches, etc. These physical properties give chance, yet such chance is not truly used for activities that they

aim at – mostly creating an environment that is friendly to non-motorized activities.

2.6.4 Proxemics

As defined, “proxemics” is the research on how people use space and how population density affects their behaviors, communication and social interaction. This term was coined by the research Edward Hall in 1950s and 1960s and involves studies on how to use space and the way many differences in the use make users more satisfied or worried [68]. Proxemics includes physical territory (e.g. why desks do not face towards a center aisle, but rather right ahead of a classroom) and personal territory, or literally known as space that a person keeps himself from others in front of him in a line. Human interactions can be significantly affected by different cultures and the color use within a physical environment [87]. However, these are two of over twenty staple factors of proxemics, for example facial expression, body warmth, eye contact, sex, number of participants in a space, subject matter and purposes of interactions, accordingly a person can automatically and continually modify his space use [88]. To conclude, there is a link between people’s activities in streets and proxemics that comprises personal and physical territory, so how successfully interpersonal interactions take place still depends on characteristics of those spaces.

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Chapter 3 A REVIEW OF URBAN STREET SPACE

3.1 Understanding Urban Street Space

A street is the basic unit of urban space through which people experience a city. It is often misconceived as the two-dimensional surface that vehicles drive on when moving from one place to another. Streets are, in fact, multidimensional spaces consisting of many surfaces and structures. They stretch from one property line to another, including the building edges, land uses, and setbacks that define each side. They offer space for movement and access and facilitate a variety of uses and activities. Streets are dynamic spaces that adapt over time to support environmental sustainability, public health, economic activity, and cultural significance.

Streets are like outdoor rooms shaped by multiple planes: the ground plane at the bottom, the buildings and the roadbed edges as the side planes, and the canopy plane like the ceiling of the room. Each plane is constructed of many individual elements that are often regulated or created by a range of different policies, codes, guidelines, and building practices (figure 3.1).

Understanding the various portions of a street as either continuous or interchangeable offers a flexible approach to street design. While sidewalk clear paths, bike lanes, and travel lanes must be continuous and connected in order to function effectively, interchangeable elements such as parking spaces, trees, parklets, and transit stops allow a street to be adapted to serve its context. The figure and terms below broaden the definition of street[1].

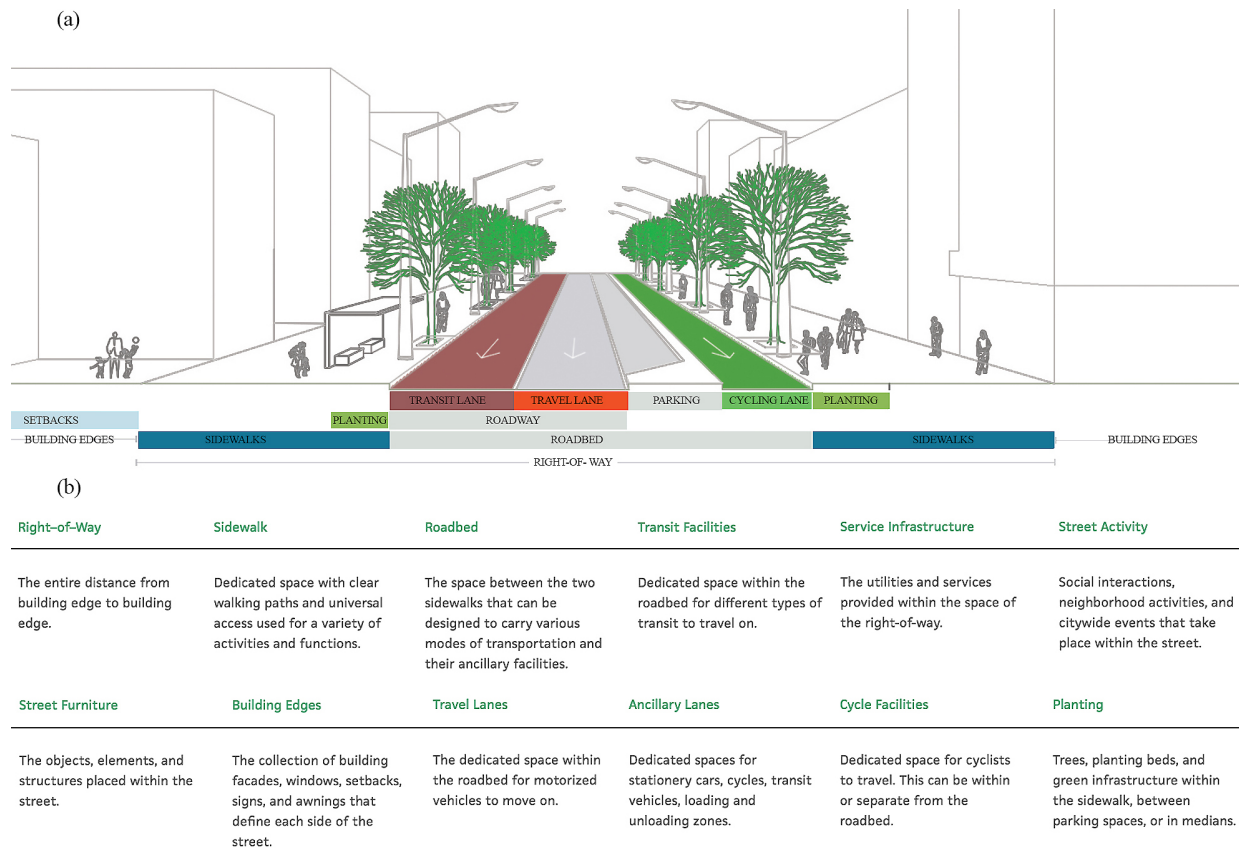


Figure 3.1 Street definition and terms: (a) elements, spatial configuration and functions of a typical street; (b) explanation of terms involving street (Initialed from Global Designing Cities Initiative).

In Vietnam’s Encyclopedia, a roadway is a public construction that features itself as a bridge between built environments on two pavements of the roadway (e.g. houses, buildings, squares, large theatres, parks, markets, supermarkets, stores and other cultural sites), or simply speaking, a roadway is what goes through or is built in one or more certain city blocks.

In the Vietnamese language, a compound noun “đường (roadway) – phố (city block)” is frequently used and there is a little evident difference between two concepts. Yet in urban studies, Đường (Roadway) and Phố (city block – the smallest area surrounded by roadway) are two concepts with completely different connotations. Indeed, urban streets are classified into two categories with two different meanings: Roadway is a space for traffic (mostly for means of transportation) with the high volume and speed. Unlike roadways, “Phố” in

English is a city block - the smallest area surrounded by roadways – with the wider definition and multiple meanings; that is, it not only has a traffic function, but is also a social, economic space; more particularly, it is a space with three physical elements as roadways, pavements and constructions on both roadsides, so “Phố” turns out to be a far more complex whole.

As for physical structures and infrastructures, a roadway is a long strip of land adjacent to buildings in an urban space, in which residents can freely commute, roam, shop or walk. Based on economic conditions and the investment to best suit the circulation and traffic, the surface of a roadway can be simply red soil covered with a lot of grime or a more sustainable, rigid material structure such as concrete, stone, gravel or brick.

In a term of spatial structure, a roadway can be divided into two parts as roadbeds and pavements. Of which, pavements function as 1) pathways for only pedestrians (at least 1.5 meters), 2) places to have urban utilities and infrastructure, to arrange power supply systems, optical cable lines, water supply pipes, sewer pipes, to install electric poles, public lighting columns, billboards and to plant trees, 3) places to access constructions along streets and to guarantee the arrangement of access points to such other traffic structures as flyovers and tunnels for pedestrians and 4) urban public space in which people can travel to, watch the world go by, go for a walk or chat with others.

3.1.1 Old Street Space

Traditional streets often refer to roadways inside traditional urban areas in Vietnam. It is important to know that Vietnam’s society before the 20th century developed more slowly than Western society or that of other developed countries. Streets in traditional urban areas were precisely where pedestrians and rudimentary vehicles commuted and those streets were limited by construction facades on both roadsides. From the French colonial period, traditional street

space was divided into different parts as traffic roads, pavements and roadside constructions; accordingly, traffic roads served vehicles, pavements served pedestrians and trading activities, while roadside constructions could be houses or places to produce and sell products.

3.1.1.1 Traditional Streets in Danang

From the decision of the Governor-General of Indochina to found Danang city and to provide management à la allotment of a type II city in 1889, French started building Danang city. Narrow dirt roads under the Nguyen Dynasty started being rebuilt and expanded on basis of the planning of a modern city. Streets in the city centre, especially avenues, all had pavements and were expanded from 5 to 7 meters. Pavements mostly served pedestrians and had lots of trees.

So, Danang's streets were originally built in the French colonial period and had three main kinds:

(1) Rue: had medium width and length with houses on both sides

(2) Avenue: had great width and relative length with two roadsides, green trees, houses and offices

(3) Boulevard: had great width and length without houses and trees on both sides.

This kind of street functions as a divider between inlying areas and suburbs.

Although pavements were given a certain location in space, the concept that pavements only served pedestrians was never accepted by a whole community.

In the traditional context of a limited number of motorized vehicles, roadbeds were often shared by means of transportation and pedestrians. Meanwhile, pavements primarily served commercial activities and the parking of vehicles (Figure 3.2).



Figure 3.2 The traditional/old streets and users' activities in Da Nang city (Photo by Steve Ferendo)

3.1.1.2 Traditional Streets in Other Urban Areas

(1) Hanoi

Hanoi now is the capital of Vietnam and also the oldest urban area during Vietnam's development history. Since the 3rd century BC, Hanoi has been founded as a centre of politics and society. Undergoing ups and downs and existing in many dynasties during the development history, Hanoi officially has had its current name since the Nguyen Dynasty and Hanoi city was founded in 1888 under the French colonial period; in 1902, it became the capital of the French Indochina. After the planning of the French, the city gradually had a new appearance. Hanoi was no longer a feudal imperial city, but partly looked like an

European city (Figure 3.3 and 3.4). Due to the remarkable development history, urban space of Hanoi could be divided into two forms:

(a) The old quarter with craft streets and street space always attached to daily and manufacturing activities of residents. Such streets associated with traditional trades as Hang Chieu, Hang Mam, Hang Be, etc. are originated from this; (b) A new quarter being closely attached to constructions built by the French.



Figure 3.3 Streets in Ha Noi Old Quarter under the French colonial period (Image source: (The Miriam and Ira D. Wallach Division of Art, Prints and Photographs: Picture Collection, The New York Public Library. "Hanoi. Rue des Radeaux." New York Public Library Digital Collections. Accessed August 7, 2019. <https://digitalcollections.nypl.org/items/c263504a-1989-b3d1-e040-e00a18061791>)

Roadbeds of streets served rudimentary and motorized vehicles, as well as pedestrians. Streets were airy and clean with asphalt roadbeds, paved pavements

and lighting poles. Trading activities were performed in shops on streets and even on pavements near lighting poles (Figure 3.3).

Apart from the existence of administrative and service constructions à la French architecture style, electric trains also appeared on the street space. Especially, large constructions that were located in the end of streets as highlights according to French planning style turned Hanoi to “Little Paris of the East” at that time (Figure 3.4).



Figure 3.4 Streets in Ha Noi New Quarter under the French colonial period (Image Source: The Miriam and Ira D. Wallach Division of Art, Prints and Photographs: Picture Collection, The New York Public Library. "Tonkin -- Hanoi -- Théâtre, Rue Paul-Bert." New York Public Library Digital Collections. Accessed August 7, 2019. <http://digitalcollections.nypl.org/items/c263504a-198b-b3d1-e040-e00a18061791>)

(2) Hoi An

Hoi An ancient town is known as an old urban area that significantly developed over the international trade period in Southeast Asian region between the 16th and 17th centuries with different names as Fayfo, Kaifo, Faifoo, Faifo, Hoai Pho and Hoi An, and still survived after devastating wars in the late 18th century. Hoi An featured narrow streets with small pavements and most roadside constructions à la traditional architecture style of the 17th to 19th century (Figure 3.5).



Figure 3.5 Streets in Hoi An ancient town (Image source: hoianworldheritage)

(3) Sai Gon (Ho Chi Minh)

Founded in the 17th century under the Nguyen Dynasty, Sai Gon then became the largest economic centre of Southern Vietnam in the late 18th century. After conquering Sai Gon in 1859, the French rushed to build Sai Gon and turn it to a

big, multifunctional city (in terms of administration, military, economy, port and so on). Under the French colonial period, Sai Gon experienced profound, rapid and obvious changes and then was known as “Pearl of the Far East” which is an elegant and vivid city (Figure 3.6 and 3.7).



Chợ Bến Thành năm 1928
Le marché de Saïgon en 1928
Ben Thanh Market in 1928



Figure 3.6 Sai Gon Streets in the beginning of 20 century (Image source: tạp chí *Xưa & Nay* – *Xưa & Nay Journal*)

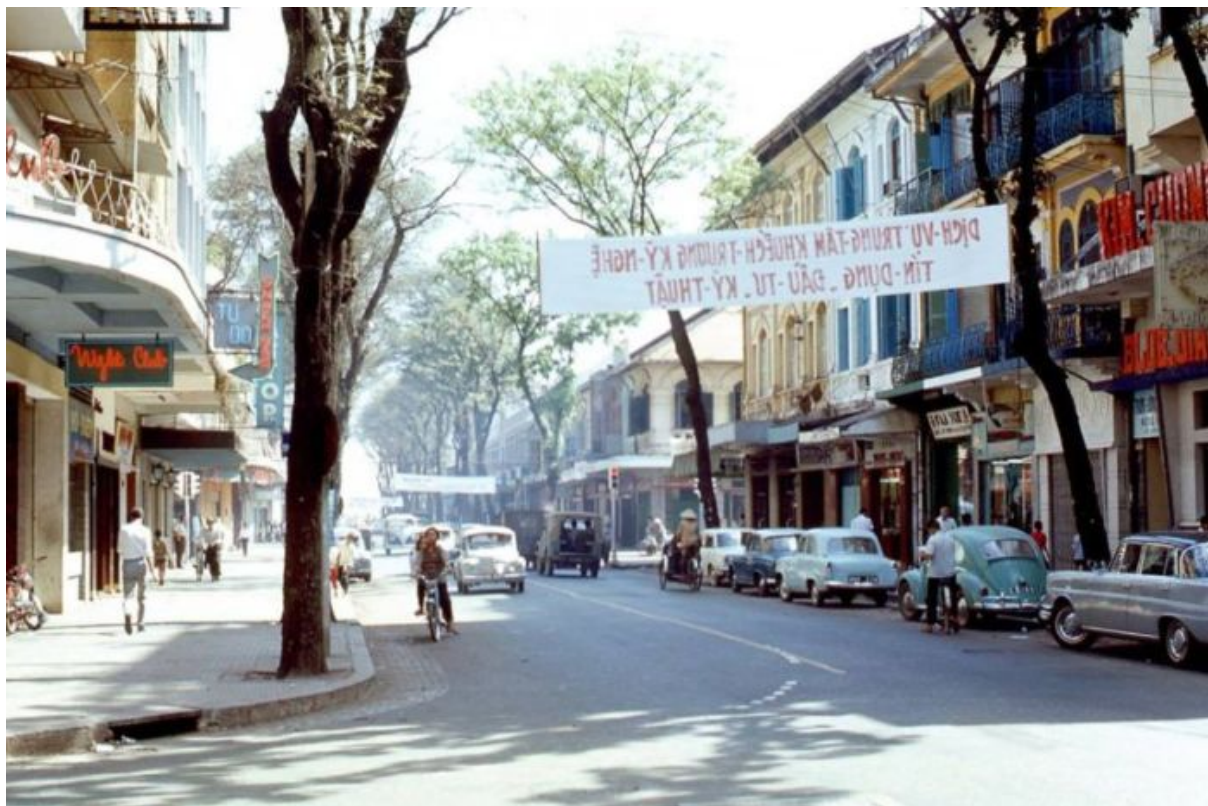


Figure 3.7 Sai Gon Streets before 1975 (Image Source: Aaron Tock)

It can be seen that Sai Gon's street space was quite busy but also well-organized. This is obviously due to the systematic planning of the French who were very experienced in planning after the planning and renovation of Paris in the second half of the 19th century (Figure 3.7).

In short, apart from Sai Gon planned by the French, in other urban areas of Vietnam, traditional street space was a multifunctional space attached to daily, manufacturing and commercial activities of inhabitants, in addition to traffic function with poor facilities.

3.1.2 Current Street Space

Nowadays, the social development leads to a soar in means of transportation, types of transport and even types of trading and commercial activities of residents. For that reason, streets become more overloaded in terms of functions and capabilities. The upgrade and renovation of streets to satisfy new needs is a pressing mission. However, all activities of street space development and renovation are only confined to expanding, renewing and upgrading the quality of materials or adding such necessary facilities as traffic signs, lights, lane dividers, zebra crossing, on-street parking area and on-sidewalk motorcycle parking line, or setting up mini trash bins, benches, bus station canopy and so on; those actions derive from arbitrary or intuitive ideas of designers[3]. Also, that the upgrade is incomplete and items last a long time leads to jagged and inconsistent streets. In addition, "roadways" are commonly seen as a public space system that serves traffic, in which roadbeds serve means of transportation while pavements serve pedestrians. Roadways are a part of the technical infrastructure category, so the design of routes, road's cross sections, red boundary line (building line) and construction boundary line management tools is purely carried out in consideration of techniques for the construction of traffic and other infrastructures attached to streets such as electricity systems, communication

systems, and water supply – drainage systems. Pavements are not separately studied, but only places for attached infrastructures of traffic roads. This approach overlooks elements related to cultures, human and urban context, thus leading to a huge gap between design and practical use. Therefore, streets and pavements in all Vietnam’s cities become messy, unattractive, dirty, fall into the dispute state and cannot accommodate pedestrians (Figure 3.8)[4].



Figure 3.8 Current street spaces in Vietnam (Đời sống & Pháp lý Magazine).

3.2 Management of Urban Street Space

3.2.1 In Da Nang

Da Nang People’s Committee issued the 2008 Regulation on the management and temporary use of pavements for non-transportation purposes on roadways in Da Nang city. As shown in this Regulation, the temporary use scope of pavements is identified based on the width; of which, pavement sections that serve pedestrians are from the outer edge of the pavement curb to the inside part of pavements; the remaining part of pavements is temporarily used for non-transportation purposes according to conditions specified in Figure 3.9 as follows.

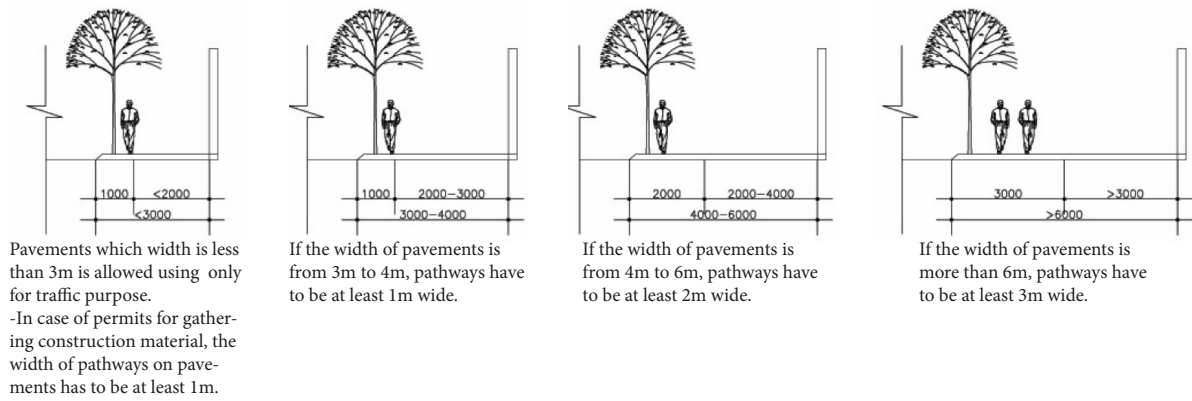


Figure 3.9 Illustration of pavement cross-section: pathways and pavement sections that are used for non-transportation purposes – as regulated by Da Nang People’s Committee.

Also, Da Nang People’s Committee has issued a variety of decisions on street space management in order to build a green, clean and beautiful city that has good traffic safety and security. Those decisions relate to the regulation on the permanent or temporary pavement use and management, the arrangement of functional areas on pavements and a clear list of routes that prohibit commercial and trading activities. Also, the city also releases decisions about the parking of vehicles on roadbeds on even or odd dates, and signs that prohibit other activities (apart from traffic ones) are also arranged in many roadways.

To solve problems of homeless people wandering and residing on streets and other parts of the city, Da Nang People’s Committee gathered, provided those people with accommodation and jobs about many years ago. This policy received support from the community and until now, Da Nang no longer has beggars, the poor or sick people who have to choose streets as a residence.

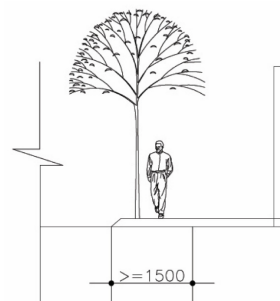
Parallel to issued regulations, the city also controls the street space use by organizing Urban Rule Team. In 2018, the city reorganized and strengthened

activities of Urban Rule Team to improve the capacity and effectiveness of inspection and control, as well as to follow rules.

3.2.2 In Other Cities

(1) Ha Noi

Ha Noi People's Committee issued a Regulation on the management and use of pavements and roadbeds in the city in 2003. As shown in the Regulation, pavements mainly serve pedestrians, while roadbeds mostly serve means of transportation. If pavements and roadbeds are used for other purposes, permits from competent state agencies are needed. When pavements and roadbeds are used, it is essential to guarantee traffic safety, order, environmental hygiene and urban aesthetics. In addition, there are regulations on the pavement and street management such as digging up pavements, roadbeds, setting up kiosks, installing canopies on pavements, building traffic signs, billboards on pavements and roadsides, and building constructions on pavements or roadbeds. Managers also regulate the cleaning of pavements, roadbeds, the management of green trees on streets, the temporary use of pavements and roadbeds for construction works, weddings, funerals, food trading and parking. If pavements are not used for traffic purpose, yet others, pathways for pedestrians have to be at least 1.5m wide (Figure 3.10).



Pavements temporarily used for non-transportation have to be at least 1.5 m wide for pedestrians

Figure 3.10 Illustration of pavement cross-section: pathway and pavement section that is used for non-transportation purposes, as stipulated by Ha Noi People’s Committee

(2) Sai Gon (Ho Chi Minh)

Ho Chi Minh People’s Committee issued regulations on the management and use of roadbeds and pavements in Ho Chi Minh city in 2008; those regulations are related to the pavement use and permits, the roadbed use, fee collection, construction and maintenance. Apart from issued regulations, People’s Committee also researches and takes many actions to manage and use street space effectively and properly, for example, dealing with the encroachment on roadbeds, pavements, and setting up barrier curbs on pavements to stop motorbikes from stepping onto pavements in rush hours (Figure 3.11).

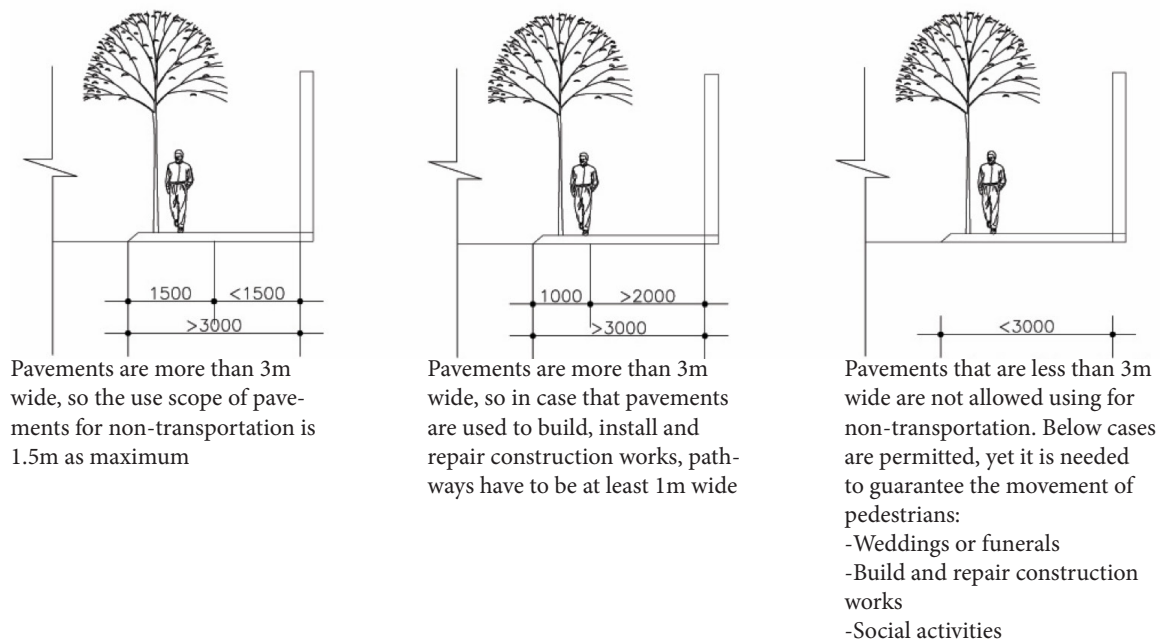


Figure 3.11 Illustration of pavement cross-section: pathways and pavement sections that are used for non-transportation purposes, as stipulated by Sai Gon People’s Committee.

3.3 Life Along Street Space

Street space, or simply known as street in Vietnam, now can be seen as the most complex public space and one of few public spaces shared by all social classes. It is even a residence for complex social objects in community such as beggars, the homeless, wanderers, street people, addicts and those who leave home.

A wide range of important social activities continue to take place on street space and underlie civilization. Streets can be categorized into different groups as alleys or lanes. Roadways are often spacious and gather vivid and bustling activities of urban life. Commercial, cultural and recreational activities as well as events can take place on street space. Alleys and lanes are much quieter and often used for motorbike parking, walking or internal daily activities of a residential area, or entertaining activities of children such as street football. The most important activity that is also seen as a testimony to a spiritual, lively and active city is circulation on streets, activities related to transportation, commerce, culture, entertainment and social interaction.

An essential part of street space is pavement in which many activities of city dwellers take place. Indeed, a pavement is a component of a street, which width represents the significance of that road or quarter. On pavements, the view point of pedestrians initiates considerations of cubes and empty spaces for constructions located in a street façade. Accordingly, the function that serves pedestrians should be prioritized; that is, the circulation, albeit slow, has to be guaranteed. Many urban, sociological and architectural professionals produce the same conclusion: a pavement is where the urban community communicates, in which human beings step out of a house/ a construction, in which individuals and groups interact with others and in which human beings will separate themselves from a simple movement on streets. Therefore, a pavement is where human beings approach to architectural constructions, judge and feel the beauty of internal and external architectures slowly and objectively. And more importantly,

a pavement is a buffer zone/ conductor/ interface that conveys values and qualities of a city to human beings.

A life along streets and pavements has changed a lot over time and according to the urban development level. Since pavements were newly built, they have served not only walking activities but also daily routines of households and functioned as a playground of children or a place for people to gossip (Figure 3.12).



Figure 3.12 Ha Noi street life in Old quarter in 1974 (Image source: *Tạp chí Kiến trúc*(Tản mạn chuyện vỉa hè Hà Nội) [5])

Nowadays, pavements become a place for shop owners to display their products, for public parking and keeping vehicles safe, a private place of houses on streets or even a bonsai garden. The function of pedestrian circulation disappears in many places. Furthermore, in rush hours in metropolitan cities, when traffic jams occur, pavements become an emergency exit for motorbikes that are being stuck on roadbeds. On the other hand, street space or pavement space is a place for the

poor in urban areas, who are peddlers, hawkers and cannot afford a rented property for trading, to make their living (Figure 3.13).



Figure 3.13 Existing life along the street space in Viet Nam

3.4 Street Space Facilities

Accompanied with the development of cities, street amenities are also added and upgraded to meet increasingly high needs of residents and tourists.

3.4.1 In Da Nang

With a priority policy of the tourism development in recent years by city authorities, urban amenities generally and street amenities particularly are concerned, set up and renovated, especially in the city centre. Danang is also one of the first cities that build a smart city model with the aim of sustainable development. Danang also pursues the target of becoming a “Green, Clean and Beautiful” city, so streets are often cleaned during a day; this is also a significant

highlight of amenities for city dwellers. Amenities can be seen on streets in Danang's center (Figure 3.14):

- Stone benches, trash bins
- Public restrooms
- Free wifi
- Clean paved pavements with lines dividing areas into the one for parking and the other for pedestrians
- Lights and decorative lights at night
- Bus stops, bus waiting points, signs and signboards
- Shady green trees



Figure 3.14 The change of Da Nang streets after facilities are provided (Image source: Zing and Báo Đà Nẵng Online Magazine).

3.4.2 Other Vietnamese Cities

(1) Ha Noi

Like other metropolitan cities, streets in Ha Noi are also equipped with such basic amenities as pavements with pedestrian sections, a system of bus waiting points, lighting systems, shady green trees, public restrooms, trash bins and so on. However, it can be seen that those amenities are inconsistently arranged in all areas, of which many substandard amenities still exist. In an attempt to improve the quality of capital life, in the late January 2019, the first tapped water risers were installed in Ha Noi's streets. This amenity not only helps residents and tourists refresh themselves in hot summers, but also brings great efficiency in enhancing the image value of the city (Figure 3.15).



Figure 3.15 The facilities provided on the Ha Noi streets (Image Source: Vietnamexpress online magazine).

(2) Sai Gon

Traffic Portal system - this system uses data from online cameras at important intersections, it is convenient for users in handling traffic, wayfinding and navigating public utilities e.g. toilets, gas stations, hospitals, parking lots, flower markets and so on (Figure 3.16).

In addition, other basic facilities are also provided to serve the demands of residents, visitors and people with disabilities. This is also one of ten cities with free public wifi system installed in Vietnam.



Figure 3.16 The facilities provided on the Sai Gon streets (Photo by Tung Tin & Diem Nguyen (Zing); Anh Tuan (HCM Government Information Portal)).

3.5 Additional Plan for Improving Urban Street Space

3.5.1 Da Nang City

Establishing parking areas and smart parks, and using the vacancies for parking. Improving sidewalks as the parking area and parklet on a number of roads such as Hai Phong, Quang Trung, Pham Van Dong and Tran Hung Dao. Proposing charged parking in both on-street and off-street parking area. Providing walking tunnels at complex intersections, pedestrian overpasses. Limit the encroachment on the roadside by organizing street blocks for pedestrians and night markets.

3.5.2 Others Vietnamese Cities

In Ha Noi

Ha Noi People's Committee approved the project "Exchange ads for 1000 public toilets" in 2016. In order to reduce the traffic congestion in the urban area ensuring smoothly users' activities, since the beginning of 2019, the local government has conducted research and announced the implementation of the project called "Zoning motorcycle traffic in accordance with current infrastructure and public transport system capacity proceeds towards campaign of stopping motorcycles within districts in 2030".

In Ho Chi Minh

One of the solutions has been proposed and implemented to reduce commercial activities on the sidewalk and roadway that is the local government has planned and launched the commercial areas on sidewalks (figure 3.17).

City block for pedestrian has a detailed landscape design of trees, light, sound, color and additional utilities that are researched and implemented in the downtown area, forming commercial streets with many shopping activities.



Figure 3.17 The legal street stall on the Sai Gon streets (Photo by An Huy – Thanh Nien online magazine).

3.6 Discussion, Challenges and Issues of Urban Street Space

Current urban public space in Vietnam contains complex relationships caused by asynchronous in infrastructure and economic development as well as community awareness. In the context of rapid urbanization, sustainable urban development and the compact city has become a common target for many cities all around the world including Viet Nam. However, there are many obstacles still remain including economic resources, community awareness, specific solutions in management and implementation.

For dealing with transportation and high volume traffic issues under the scarcity of urban area, developing various public transportation categories and reducing private/ personal vehicles is one of the reasonable solutions. Solving social safety problems, ensuring the balance in developing various commercial types involving street space. Providing specific street space serving tourism activities. For a better quality of life, streetscape should also be upgraded meets the demands of inhabitants

Jane Jacobs, a world-renowned urbanist, who has created a profound influence on postmodern urban design mindset, said: "Streets and their sidewalks, the main public places of a city, are its most vital organs. Think of a city and what comes to mind? It's streets. If the city's streets look interesting, the city looks interesting;

if they look dull, the city looks dull".[6, 7]. Street space has a close relationship with all society components, whether or not everyone in the city has to face existing problems in this space (e.g. encroaching roadside and pavements, garbage, evils, lack of amenities). The problem is that it is necessary to find specific solutions in design combined with related education, management and policy solutions.

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Chapter 4 THEORETICAL FRAMEWORK AND METHODOLOGY

4.1 Methodological Approach

This research is part of Environment-Behavior and Ecological Psychology areas. During the research time, behavior settings, affordance features and proxemics are used to find out impacts of unimproved and improved street spaces on user's behaviors; concurrently, a single-case empirical inquiry is employed to investigate a contemporary phenomenon within a practical context in which numerous sources of evidence are exploited, yet there is no clear boundary between phenomenon and context [1, 2]. Each researched case is a single experiment [1]. The study aims at providing factual evidence about influences of physical environment improvements on a street on user's behaviors and their cognition. Researchers observed users of both unimproved and improved street spaces that were assessed and chosen in Da Nang city. Questionnaires were conducted to identify which of unimproved and improved street spaces drew human attention. The research also used Capture Evaluation Method Survey to discover physical elements that were often attended to by users when they used street spaces. Furthermore, Behavior Mapping Survey was applied to determine users' behaviors and behavior settings along the streets. These research findings can contribute to learn how to produce the most useful improvements. In addition, detailed information collected from questionnaire interviews can help researchers know more about user's feelings, opinions and attitudes toward both unimproved and improved street spaces. Methods used in the research will be examined in Chapters 5, 6, 7 that mentioned the response of behavior variables to physical changes to street spaces. More especially, this study pays attention to streets that allow non-motorized/ motorized transports (parking/ stopping) and social interaction in respect of living quality and well-beings.

4.2 Research Methods

A mixture method research, which combined both quantitative and qualitative methods, was conducted in this work (Table 4.1). Quantitative method was used to measure different variables collected from statistical studies and a numerical data acquired from data collection process. These data were analyzed to complementarily support the qualitative data and analysis. Qualitative data and analysis were used to better describe characteristics of both improved and unimproved street spaces, and understand conditions, phenomena, considerations, preferences, and experiences of users and parties involved in Vietnam's street space.

Table 4.1 Overview of research methods

	Methods	Objective
Quantitation and Qualitation	Questionnaires	1. To determine which unimproved and improved street space needs investigating 2. To help understand users' feelings, perceptions, and attitudes toward a streetscape environment.
	Analysis: 1. Extreme value analysis 2. Coding and statistical analyses	
Qualitation	Capture Evaluation Method survey (CEMs)	1. To determine physical elements set along chosen street space that affects users' attention in both positive and negative terms.
	Analysis: 1. Affinity diagram (sometimes called the KJ method) 2. Statistical analyses e.g. regression, correlation, clustering, PCA	
Quantitation and Qualitation	Visual Encounter Survey method (VES) and Behavior Mapping	1. To determine user's behaviors on street space and various types of behavior settings. 2. To reveal the relationship of environments with behaviors
	Analysis: 1. Behavior Setting 2. Statistical analyses e.g. PCA, Clustering 3. Behavior Definition based on Proximity Theory	
Quantitation	5-Scale Likert Questionnaires	1. To understanding users' cognition on accessing/ using street space in both physical and non-physical variables.
	Analysis: Statistical analyses & testing e.g. Anova, Chi-square, correlation, regression	

4.3 Site Selection

4.3.1 City Selection

The research was based on a wide range of case studies in Da Nang city which lies on the Central Vietnam (Figure 4.1). This city was built up under French colonial period and then became a military center in the war. After 1980s, the city developed to one of the three largest cities in Vietnam. Da Nang is an important port city of Vietnam, the third largest city in the country. With the potential economic development, the population is predicted to double by 2030 (with about

2 million). Da Nang has a natural area of 1,283.42 km², of which the central districts occupy an area of 241.51 km², and the suburban districts occupy an area of 1041.91 km². Da Nang is located at 15°55' to 16°14' North, 107°18' to 108°20' East. The city has a tropical climate dominated by a dry season that lasts roughly from April to August and a wet season from September to March. The humidity rarely drops below 60% in the city, averaging roughly 80% and the mean annual temperature is 25.9 °C [3].

There are two key reasons behind the act of choosing Da Nang for the implementation of this study. Firstly, although other metropolitan cities have the longer development history, Da Nang is one of a few cities developed based on old planning criteria of Americans and the French that were mostly applied in the urban construction in Vietnam after the reunification day (1975). Secondly, Da Nang has the high economic potential with PCI (Provincial Competitiveness Index) coming second [4]. With such a growth potential, the city population is predicted to double to approximately 2 million in 2030. Thirdly, aiming to promoting tourism, the municipal authority prioritizes the investment in construction projects which contribute to raise the city's profile and improve the urban quality of life to serve citizens and tourists. Campaigns to improve, build and manage “green, clean and beautiful environment” (or streets) were launched; also, street space improvement projects were conducted in some certain routes. In short, as explained as a place with an important position, especially in historical terms, and active policies of the local authorities, Da Nang is deemed as an

appropriate case study of the improvement of street space in Vietnam which can be precondition for further development projects in other urban areas.

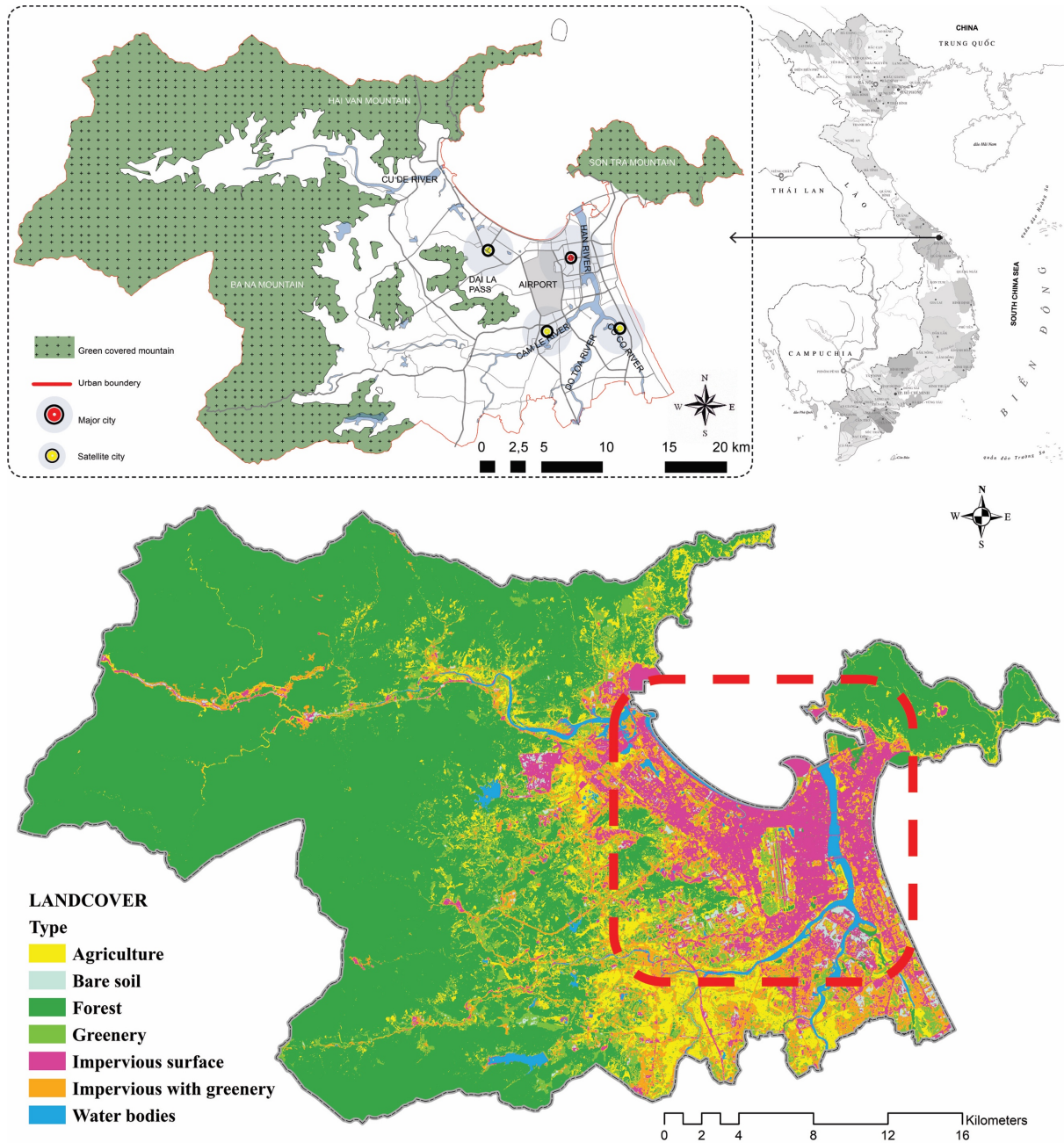


Figure 4.1 Major landform features, main roads and urban centre of Da Nang city

4.3.2 Determine The Street Candidate

There are various different definitions and classifications of streets; many of which have different meanings, and are inconsistently applied. However, the most

notable is Rykwert's theory that was based on classification of three different street groups [5]. Meanwhile, Moughtin defined street as a place to allow movements to destination, the circulation of commuters and goods by motorized vehicles, animal traction or by walking, fast moving or heavy mechanics with all its technical requirements, and it is a relatively wide road in the town or village but different from a lane or alley[6]. Several authors have defined the boundaries between the built environment and the public realm, such as Lynch (1994), Eisner (1993) and Gallion (1963), but the hierarchical classification of streets that divides it into four levels of complexity is widely accepted. Those four levels are: minor streets (loops or cul-de-sacs), collector streets, major arterials and freeways/highway. Except for freeways/highway, the other three groups of roads support traffic-free pedestrian streets which have the greatest potential to support human activities and social interaction. These types of streets may also be named according to their function as the roads of residential areas, riverside street, tourist street etc. to form a strict hierarchy of streets with the great importance in street design and analysis. Based on the Da Nang City Traffic Plan (Figure 4.2), the black-coloured roads are the ring roads, which have a high volume of heavy vehicles and therefore, these roads do not have the high potential of supporting

human activities and social interaction and it is considered as being out of research scope.

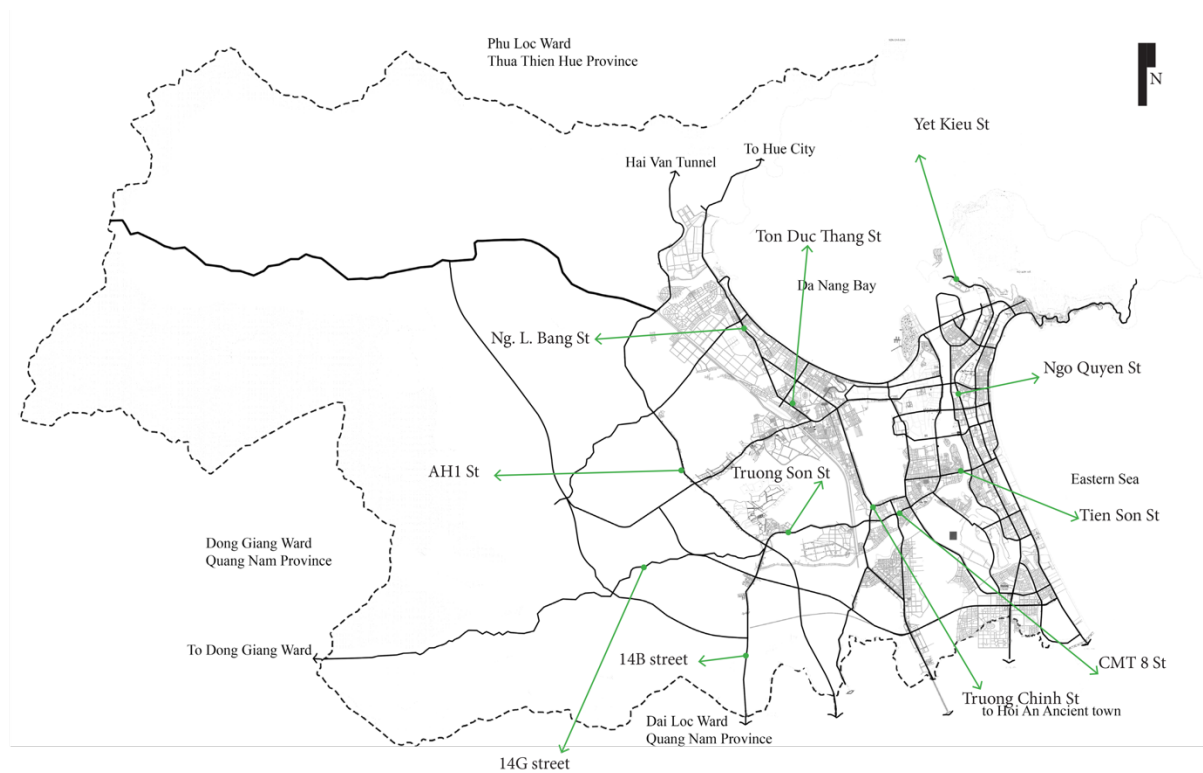


Figure 4.2 The hierarchy of street network system of Da Nang and the ring-belt roads.

Due to the large number of streets along with many intricate features, a semi-structured questionnaire was designed to sort out chosen street space in six districts of Da Nang city. Because of various social classes in the street, 598 survey questionnaires were collected randomly from those being 14 and 87 years old ($M = 28.5$; $SD = 9.7$) with occupational diversity. Based on the results of the survey, a total of 203 streets, were marked by inhabitants as either positive, 114 streets, or negative, 89 streets. According to street definition, nine roads with movements of heavy vehicles are excluded out of the candidate list. Next, based on extreme value analysis [7] and purposes of the survey, streets with high ratings remained (33 street spaces) and were classified into two improved and

unimproved groups in accordance with the development of street space policy by the local government, and eventually, eight street spaces were chosen for research survey (Figure 1.3).

4.4 Data Collection

4.4.1 Previous Review

A literature review to previous research and publications which are related to topics and theories about the architectural urban design, human behaviors, cultures, psychological environments and environmental behaviors were conducted to determine links between different aspects and to prepare the theoretical framework for research and data collection. Concepts of socio-cultural factors, public and private space, economic pavement, street space's physical environments and human activities were studied and compared together in this research in order to identify their interaction and relation.

4.4.2 Qualitative and Quantitative Data

Collected data were used to learn about street space and users' activities therein. Apart from collecting fundamental information regarding a research location, an urban context and form, current planning documents in 2017 and orientation planning up to 2050, this research primarily collects data from on-site investigation that took place in three different stages.

The first stage studied which physical settings in a street would catch user's attention. Accordingly, qualitative and quantitative data were acquired from 8 chosen streets in Da Nang, albeit improved or unimproved, by CEMs in October 2017.

The second stage examined which various types of behavior settings would appear in old street space, concurrently explored the relationship of behaviors, activities and physical environments in such space; data were collected in two 2

unimproved street spaces including Tran Phu and Ong Ich Khiem Street in May 2018 by using site observation as VES and Behavior Mappings.

The third stage found out differences in user's behaviors and behavior settings of unimproved and improved street space. Data were collected in two unimproved and improved streets as Ong Ich Khiem and Le Duan Street in May 2018 and January 2019 by using VES and Behavior Mappings. Furthermore, differences in the user's perceptions were also revealed as a result of the questionnaire survey on two given street spaces in March 2019.

4.4.2.1 Capture Evaluation Method Survey

CEMs is a method applied by Koga [8] based on Noda's PPM (photo projective method) and the "Evaluation Grid Method" was proposed by Sanui and Inui [9]. Noda's NPPM (photo projective method) is a psychological method that analyzes the deep psychology of children who are not proficient in fully expressing their thought by language. They were given a camera and allowed taking what they like, then conducted a psychological analysis by understanding the photos taken. Even in the field of urban architecture, many years ago, this NPPM method gained in popularity (including Takahiro Hisa, Kunihiro Narumi, Neto et al.). This survey method allows participants to experience the actual environment to identify problems, or factors they encounter or concern. This method helps to explore the users' concerns in that space without any limits. Survey's participants walk freely with a camera in selected roads; when they encounter a factor in street space that they think "good/not good", they will photograph it, make a report card, accompanied by notes corresponding to the following content. Firstly, the general assessment is given: this landscape is good/not good. Next, the landscape

will be described based on three points: What element it is, how characteristic it is and what it does give an impression [8, 10].

By using CEMs (capture evaluation method survey), the survey was carried out in the period of time between August and September 2017 in mornings (6:00-9:00) and afternoons (5:00-8:00). This is the most appropriate time for outdoor activities. The data were collected from 20 participants (8 females and 12 males) who are architecture students, aged between 19 and 26 years old ($M = 21.25$; $SD = 1.65$). Each street was visited by 20 participants, leading to a total of 160 responses. The participants used specialized language [11], as a laypersons description of the environment would be too broad to be useful for this study. However, some researchers stated that there were no differences between perceptions of architects and laypeople in the evaluation of outdoor spaces [12, 13]. From such eight street spaces, 3,025 report cards were made. These cards were classified and divided into groups by similarity via Affinity diagram (sometimes called the KJ method), which sorts out answers based on their natural relationships. Because the research would like to focus on identifying elements on street space that concerned inhabitants; characteristics and impression responses found were ignored.

4.4.2.2 Virtual Encourter Survey

Visual Encounter Survey (VES) method is used to document the presence of individuals, and it can provide both quantitative and qualitative data and were formalized by [14]. It was conducted by observers walking through a designated area for a prescribed time, visually investigating required objects. The physical environment investigation was conducted in May 2018 using the VES method that requires observers to walk along the street to collect all data regarding the

current situation of the street environment such as physical settings, audio and scent.

4.4.2.3 Behavior Mappings

The place-centered behavioral mapping (PcBM) is used to make a graphical representation of the study location, with the classification into different segments. The observation contains photographs or time-lapse recordings of behaviors and positions of people in each segment. This type of observation is considered more suitable for the study of a particular physical space [15]. User's activities were collected by PcBM in two weekend days and two weekdays of May 2018 that recorded all users' activities in physical, social and stationary terms. Participants in one certain activity were considered as an activity unit.

4.4.2.4 Questionnaires (Likert scale 5 point)

A Likert scale is a psychometric scale invented by psychologist Rensis Likert [16], commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research, so that the term is often used interchangeably with rating scale, although there are other types of rating scales. This survey, which provides 5-point answers, simply stated that the respondent is asked to evaluate by giving it a quantitative value on physical, personal, and social dimensions, with level of agreement/disagreement being the most commonly used dimension. Eventually, 354 questionnaires were collected in both unimproved and improved street spaces in March 2019. (175 responses in LD St and 179 in OIK St)

4.5 Analysis Process

Based on the data acquired from CEMs, these entries were classified into groups using the KJ method, which agglutinates answers by similarity. Data collected by VES and Behavior Mapping, scaled drawing of street space related to user's behaviors and physical environments/settings, were drawn, counted and calculated. These numerical data were compiled and prepared for analysis. Moreover, data acquired from cognition questionnaire dispatches were compiled and arranged. In this phase, the analysis of interview and questionnaire data, literature studies, and plan drawings were conducted, to produce the result of analysis, conclusions and suggestions. Also, based on the conclusions acquired from this study, further discussions were conducted, and plans for future steps of the research were formed. Figure 4.3 provides the whole information flow

involving research methods, analyses, and its flow work to obtain the various research objectives.

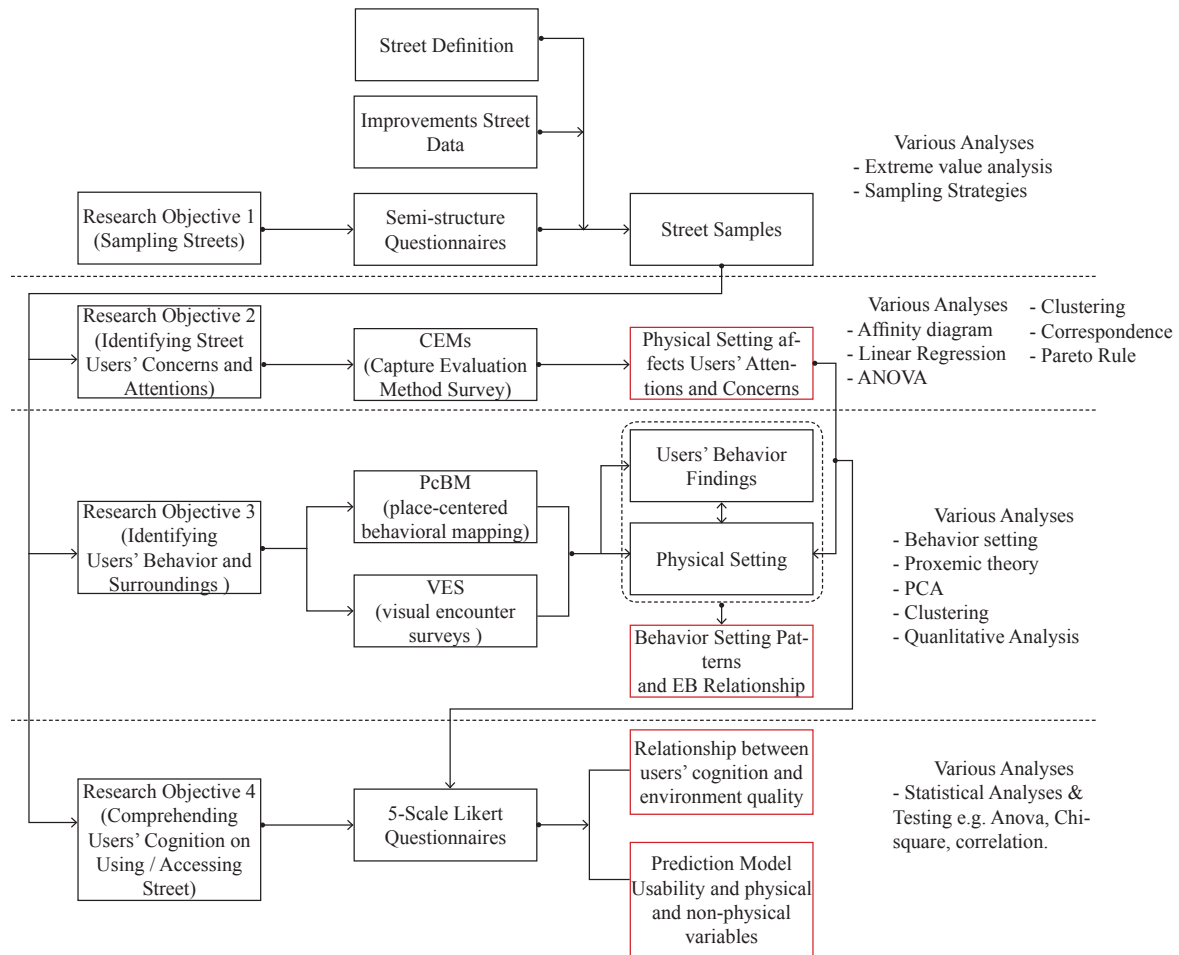


Figure 4.3 Methodology and Process flowchart

4.6 Research Limitations and Delimitations

This study has a number of limitations related to the conceptual framework, methodology and questionnaires, which are as follows:

In CEMs, the survey participants have different concerns or attentions to physical factors on streets. Data from such a survey are often affected by psychological elements and cognition of participants. Also, different concerns often render the data collection from the fulfillment of the original objective. However, survey participants tend to be influenced by the researcher. The researcher reduces bias

as much as humanly possible by providing detailed guidelines to control emotional reactions. A proper training and a pilot survey are useful in avoiding human bias.

Time constraints affect the respondents and surveyors. The additional time allotted to the survey can determine if all street behaviors in different time frames and different patterns of behaviors can be identified; or which can confirm if the previous sampling was sufficient. With the aim of involving all activities in street space and pavements, the survey time would be set from 6am to 7pm. Also, to avoid the bias, each street sample will be observed twice on weekdays and weekends. All survey information would be recorded by multiple video cameras and photos. Weather conditions and seasons also affect human activities on streets. However, the bad weather curbs outdoor activities of human beings. This research scope aims at studying a wide range of human activities to encourage their outdoor activities and improve the quality of life. Hence, this study did not consider time frames when the awful weather took place. Fortunately, as the investigation covered different seasons in a year, this factor would be introduced to the database and then analyzed as well. Furthermore, the difference in social issues that exist in the research area did not nearly emerge, so the survey data would not be influenced by this variable.

The street samples were confined to the major area of the city, which is primarily dominated by the middle-class/ upper-class. Future research may consider differences in demographics, as the literature review showed differences in activities and social interaction for various groups. Additionally, this area has a long history with various types of land uses, including residential areas with the high population density. Meanwhile, in secondary districts, street space often has a shorter development history is used for a certain purpose; for example, Lien Chieu district has been developed for the industrial purpose. However, due to the

mixed landuse in residential areas and shop houses in Vietnam, differences in social conditions in the research area are insignificant, then possibly ignored.

The study did not take motivations and characteristics of a particular respondent into account. Individuals choose to or not to engage in activities and social interaction for many complicated reasons. This study focused on objective, microscale, physical environment improvements to street space and users response to those variables. Users were considered as respondents to the environment. Therefore, it is not necessary to include personal characteristics as part of this study.

Limitations in the traditional technical survey would be revealed. In addition, precisely using behavior mapping in street space and matching them with the map are time intensive and require good skills to do well. The near future employment of GPS/GIS will help to save time and improve the accuracy of this process.

There is limited previous literature research on physical settings of street space. This topic has not been widely studied in Vietnam, and there are not so many publications about street space in Vietnamese culture and urban context, especially those as to detailed observations to public-private space, activities, and physical environments. In order to find more references regarding street space, literature studies to a number of references in various disciplines were conducted.

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Chapter 5 CONCERNS OF USERS ON STREET SPACE

5.1 Introduction

5.1.1 Background

Vietnam has little history of public space and Western culture has just begun to influence modern society through pseudo-public spaces such as private leisure spaces. Still, the most commonly public space is the street space [1]. Due to the lack of public spaces, the local government implemented a plan to improve urban street space, improving urban street settings through the use of design elements and facilities that enhance quality of life and encourage human activities. Several researches reckon the most important design criteria for a livable street is the provision of comfort such as Carr, S. (1992), Jacobs, A. B. (1996) and Carmona, M. (2003). Indeed, the environment is not the background of human activities but its nature; the environment is the mechanism in which human behavior is affected. Similarly, the relationship between the environment and human activity is inseparable [2-4]. The relationship between space and human behavior in the street space has been studied by scholars in a variety of different types of space and object. Except for traffic, street space is used as a public space, expressing various habits and activities. As Jacobs once said, street space should provide many services and functions as a gathering place, group interaction, and a space to soothe loneliness.

Study of human behavioral interactions with street space reveals the factors that affect the various positive and negative aspects of human behavior such as Anne and Moriez, White, Camillo [5-7]. Jacob [8] believes that physical quality affects the livability of street space. To extend this idea, Appleyard and Ismail [9, 10] found the significant role of activities on the street that made the livability of the environment. The physical design of the street is the actual structure of the place [11, 12]. Rahman [13] identified that there are five main factors that make people use the street: attractions, activities, proximity, congestion and supportive factors.

He also believes that the character of the streets varies according to the purpose and function of the location, physical form and appearance, socioeconomic and cultural characteristics of user as well as the inhabitant.

Unfortunately, the existing studies are either based on western social and cultural context, or only to a generalized level. When considering Vietnamese society which is currently transforming, or upgrading street space from old standards to new ones, there are still no specific studies to understand the impacts on street space. We hypothesize that only some of the basic elements in street space correlate with human attention behavior. This study aims to understand the relationship between user's attention behaviors in different street spaces. In more specific, it reveals within the features of street groups, human attention behavior and assessment along distinct street spaces and fills the gap in knowledge regarding to the design, improvement and management of street space based on human needs, local culture and diminishes the differences between actual requirement and exotic or intuitive design ideas of designer. The findings are also expected to support urban designer and policy maker in creating attractive space with regional characteristic and improving the quality of life as well as the urban environment.

5.1.2 Method and Materials

This study applied following research methods that can be summed onto outline of investigation:

1) Screening Survey

Due to the large amount of street space, along with many intricate features, a semi-structured questionnaire was designed to sort out the candidate street spaces within six districts of Da Nang city (see appendix 1). Because of various social classes in the street, 598 survey questionnaires were collected randomly from 14 and 87 years old ($M = 28.5$; $SD = 9.7$) and occupational diversity. Based on the

results of the survey, a total of 203 streets, were marked by inhabitants as either positive, 114 streets, or negative, 89 streets. According to street definition, nine roads with movements of heavy vehicles are excluded out of candidate list. Next step, based on extreme value analysis [14] and purpose of the survey, the streets with high ratings were retained (33 street spaces) and classified into two groups of improved and unimproved street space based on upgrading street space policy of local government, and eventually, eight street spaces were chosen for research survey (Figure 1.3) (Bach Dang St, Nguyen Tat Thanh St, 2-9 St, Tran Phu St, Le Duan St, Dien Bien Phu St, Ong Ich Khiem St, and Nguyen Huu Tho St).

2) Capture Evaluation Method Survey

By using CEMs (capture evaluation method survey), the survey was carried out in the period of time between August and September in the morning (6:00-9:00) and afternoon (5:00-8:00). This is the most appropriate time for outdoor activities. The respondents were collected from 20 participants (eight females and twelve males) who are architecture students, aged between 19 and 26 years old ($M = 21.25$; $SD = 1.65$). Each street was visited by 20 participants, leading to a total of 160 responses. The participants used specialized language [15], as a laypersons description of the environment would be too broad to be useful for this study. However, some researchers state there are no differences between the perception of architects and laypeople in evaluation of outdoor spaces [16, 17]. CEMs is a method applied by Koga [18] based on Noda's PPM (photo projective method) and the "Evaluation Grid Method" was proposed by Sanui and Inui [19]. Noda's NPPM (photo projective method) is a psychological method that analyzes the deep psychology of children who are not proficient in fully expressing their thought by language. They were given the camera and allowed taking of what they like, then conduct a psychological analysis by understanding the photos

taken. Even in the field of urban architecture, many years ago, this NPPM method has come popular (including Takahiro Hisa, Kunihiro Narumi, Neto et al.).

This survey method allows the participants to experience the actual environment to identify the problems, the factors they encounter or concern. This method helps to explore the users' concerns in that space without any limits. Survey's participants walk freely with a camera in the selected roads, when they encountered a factor in street space that they thought "good/not good", they photographed, made a report card, accompanied by notes corresponding to the following content. First, general assessment: this landscape good/not good. Next, point out by describing the landscape in three points: What element it is, how characteristic it is and what it does give an impression [18, 20] (See Appendix 2). From eight street spaces visited, 3,025 report cards were made as in detailed Table 5.1.

These cards were classified and divided into groups by similarity via Affinity diagram (sometimes called the KJ method), which organizes answers based on their natural relationships. Because the purpose of the research focuses on identifying the elements on street space that concerned the inhabitants; the

characteristics and impression responses found were ignored. The elements found along eight street spaces were classified into categories (Figure 5.1)

Table 5.1 The summary of CEM survey report card.

	Un-improved streets (UNImS)	Report number	Improved streets (ImS)	Report number
Positive	2-9 (2-9)	409	BD (Bach Dang)	402
	TP (Tran Phu)	352	NTT (Nguyen Tat Thanh)	409
Negative	OIK (Ong Ich Khiem)	368	LD (Le Duan)	361
	NHT (Nguyen Huu Tho)	357	DBP (Dien Bien Phu)	367

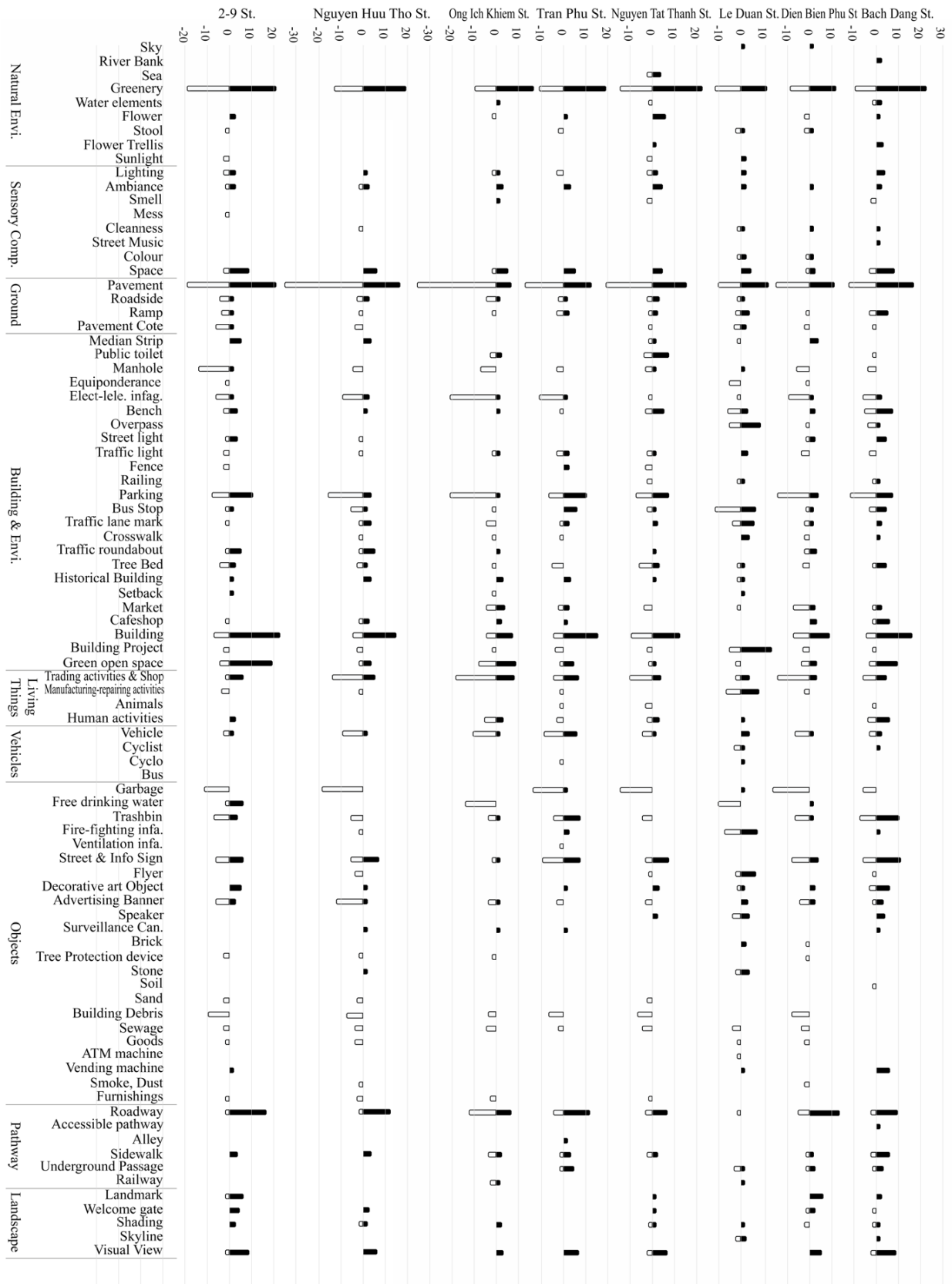


Figure 5.1 User’s attention behavior extracted from CEMs (unit: Attention Frequency in both negative (-)and positive side(+)).

5.2 Characters of Users' Attention Behavior on Street Space

In brief, users' attention behavior (or concerns) along the street space aimed at 88 elements and classified into nine categories, including [I. Natural Envi.], [II. Sensory Comp.], [III. Ground Surface], [IV. Blv&Envi], [V. Living Things], [VI. Vehicles], [VII. Objects], [VIII. Pathway], [IX. Landscape] (Figure 5.1). Because of the difference in length of street and sample size at each of surveyors' eight street spaces, instead of direct comparisons between investigated groups, there is another approach of comparing the attention (or concerns) frequency of users to elements between different street spaces.

5.2.1 Fundamental Elements for Necessary Activities

It's clear that, the frequency of the user's attention can be summed in both negative and positive sides. By comparing the elements (over average) concerned by people on eight street spaces, author found eight elements that are most attention and throughout streets as follow sidewalks (recorded 335 times), greenery (recorded 296 times), building (recorded 164 times), parking (recorded 148 times), Trading activities & shop (recorded 126 times), garbage (recorded 114 times), roadway (recorded 124 times) and trashbin (recorded 69 times). Those account for 1,376 times (47.86%) of 2,875 times extracted from CEMs.

5.2.2 The Impact Level of Fundamental Elements to Human Attention Behavior

In this part, “the impact level” is defined as potential impact of an element resulting in use’s assessment of street space.

Using multiple linear regression analysis, the variables were introduced into the model by the Enter method.

The adjusted R² correction is 0.278, indicating that the relationship between the independent variable and the dependent variable is significant, namely the independent variables such as sidewalks, building & trading activities and shop explain 27.8% of the difference of negative/positive assessment of the users (Table 5.2).

Table 5.2 Verify the concordance between the samples and its whole.

Model summary				
Model	R	R square	Adjusted R square	Std. error of the estimate
1	0.543a	0.295	0.278	0.757

a. Predictors: (constant), trash bin, greenery, trading activities & shop, building, street, garbage, parking, sidewalks.

After analyzing ANOVA for the suitability of the overall linear regression model (F = 17.240 with Sig. = 0.00) (Table 5.3), regression analysis showed that sidewalks, building and trading activities & shop were involved in the assessment of the users with B ≠ 0 and Sig. < 0.05.

Therefore, the sidewalks and trading activities & shop elements have a positive impact on the user’s evaluation and the building factor has a negative impact. According to the beta standardized coefficients (Table 5.4), the level of impact of the eight common elements on street spaces can be classified in the order as follow: Sidewalks > building > trading activities > garbage > street > greenery > trashbin > parking.

Table 5.3 Variance analysis.

ANOVA _a						
Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	79.114	8	9.889	17.240	0.000 _b
	Residual	188.720	329	0.574		
	Total	267.834	337			

a. Dependent variable: positive/negative.

b. Predictors: (constant), trash bin, greenery, trading activities & shop, building, street, garbage, parking, sidewalks.

Table 5.4 Linear multiple regression analysis.

Coefficients _a						
Model	Unstandardized coefficients		Standardized coefficients	t	Sig.	
	B	Std. error	Beta			
1	(Constant)	2.308	0.376		6.134	0.000
	Greenery	0.063	0.052	0.064	1.216	0.225
	Sidewalks	0.522	0.077	0.567	6.759	0.000
	Parking	0.009	0.082	0.007	0.113	0.910
	Building	-0.235	0.088	-0.185	-2.677	0.008
	Trading activities & shop	0.153	0.074	0.108	2.055	0.041
	Garbage	-0.175	0.115	-0.096	-1.528	0.128
	Street	-0.118	0.106	-0.071	-1.113	0.267
	Trash Bin	-0.100	0.084	-0.059	-1.195	0.233

a. Dependent variable: positive/negative.

5.3 User's Concerns Analysis according to Classification of Street Space

In this part, to go beyond analyze users' attention behavior, correspondence analysis and cluster analysis are used to reveal the difference of users' attention behavior with the classified street spaces.

Due to the prolonged survey process and rapid improving implementation in street spaces, it resulted in heterogeneity data between the street groups of

improved and unimproved roads. Therefore, instead of comparing user's attention behavior between two kinds of street spaces (improved and unimproved), authors decided to explore difference freely. This helps to determine specific relationship of user's attention behavior in each street space with specific settings and backgrounds.

5.3.1 Classification of Street Spaces

Based on CEMs, data related to street space characteristics were extracted, illustrated and classified according to its presence or non-presence in each street space (Table 5.5 and Figure 5.2).

By applying correspondence analysis for data of [feature of street spaces], the result indicates that cumulative is over 85% as shown in 1st-3rd axis (F1-F3) (Table 5.6).

On the F1, the yellow eigenvalue indicated features [relation with building in both sides and one side], [building debris], [vending machine] and [decorative art objects]. It means that the 1st axis mainly built based on the relationship between street space and building and presence of amenities

Similarly, on the F2, the highlight eigenvalue indicated features [median strip with greenery], [one-way roadway], related to [Tree]. It indicates the 2nd axis mainly built based on the comparison between presence of road diet, type and tree Eventually, the high eigenvalue of [quality of sidewalks], [spontaneous market], and [greenery on sidewalks] on F3 indicated the 3rd axis that can be understood as the relationship between street space and sidewalks quality, setting and spontaneous market.

Next, applying cluster analysis to cluster the data of quantification of eight street spaces. The results show that 8 different street spaces can be categorized into

three groups with the homologous characteristics (Figure 5.3). Figure 5.4 describes the relationship of streets in group based on cluster analysis.

5.3.2 Difference of Users' Attention Behavior to Elements Based on Groups of Street Spaces

User's attention behavior to the street spaces was recorded at 88 elements, therefore, the average frequency of each element caught human attention is normally reasoned at around 1.14% (assuming people attention behavior to elements on each street space is the same to each other.). For what factor that frequency appears less than 1.14% is considered a low frequency. While the frequency of a certain attention behavior to an element was found to be over 1.14% in more than half of the street spaces, when we focus on one group of street space, this element which caught people's attention in its group is defined as "frequent". Also, according to this rule, while the frequency of a certain user's attention behavior to an element was under 1.14% in all the street spaces, when we focus on one street space group, the user's attention behavior in this group is treated as "infrequent".

[Greenery], [Space], [Sidewalks], [Parking], [Building], [Trading activities], [Vehicle], [Garbage], [Trash bin], [Street & info Sign], [Roadway], [Building debris], and [Visual view], that were observed as "frequent" caught people's attention in most of street space's groups, and it can be classified as common characteristics along street space. Similarly, the differences of other attention behaviors to elements are also figured out according to different groups of street spaces (Figure 5.5).

[Manhole] & [Advertising Banner]: Users tended to pay more attention while they were walking along the unimproved street spaces. Typical group of street space are shown in [Group 1] such as Tran Phu St., Ong Ich Khiem St. and

Nguyen Huu Tho St. This implies that these two elements seem to make significant negative impression of street space in Group 1.

[Elect-tele infras.], [bus stop] & [green open space]: User’s attention behavior to these elements is found frequently on [Group1 and Group 2]. At first it seemed a little confused about this result, however, these two elements frequently appeared in these two groups make two opposite attentions—one is negative and another is positive.

Table 5.5 Typical feature of street spaces

Physical Features	UNImS				ImS				Physical Features	UNImS				ImS			
	BD	DBP	LD	NTT	TP	OIK	NHT	2-9		BD	DBP	LD	NTT	TP	OIK	NHT	2-9
Width pavement/ side-walks >5m *	1	1	0	1	0	0	1	1	illegal market	0	1	1	0	0	0	0	0
Adjacent to water	1	0	0	1	0	0	0	0	high curb * >15 cm	1	1	0	1	0	0	1	1
Relation with building	both side	0	1	1	1	1	1	1	Ramp	1	1	1	1	1	1	0	0
	one side	1	0	0	0	0	0	0	welcome gate	1	1	1	0	0	0	0	1
Bench	1	0	1	1	0	0	0	0	advertising banner	1	1	1	1	1	1	1	1
Median strip with greenery	0	1	0	1	0	0	1	1	Instruct sign	1	1	1	1	1	1	1	1
One-way roadway	1	0	0	0	1	0	0	0	Building debris	0	1	1	1	1	1	1	1
Width setback	0	0	0	0	0	0	0	1	greenery on pavement	1	1	1	1	1	0	0	1
footpath	1	1	1	1	0	0	1	1	elec-tele infra. messy	0	0	0	0	1	1	1	0
Tree*	Small	0	1	1	1	0	1	1	elec-tele infra. orderly	1	1	1	1	0	0	0	1
	Big	1	0	0	0	1	0	0	business street	1	1	1	0	0	1	1	0
Quality of sidewalks**	Good	1	1	1	1	1	0	0	Parking on Sidewalks	1	1	1	1	1	1	1	1
	Bad	0	0	0	0	0	1	1	Parking on Roadway	1	1	1	1	1	1	1	1
Roadway*	Wide (>15m)	1	1	1	1	0	0	1	bus stop shelter	1	0	1	1	0	0	1	1
	Narrow (<15m)	0	0	0	0	1	1	0	Green space/ Canopies	1	0	1	1	0	1	0	1
Trash bin**	Big size	1	1	1	1	1	1	1	flower trellis	1	0	0	1	0	0	0	0
	Small size	1	0	1	0	1	0	0	vending machine	1	0	0	0	0	0	0	0
Trading on sidewalks	1	1	1	1	1	1	1	1	historic building	1	0	1	0	1	0	0	0
garbage	1	1	1	1	1	1	1	1	viewing platform	1	0	0	1	0	0	0	0
public toilet	0	0	0	1	0	0	0	0	traffic light	1	1	1	1	1	1	1	1
									decorative art objects	1	0	0	0	0	0	0	0
									Stagnant waste water	0	0	0	0	0	1	0	0
									landmark	1	1	0	0	0	0	0	1
									Accessible pathway	1	0	1	0	0	0	0	0
									Cyclist path	1	1	1	1	0	0	0	1

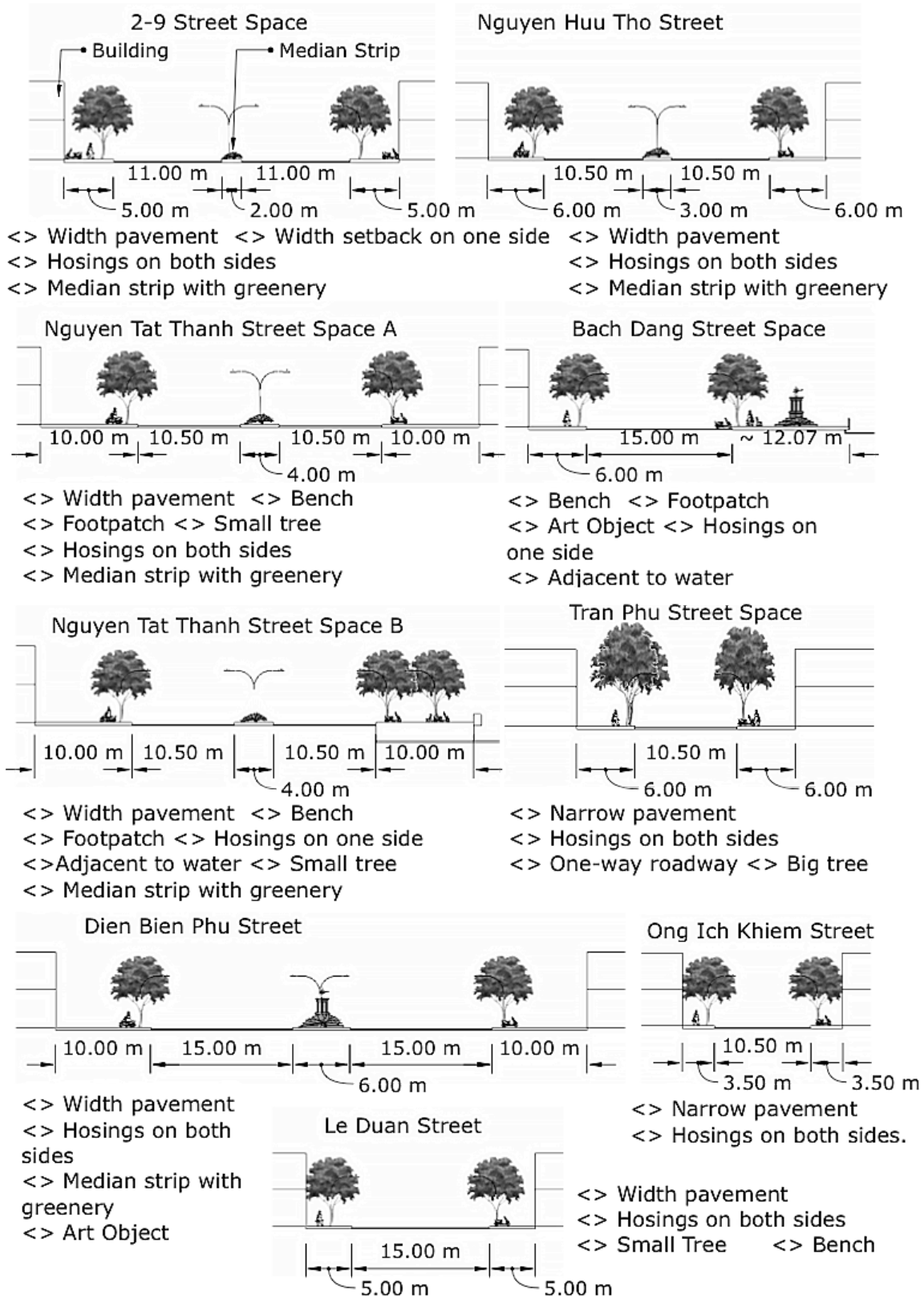
*. Based on the TCVN (Vietnam Urban Roads - Specifications for Design)

** . Based on the apparence of observed objects

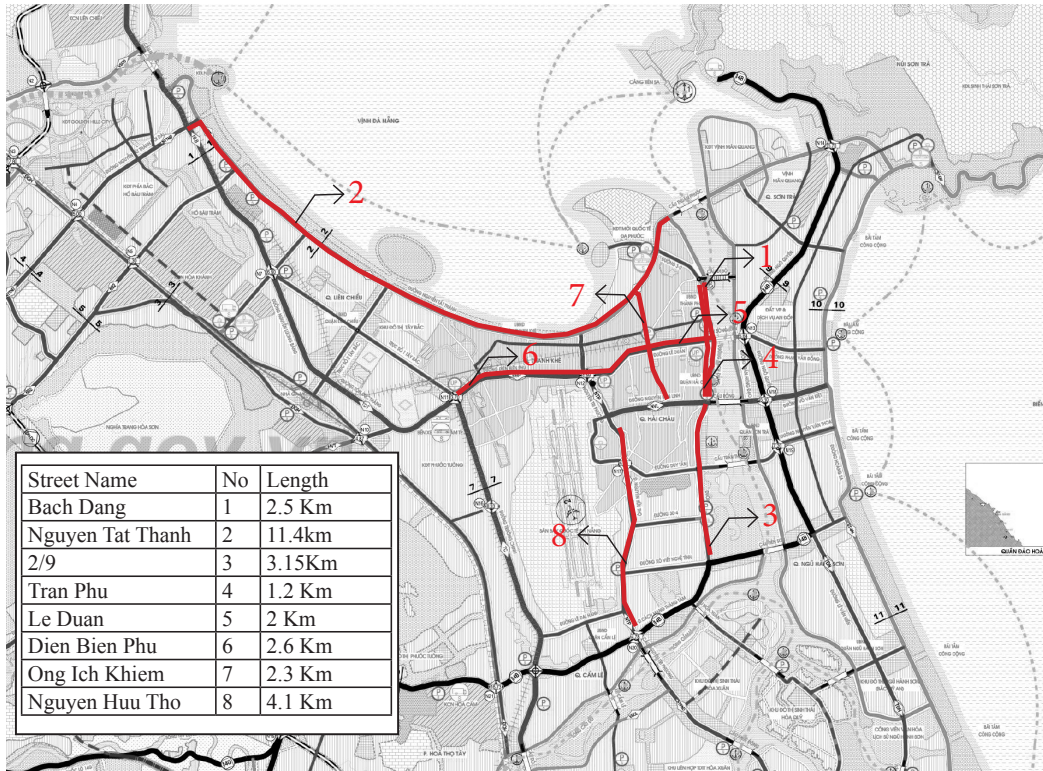
1= Existence ; 0 = Non-existence

Table 5.6 Scores of street space features in three axes.

Feature of street space	F1	F2	F3
relation with building both side	0.041	0.020	0.020
one side	0.041	0.020	0.020
Median strip with greenery	0.000	0.045	0.007
One-way roadway	0.009	0.054	0.000
Tree Small	0.009	0.054	0.000
Big	0.009	0.054	0.000
Quality of sidewalks good	0.026	0.000	0.054
bad	0.026	0.000	0.054
spontaneous market	0.001	0.006	0.091
Building debris	0.041	0.020	0.020
greenery on sidewalks	0.026	0.000	0.054
vending machine	0.041	0.020	0.020
decorative art objects	0.041	0.020	0.020
Eigenvalue	0.282	0.192	0.1
Inertia (%)	35.004	23.837	12.421
Cumulative %	35.004	58.841	71.261
Adjusted Inertia	0.071	0.030	0.006
Adjusted Inertia (%)	56.044	23.993	5.073
Cumulative %	56.044	80.037	85.110



(a)



(b)

Figure 5.2 Typical cross sections and street location in the whole city; (a) cross sections; (b) street candidates in entire city.

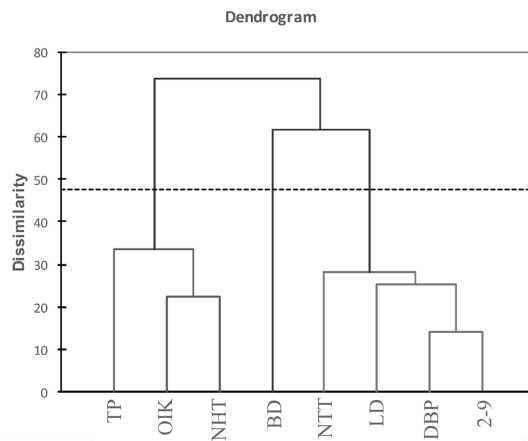


Figure 5.3 Cluster of street spaces.

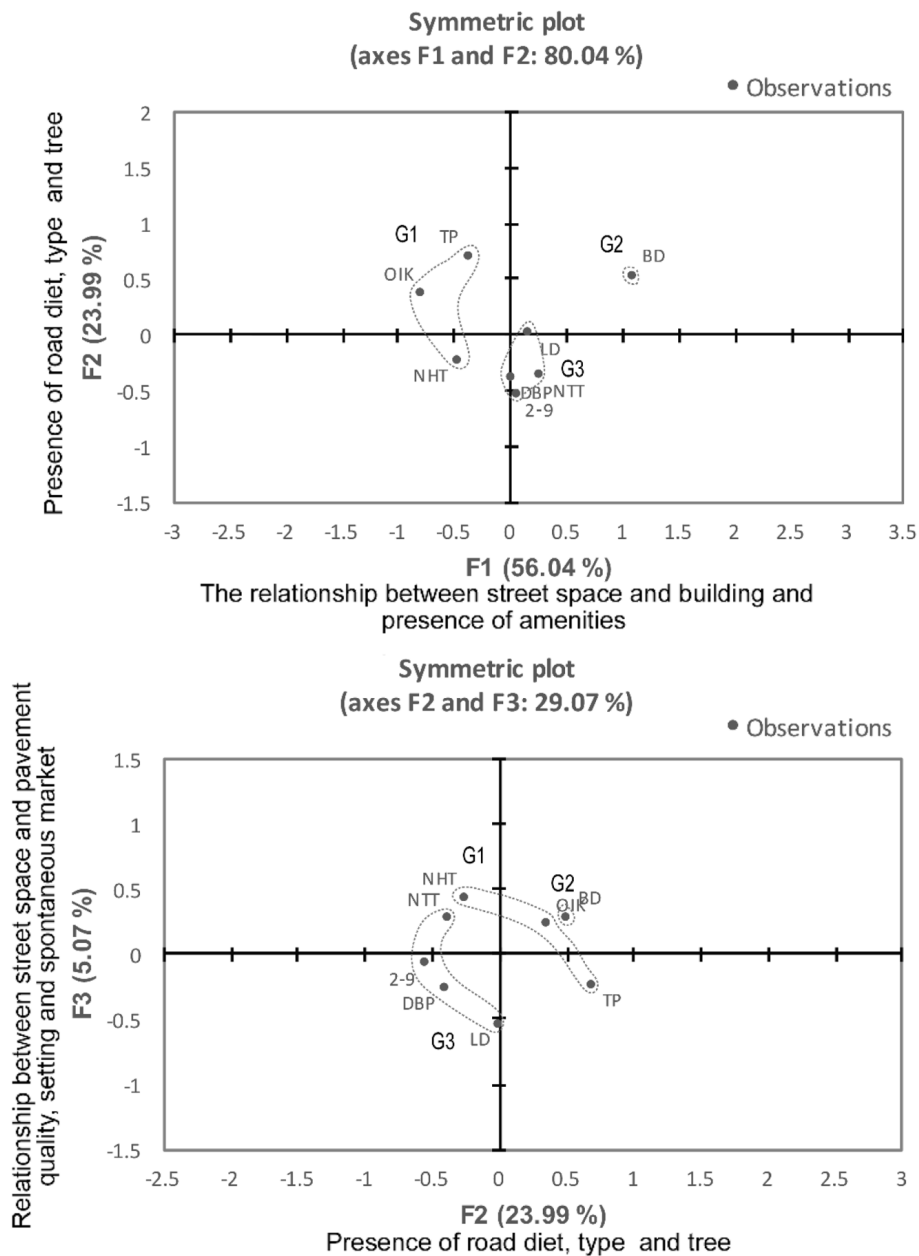


Figure 5.4 Cluster of quantification scores.

[Bench]: People frequently tended to be attracted to the seat while they are participating on the street space of [Group 3] & [Group 2]. This is plus point for a positive street space

[Tree bed]: [Group 3] was the only group where users frequently paid attention on these elements. Compared to other groups, even though improved street spaces [Group 3], the users still did not pay much attention to this element.

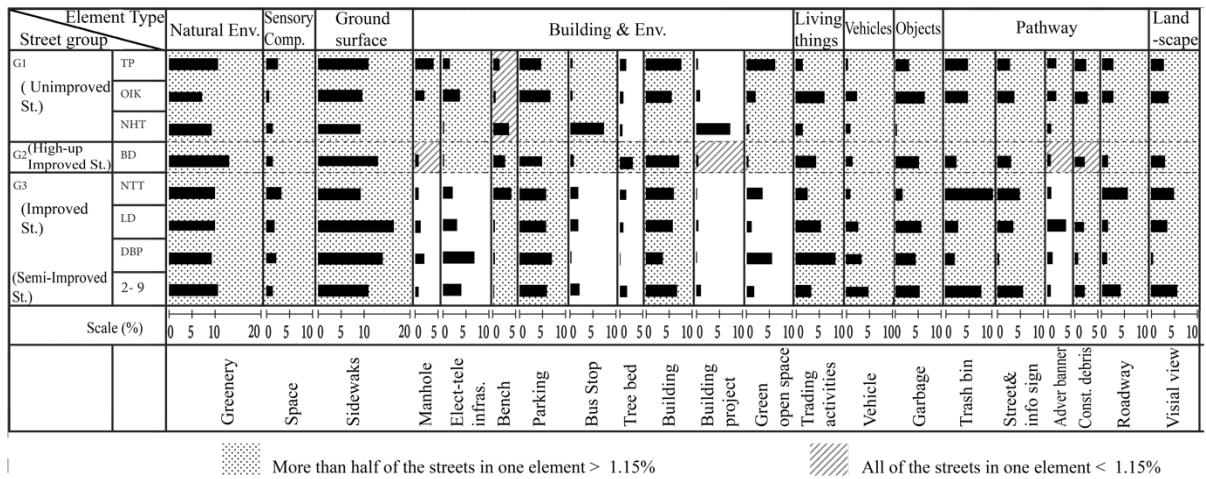


Figure 5.5 The difference of attention behaviors between street groups

5.3.3 Difference of Users' Assessment

To better understand the intrinsic difference of the user's attention in negative and/or positive side corresponding to each different street space groups, the difference of users' assessment (positive and negative) at each group of street space was compiled and shown in Figure 5.6. The user's assessment is defined as an element that caught people's attention in positive or/and negative side.

According to 80/20 rule (Pareto Rule), user's assessment that has as a cumulative rate of elements equaling 80% is defined as the threshold to find out which elements affect the behavior of the passengers' attention in this analysis.

Street Group 1

80% passengers' positive attention (assessment) lies on 10 elements as follows: greenery, building, sidewalks, roadway, trading activities & shop, green open space, space, parking, street & information sign and visual view.

80% passengers' negative attention (assessment) lies on 10 elements as follows: sidewalks, garbage, parking, electric-telegram infrastructure (elect-teleg infras.),

trading activities & shop, greenery, vehicle, roadway, street & information sign, building debris.

Street Group 2

80% passengers' positive attention (assessment) lies on 11 elements as follows: greenery, sidewalks, green open space, visual view, space, parking and bench.

80% passengers' negative attention (assessment) lies on 10 elements as follows: sidewalks, parking, greenery, trash bin, trading activities & shop, garbage, street & information sign, electric-telegram infrastructure, bench and building.

Street Group 3

80% passengers' positive attention (assessment) lies on 9 elements as follows: greenery, sidewalks, building, roadway, green open space, parking, visual view, space and street & information sign

80% passengers' negative attention (assessment) lies on 12 elements as follows: sidewalks, greenery, garbage, parking, trading activities & shop, building,

building debris, manhole, electric-telegram infrastructure., trash bin, street & information sign, and bus stop.

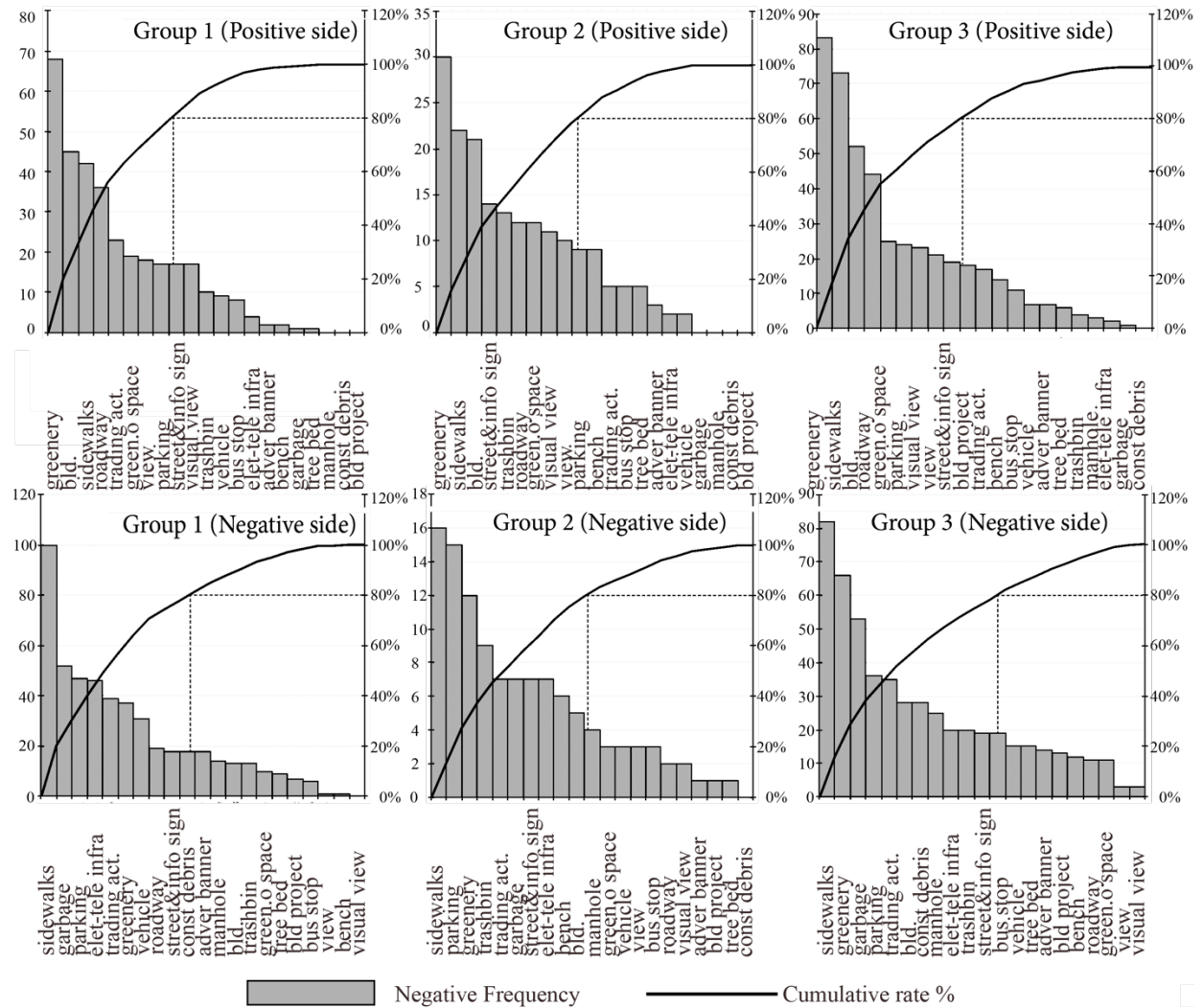


Figure 5.6 The difference of user’s assessment in both side among street groups

5.4 Summary and Discussion

5.4.1 Summary

The purpose of this research is to seek the relationship between user’s attention behaviors in different street spaces. Research findings reveal that the basic factors

attracting the most attention in the street space of Vietnam society can be summarized as:

(1) According to CEMs extracted, passengers' attention behaviors (or concerns) along the street space are focused on 88 elements and classified into nine categories, including [I. Natural Envi.], [II. Sensory Comp.], [III. Ground Surface], [IV. Bld&Envi], [V. Living Things], [VI. Vehicles], [VII. Objects], [VIII. Pathway], [IX. Landscape].

(a) Users' attention behavior characters

Users' attention behaviors (or concerns) along the street space are dominant on eight elements that are most attention and throughout all streets as follow: sidewalks, greenery, building, parking, trading activities & shop, garbage, roadway and trashbin.

(b) The impact level of fundamental elements to human attention behavior

Although the user is interested in the elements that can be positive or negative side, or sometimes both, the impact level is defined as potential impact of an element resulting in use's assessment of street space and the statistic results showed that passengers' attention behavior was impacted in the following order: Sidewalks > building > trading activities > garbage > street > greenery > trashbin > parking.

(2) According to correspondence analysis and cluster analysis, street spaces were classified into three groups with common features and characteristics. Therefore, the difference of passengers' attention behavior and their assessment are revealed as follows:

(a) Difference of users' attention behavior

Beside 13 elements including [Greenery], [Space], [Sidewalks], [Parking], [Building], [Trading Activities], [Vehicle], [Garbage], [Trash bin], [Street & Info Sign], [Roadway], [Building Debris], and [Visual View] that reckoned a cause of

users' attention behavior in all street groups, the differences of each group are also revealed.

Passengers paid more attention to [Manhole] & [Advertising Banner] in unimproved street spaces (Group 1), whilst [Elect-tele Infrs.], [Bus Stop] & [Green Open Space] are caught frequently human attention in unimproved street and high-up improved street space (Group 1 & 2).

Users were interested in [Bench] while they were walking on the street space in improved street spaces (Group 2 & 3) and only [Tree Bed] was concerned by passengers when participating in high-up street spaces (Group 2).

(b) Difference of users' assessment

In positive responses

Most of positive attention in three street groups (high-up improved, improved & semi-improved, unimproved) is mostly the same (with nine elements in Figure 5.5), however, there are some unique elements existing on specific streets which are result of its difference.

On unimproved street space (Group 1), [Trading Activities & Shop] took a part in catching users' attention, whilst, high-up improved street (Group 2) was added more two elements of [Trashbin] and [Bench].

In negative responses

Almost a half of elements in the list that bring negative attention to passengers are the same among street groups (with seven elements in Figure 5.6). However, there are some overlaps between each pair of street group namely [Building Debris] is caught negative attention on unimproved street space and improved & semi-improved street space; [Trashbin] and [Building] concerned as negative point in improved street spaces (Group 2 & 3).

The distinct difference among street groups that considered to be the cause of users' negative attention is: [Vehicle], [Roadway] on unimproved street spaces

(Group 1); [Bench] on high-up improved streets (Group 2); [Manhole] and [Bus Stop] on improved and semi-improved spaces (Group 3).

5.4.2 Discussions and Implications

For this case of street space improvement, physical settings are the most important part of creating the interaction between human and space initiating with human attention, thus, necessary elements for human requirement should be detected and given priority in design. Moreover, characteristics of passengers' attention behavior and their assessment on each specific street space need to be understood to support street space design process and improvement.

Based on the above findings and conclusions, the improving street space design should focus on eight fundamental elements to satisfy general users' requirement along street space. Priority in design and implementation is ordered in the following order [sidewalks/sidewalks] > [building] > [trading activities] > [garbage] > [street] > [greenery] > [trashbin] > [parking].

Based on street space characteristics, street spaces can be divided into three different groups, indicating that there is another different classification of street spaces rather than two as in the original definition (unimproved & improved). Each of these street groups contains common and specific elements that attract the users' attention. In order to develop a variety of spaces and satisfy human needs, the findings of the user's evaluation show that the elements (Figure 5.6, Table 5.7) in each street group contribute to the improved efficiency up to 80%. In this study, the characteristics of user's attention behavior and what way they were caught attention are revealed in relation to their street space in a systematic

way. The next studies will focus on user's cognitive and activities on street spaces to compare the characteristics of human behavior between street space groups.

Table 5.7 Factors that affect up to 80% of the assessment value of the user.

	Group 1 (UNImS)	Group 2 (high-up ImS)	Group 3 (ImS & semi-ImS)
Positive responses	1. Greenery	1. Greenery	
	2. Building	2. Walkpath	1. Greenery
	3. Walkpath	3. Building	2. Walkpath
	4. Roadway	4. Street & info sign	3. Building
	5. Trading act & shop	5. Trash bin	4. Roadway
	6. Green open space	6. Roadway	5. Green open space
	7. View	7. Greenery open space	6. Parking
	8. Parking	8. Visual view	7. Visual view
	9. Street & info sign	9. View	8. View
	10. Visual view	10. Parking	9. Street & info sign
		11. Bench	
Negative responses			1. Walkpath
	1. Walkpath	1. Walkpath	2. Greenery
	2. Garbage	2. Parking	3. Garbage
	3. Parking	3. Greenery	4. Parking
	4. Elect-tele infra.	4. Trash bin	5. Trading act
	5. Trading act	5. Trading act	6. Building
	6. Greenery	6. Garbage	7. Bld debris
	7. Vehicle	7. Street& info sign	8. Manhole
	8. Roadway	8. Elect-tele infra.	9. Elect-teleg infras
	9. Street & info sign	9. Bench	10. Trash bin
10. Building debris	10. Building	11. Street & info sign	
		12. Bus stop	

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Chapter 6 CHARACTERISTICS OF ENVIRONMENTAL BEHAVIOR ON UNIMPROVED STREETS

6.1 Introduction

6.1.1 Background

The quality of urban open space has been proved to provide social, psychological, and economic benefits [1] that contribute to the sustainability of urban development [2, 3]. Street not only serves as traffic function which connects urban environment elements together, but also as open space providing a place for social interactions, community engagements, and daily activities such as trading, physical exercises, active travel and private use [4-10]. Although Vietnam has poor history of public space, modern society has been influenced by Western urban phenomena in constructing pseudo-public spaces [11]. Nevertheless, Vietnamese people often tend to use street space and its pavements as a public space for their leisure and daily activities [11]. In context of Vietnamese urban street, the difference of two terms “public” and “private” that was described by Drummond (2000) is ignored. The boundary of using public and private space on the street is unclear and transgressed or blurred from “inside out” [11]. This means, individuals utilized street space for private activities that turns part of the public street space to their nominally private space [11]. This phenomenon is explained by Drummond (2000) in the description of Vietnamese social and cultural behaviors. Domestic scholars have further explained the use of street sidewalks as a living habit; the so-called “pavement culture” of the Vietnamese is closely tied to the concept of “economic pavement”, both of which make a distinctive characteristic of Vietnamese cities [12]. Over years, streets and their pavements have been encroached upon for various purposes that affect traffic safety as pedestrians have to travel on roadways congested with motor vehicles. The street environment is also affected by the litter. The chaotic status and irregular use of sidewalks for various purposes distort the urban visual view,

affecting the streetscape and image of the city. To address mentioned problems, municipal authorities have upgraded street space by expanding road-widths, arranging street furniture, increasing pedestrian paths, improving the quality and area of pavement, with the aim of making street space tidy and more orderly. Also, the campaign namely “Taking pavements back to pedestrians” has been deployed to remove or curb/control private uses of street space and pavements.

6.1.2 Previous Studies

Perspectives of street space and pavements have turned those places intended by design for a purely traffic function into multifunctional spaces which then play a role as public places. Initially termed by Jacobs in the work namely “The death and life of American cities,” street space was seen as public one [13]. Appleyard (1980) introduced plenty of concepts that considered a street as a community; as a place for lots of public activities for residents nearby; as neighborly territory [14]. In accordance with those perspectives, studies of Hoehner (2005), Mehta (2008), Mateo-Babiano (2007), and Espina (2018) aimed at impacts of street space and pavements on human beings; focusing on aspects like public health, and recreation [15-18]. The socio-culture cohesion was examined to produce some solutions for building, designing and renovating better street space for citizens. In many Vietnamese cities, attempts of the government to upgrade and expand open street space are the most feasible for meeting demands of inhabitants when faced with the scarcity of urban open space. Most recent attempts to the management of street space and pavements by banning private and trading activities encroaching on pavements have been undertaken; where the government expects to establish Western-like, modern and neat urban space. This has become a matter of controversy among Vietnamese scholars. It is true that different users may perceive space in different ways [19]; to illustrate, for designers, visual quality is often the top priority in building open space, while

this element is frequently underrated by users [1]. Besides research that proposed to design street space based on Western countries' experience, with the aim of building pedestrian-friendly street space and promoting social interaction[20], other studies put emphasis on respect and preservation of street activities in Vietnam as part of cultural value and accepting such a multifunctional space as a feature of Vietnamese cities [11, 12]. Research on the relationship between environment and user's behaviors helps to provide a sustainable and livable environment. With respect to Vietnamese street space, the research of Do (2018) identified factors that affect user's attention and established which physical elements should be prioritized in this space [21]. However, no study has yet focused on the relationship between environment and user's behaviors in this space. Moreover, no approach has been done to renovate street space based on how user's behaviors respond to street environment.

6.1.3 Objective and Significance of Research

Given methods of renovating and managing street space and pavements have aroused the controversy about how to build up environments for sustainable that matches the socio-cultural context of Vietnam. Although some research suggested general solutions by referencing models of other countries, the most important design standard for a good living space is satisfying the demands of users [22], and each social class also affects the different use of the street space [23]. So, most importantly, it is necessary to research the relationship between user's activities and environmental factors in unimproved streets as this will become a vital input in designing, renovating and establishing management methods of street space. This study seeks to discover Vietnamese behavioral characteristics and psychological needs in urban street space and associated pavements, and to understand the impact of street environment elements on users'

behavior, so as to provide the foundation for improving quality and usability of street in the near future renovation and management.

6.1.4 Unimproved and Improved Street Definitions

The trend of movements toward multifunctional, pedestrian and cycle-friendly streets can be found in the 1970's as described in the 1976 perspectives of Jane Jacobs in her work that called for return to and eyes on the streets [24]. The street renovation was firstly introduced in the Netherlands under the Woonerf scheme that residential streets can be managed by inhabitants[25]. This renovation led to the interaction between traffic and commuters, but separating activities of pedestrians and cyclists from automobiles traffic[25]. Some woonerven projects have eliminated curbs, reduced traffic by using speed limits signs, modifying infrastructure such as speed bumps, street narrowing, and four-way stop signs that promoted the social cohesiveness[25]. In early 1990s, "Home zones" were made in the UK that share the street space for pedestrian and vehicle traffic[26]. The term of "Complete Streets" was initiated in the USA by Appleyard's research that since then has recently inspired countries to aim at influencing physical and social activity by a means of street improvements. Therefore, street improvement initiatives aim at increasing street use of pedestrian and non-motorized movement; also, streets are designed and managed to provide safe access for all users[27].

Following that trend, Vietnam's urban areas have begun to upgrade and renovate street space. Streets were actually built up in accordance with old standards of French or American colonial periods, in order to serve Vietnam wars and mainly function as means of commute. This previous intent of use does not meet the demands of modern cities with the high population density and resident's use of motor vehicles. Cities previously had the lower population density; moreover, citizens at that time rode bicycles and walked, so roads were narrow without any

street furnitures and simple pavements. The upgrading of Vietnam’s street spaces included two main steps. The first stage is embellishing streets by such installation of amenities common elsewhere in the world such as paving sidewalks, arranging signs, traffic lights, and street lights, and drawing parking lines with pedestrian crossing (Figure 6.1). This stage is mostly complete for the urban streets of Vietnam. However, the second stage that focuses on expanding streets, pavements, enhancing pavement quality by using higher quality surfaces finishes, growing trees, arranging visual objects, benches, design trash bins, greeneries, parking areas/ line and ban or manage vendors/ traditional trading/ private activities is a recent phenomenon and has been achieved in limited locations.



Figure 6.1 Renovation situation of street space in Vietnam.

6.1.5 Materials and Methods

This study applied following research methods that can be summed onto outline of investigation:

1) Selecting Research Area

Two chosen streets for this research are Ong Ich Khiem Street and Tran Phu Street located in Da Nang city - in the Central Vietnam (Figure 6.2, Table 6.1). This city was built up under French colonial period and then became a military center in the war. After 1980s, the city developed to become one of three largest cities in

Vietnam. Two mentioned streets were built pre-1980, then being embellished and used until now for a variety of activities and functions. In addition to commuting and travel, the streets are used for private and commercial function. Some of these functions have a negative impact on the street space. Indeed, although those streets have yet to be renovated with poor quality and physical settings, many activities have encroached pavements and roadway exerted series of mutually negative impacts in such space. These are a suitable place for research on good

features of the relationship between human activities and the environment in old streets.



Figure 6.2 Street space samples location and current situation.

Table 6.1 Street space samples overview.

Street Name	Ong Ich Khiem	Tran Phu
Street Type	Collector Streets	Collector Streets
Length	2.22 km	2.3 km
Width	10.5 m	10.5 m
Pavement Width	1-4 m	4-6 m
Landuse along the street	Residences, Commercial Buildings, Greenspace, Markets, School, Shop house, Administration Agency, Public building	Residences, Commercial Buildings, Greenspace, Markets, School, Shop house, Administration Agency, Public building
Setback	1.2 m	1.2 m

2) Outline of investigation

To avoid bias and in an attempt to obtain a complete list of all activities along the streets; observations were conducted for 3 different time frames including morning (6am-9am), noon (11am-2pm), afternoon (4pm-7pm) on two weekdays and two weekends. The observations included two stages; firstly, the investigation of current structures and kinds of physical settings that the streets contained was carried out and reported; secondly, all user's street activities were recorded on the paper-based maps based on place-centered behavioral mapping (PcBM) and visual encounter surveys (VES) (For further descriptions, see appendix 3). The place-centered behavioral mapping (PcBM) is used to make a graphical representation of the study location, dividing into different segments. The observation contains photographs or time-lapse recordings of behaviors and position of people in each segment. This type of observation is considered more suitable for the study of a particular physical space[28]. Visual Encounter Survey (VES) method is used to document the presence of individuals, and it can provide both quantitative and qualitative data and were formalized by Campbell & Christman (1982)[29]. It was conducted by observers walking through a designated area for a prescribed time, visually investigating the required objects. The physical environment investigation was conducted on May 4th (Friday) and May 5th (Saturday) using VES method that requires observers to walk along the street to collect all data regarding current situation of street environment such as physical setting, audio and scent (Figure 6.3). User's activities were collected by PcBM on two weekend days and two weekdays; May 12th (Saturday), May 19th (Saturday), May 15th (Tuesday) and May 17th (Thursday) that record all users' activities in physical, social and stationary terms. Participants in one certain activity were considered as an activity unit (Figure 6.3).

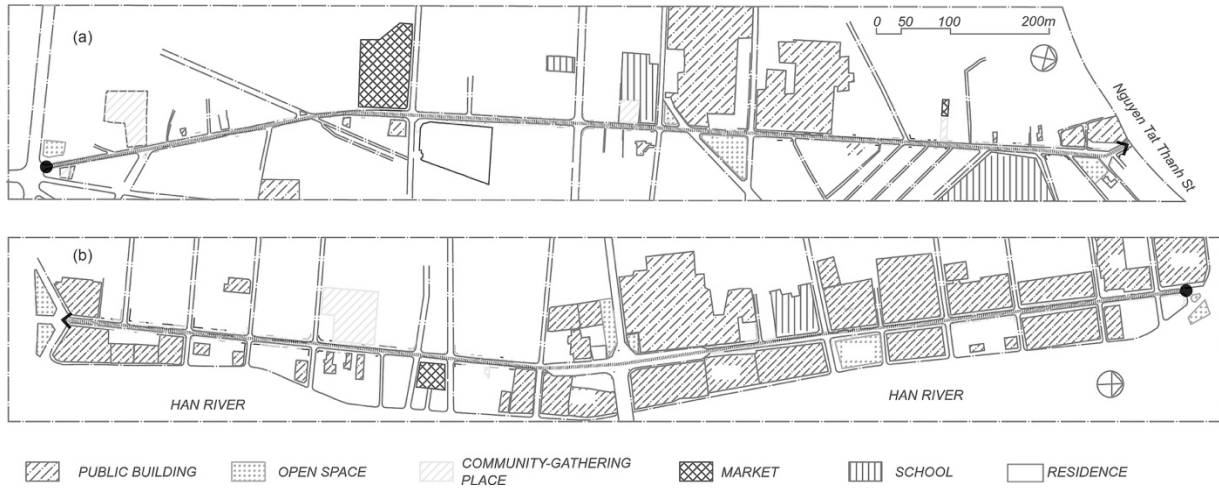


Figure 6.3 Investigation route in two street spaces: (a) investigation path on Ong Ich Khiem St; (b) investigation path on Tran Phu St.

3) Definition of users' behaviors and its categories

User's behaviors were defined based on their action/activities within personal environment and then classified into behavior categories according to behavior settings, which are ecological units where the physical environment and the behavior are indissolubly connected[30-32]. Based on investigation data (i.e. photos, video records), all typical user's behaviors were collected. Due to the huge quantity and variety of activities on streets and pavements, user's behaviors, before classification, would be thoroughly observed and common behavior settings that present in the street space would be carefully created and denominated to describe purposes of relevant activities to surrounding

environment based on the theory of proxemics proposed by Edward T. Hall [33](Figure 6.4).



Figure 6.4 Schematic representation of user's behavior definition.

4) Division of street segments

According to street space characteristics and behavior setting concepts mentioned in the last section, the street environment and user's behaviors can be divided into sections (Figure 6.5). Section A, which describes the space where two or more streets intersect (excluding small alleys as they do not attract no motorized traffic movement), has potential in various traffic movements. Intersections of both streets Ong Ich Khiem Street and Tran Phu Street were defined as Section A and A7 respectively. Section B refers to segments where houses are on both sides of the street and they were named B and B' for these spaces in Ong Ich Khiem Street

and Tran Phu Street respectively. The typical sections of each type are illustrated in Figure 6.6.

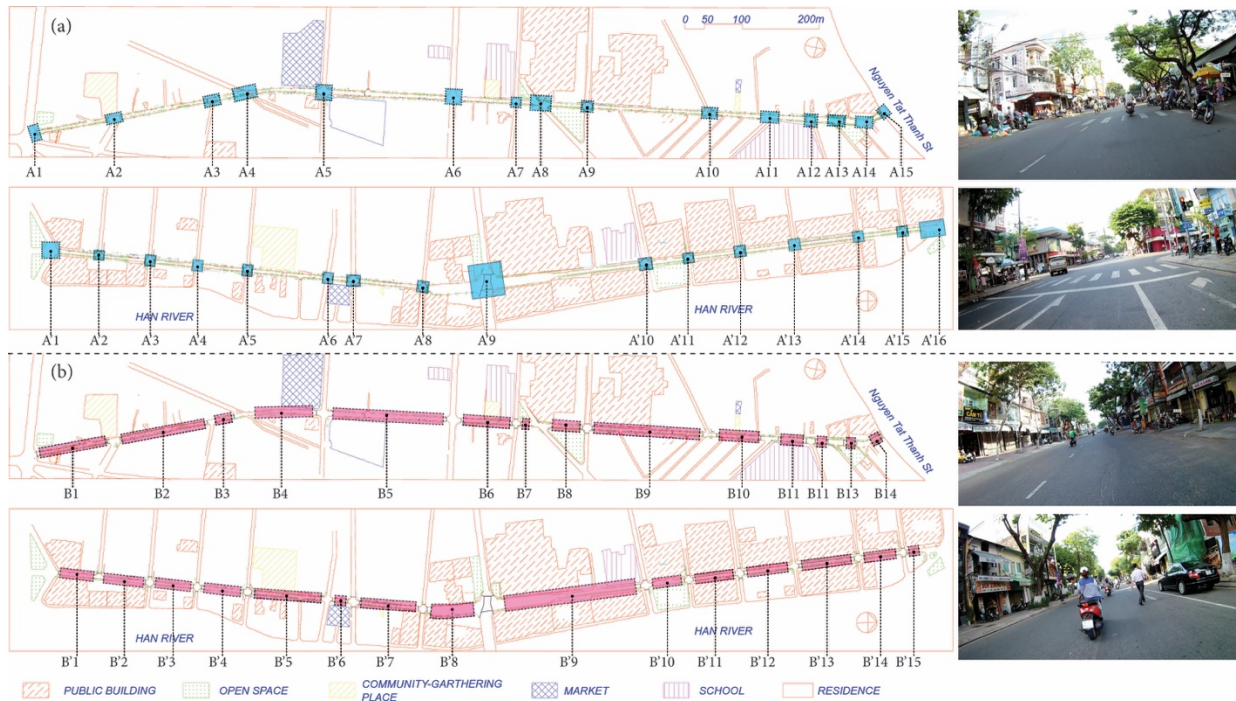


Figure 6.5 Street sections division: (a) A sections - intersection spaces; (b) B sections (middle street segment)– unit front houses in both side.

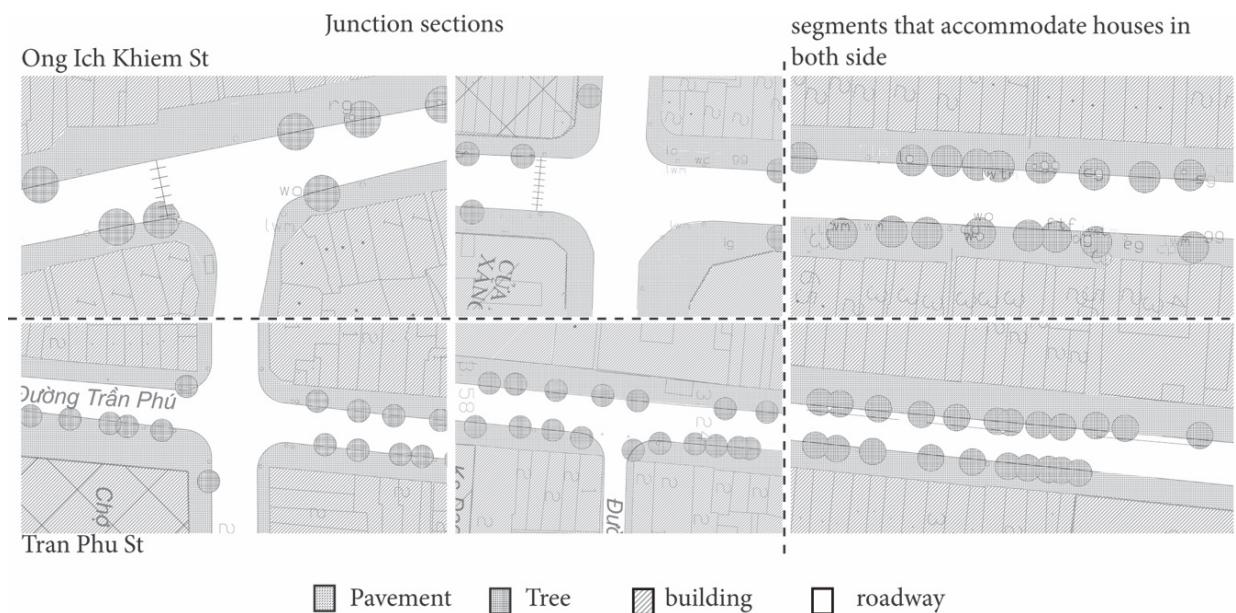


Figure 6.6 Typical space structure of both kinds of sections in two streets.

Behavior Settings on Unimproved Street Space

6.1.6 Behavior Categories

All user's behaviors were collected, described and the descriptions classified into 6 categories and 26 subgroups (Figure 6.7).

(1) The first group refers to the accessibility by users. This category describes the act of walking to a destination or arriving and departing that place by motor vehicles. This behavior group consists of four types. The first one is "crossing road" which happens when being allowed or not, residents cross the street when needed. The second one as "walking for destination" refers to the act of walking along the street on sidewalks and street. In the social context of Vietnam, pavements are often occupied for personal purposes of residents, thereby pedestrians have to travel on street. The third and fourth types are called "coming/leaving with motorcycle/without motorcycle", which describe the act that residents plan to leave pavements to participate in mainstream traffic on roads, or to approach certain areas of pavements from mainstream traffic on roads.

(2) The second kind of user's behavior regarding trading activities includes 4 medium types. Firstly, "fixed food transaction place" is primarily fix location food vendors that operate from the pavement area. The second type is similar to the first one, but are mobile food trading along pavements or roadsides, or what is commonly known as street vending. The two remaining types are similar, describing the trading of such goods as consumer goods or unprocessed food.

(3) The third category is about idling behaviors like standing and waiting for something. This type is divided into four subcategories; firstly, "waiting before crossing road" details the act of waiting for red traffic light in intersections before crossing roads. Secondly, "waiting for others" describes the act of temporarily parking motorbikes at roadside or on pavements to wait for relatives buying something or doing something in a short time. Thirdly, "waiting for the bus" often

occurs in bus stops. Finally, “waiting for the customers” refers to the long-term wait, which often occurs on pavements where motorbike drivers wait for new guests.

(4) The fourth category that describes behaviors of service/maintenance consists of 5 subcategories. The first group mentions “cleaning” activities, which, as the name states, mentions the act that residents clean pavements in front of their houses or shophouses. Meanwhile, “commercial preparation” refers to activities of arranging and displaying goods for sales, which often take place on pavements. “Guarding” is named for the activity of those getting chairs outside shops on pavements and observing or supporting customers, concurrently keeping motorcycles away from thefts in some stores or banks. That environmental staff takes care of plants along streets or collect litters is classified in the category of “public maintenance”. Finally, the act of “repairing” occurs on pavements to serve needs of repairing vehicles, making keys, and other amenities.

(5) The fifth classification of user’s behaviors is regarded as for relaxation that can be divided into 6 smaller groups. “Playing” that refers to children-related activities occurs on pavements or in the roadside. “Reading” includes reading newspapers, reading books or reading other information on electronic devices; those activities often occur on pavements. The act of “strolling” of citizens and travelers often takes place on both pavements and roadsides and they regularly go for a walk to sightsee and enjoy the urban atmosphere or simply escaping from cramped spaces of roll houses. On sidewalks right in front of house doors, people often lean back on their chairs, do nothing and watch the world go by, which are seen as a means of relaxation and denominated as “looking others”. “Resting” refers to relaxing activities occurring on pavements as taking naps on chairs or motorbikes or taxis. The final one is the act of gathering to “chat” on pavements, or even in roadsides.

(6) The last group can be called as “others” that mentions 3 subgroups. The first one indicates “inquiring” behavior that can be seen when people stand on

roadsides and quickly asking/ communicating with others for something. The two remaining behaviors are related to “eating” and “drinking” that occur on pavements occupied by food or beverage vendors. People sit on chairs with tables in front of them.





(a) Typical behavior pictures		(b) Behavior findings and categories			
	Resting, Sidewalk, semi-private space *: In front of the wall with notice board, with awning and canopy above, behind electric pole **: Moto-taxi driver leaned against the wall take a rest. ***: 1	Walking over roadway Walking along roadway/sidewalk Walking/Driving in/out sidewalk	Crossing road Walking for destination Coming/Leaving	Access- bility	
	Waiting for the bus, sidewalk *: Bus stop, next to the tree, the public building was set behind **: User sat at the bus stop to wait for the bus	Standing/Siting at food spot on sidewalks/semi private Standing/walking at food spot on roadway Standing/Siting at retail/service on sidewalk/semiprivate Standing/walking at retail/service on roadway Standing/Siting at bus stop/ bus stop sign on sidewalk	Food transaction fixed Food transaction mobility Goods transaction fixed Goods transaction mobility Waiting for the bus		
	Assessibility, Roadway *: In the roadway, both side is shophouse **: The female crossed the road for her destination ***: 1	Stopping/standing at crossing-pedes./traffic light on sidewalk Siting at retail/service on sidewalk/semiprivate Stopping/parking at with scooter on roadside/sidewalk Sweeping/tyding up with gear on sidewalk/semiprivate Setting out certain things at retail/service on sidewalk/semiprivate	Waiting for crossing road Waiting for customers Waiting for others Cleaning Commercial Preparing Tree/Public maintenance Guarding	Service/main- tenance	Relaxation
	Inquiry, Sidewalk, roadside *: In front of residence, next to the entrance and intersection, with canopy and awning, tree **: People communicated about something ***: 3	Pouring water at greenspace/lawn/tree on vacancy Siting/standing/watching scooter at retail/service on sidewalk/semiprivate Working with machine at retail/service on sidewalk/semiprivate Teasing together at sidewalk/semiprivate/ roadway Setting/Looking into the book/ news sidewalk/semiprivate/ roadway Walking/Looking around by group at supermarket/plaza/sidewalk/roadway Siting/standing look other action housing eaves/semiprivate Siting/leaning against the wall, chair, saddle Siting/standing by group and talking retail/service on sidewalk/semiprivate Siting at retail/service/food spot on sidewalk/semiprivate Standing and talking on roadway	Reparing Playing Reading Strolling Looking others Resting Chatting Eating/ Drinking Inquiring		

Figure 6.7 Summary of users’ behaviors along streets and its pavements: (a) identifying behaviors samples; (b) behavior setting and its categories

6.1.7 Statistics of Users’ Behavior

Within four survey days, the frequency of behavior units appearing on both streets was 3636 times. On basis of behavior category as mentioned on Section 3.1, the occurrence frequency of user’s behaviors on each group is shown in Table 6.2. The behavior group as “Accessibility” occurred the most frequently and could be considered as the dominant behavior on two streets (recorded 1287 times). In the subdivision of “accessibility”, “leaving/coming with motorcycle” was treated as the behavior with the highest frequency of 626 times compared with others on the street. Three kinds of behaviors as “walking for destination”, “waiting for others”

and “looking at others” came the second in the same street with the reported frequency of 331 times, 314 times, and 302 times respectively.

The sections with the highest frequency of behaviors in two streets were revealed in Figure 8. Most noticeably, those sections emerged in middle street segments that accommodate residents with row houses in both sides as B1, B2, B4, B5, B9, and B'5 recording 242, 239, 230, 505, 232 and 231 times respectively (the overall average behavior frequency is 60.6 times). By contrast, in some junctions, the frequency of human behaviors was low (below average), only Section A'7 was recorded with nearly average frequency of 61 times.

Meanwhile, the diversity of behaviors appearing in all sections of both streets were found on Sections B4, and B5 with 25 or more kinds of behaviors; B1, B2, B6, B8, B'2, B'5, B'7 with over 20 kinds of behaviors; A2, B3, A4, A8, B10, B11, B'4, A'7, B'9, B'13 with over 15 kinds of behaviors. The remaining sections had the nearly average or lower frequency, which refers to the poverty of human activities in this space, most noticeably as A'15, B'15, A'10, A'1.

Table 6.2 Occurrence frequency of users' behavior.

Behavioral Category	Specific Behaviors	Behavior frequency in Ong Ich Khiem St	Behavior frequency in Tran Phu St	Total
Accessibility	crossing road	62	48	110
	leaving/coming with motorcycle	421	205	626
	leaving/coming without motorcycle	146	74	220
Trading	walking for destination	204	127	331
	food transaction fixed	66	8	74
	goods transaction fixed	25	2	27
	food transaction mobility	78	4	82
	goods transaction mobility	51	21	72
Idling	waiting for crossing road	46	24	70
	waiting for others	225	89	314
	waiting for the bus	4	11	15
Service/ Maintenance	waiting for customers	70	55	125
	cleaning	73	23	96
	commercial preparation	57	16	73
	guarding	46	111	157
	public maintenance	20	17	37
	repairing	51	8	59
Relaxation	playing	21	9	30
	reading	75	36	111
	strolling	72	117	189
	looking others	210	92	302

Others	resting	29	29	58
	chatting	50	32	82
	eating	89	9	98
	inquiring	76	34	110
	drinking	122	46	168



Figure 6.8 The sections with high occurrence frequency of behavior in two streets.

6.2 Behavior Analysis according to Physical Environment Classification/ Distribution of User' Behaviour Response to Street Space Characteristics

User's behaviors and street environments were further analyzed using principal component analysis (PCA) and cluster analysis (CA) to reveal the distribution of user's behaviors related to physical environment features along the streets.

6.2.1 Classification of Environmental Characteristics of Street Space

Data related to physical environment features around streets and their pavements were collected and tabulated in Table 6.3, denoted by "1" and "0" for the presence and absence respectively. The characteristics of street environment were processed by PCA via Xlstat statistical software add-in of Microsoft Excel.

The analysis results show that the cumulative contribution rate is 67.1 % explained in the 1st to 4rd axis as shown in Table 6.4.

On the first axis (F1), the negative eigenvalues indicate the feature of offices/ public agency, vacancies, greenspace, curb cuts, fire hydrants and unofficial signs, while the significant positive eigenvalues indicate the feature of retail & service, food spots, residence, awning, balcony, and store sign. Therefore, the 1st axis stands for Multifunctional usage and Vision of street space.

On the second axis (F2), the significant negative eigenvalues point out the features of sidewalk width of over 6m (TP)/ over 4m (OIK), trashcan, motorcycle parking line, and official signs, while the significant positive eigenvalues marks

the features of Street width of over 10.5m out. Therefore, the 2nd axis stands for Walkable and Navigation of space.

The significant positive eigenvalues on the third axis (F3) indicate recreational facilities, car parking area, and crossing pedestrian. Therefore, the 3rd axis stands for facilities of street

Finally, on the fourth column (F4), the significant positive eigenvalues indicate the feature of fence, and sign poles, while the significant negative eigenvalues aim to electric poles/infra. Hence, the 4th axis is for The Obstruction.

To some extent, four axes may explain all qualities and features of street spaces in this study. Using the environment characteristic data distributed within 60 sections to perform the cluster analysis, the sections can be classified into 12 groups (Figure 6.9 and Figure 6.10).

Table 6.3 Characteristics of physical environment in streets.

Section		A1	B1	A2	B2	...	B3	B'15	A'16	
Commercial/ private component	Retail + service	1	1	1	1	...	1	0	1	
	Food spots	0	1	1	1	...	0	0	1	
	recreational facilities	0	0	0	0	...	0	0	0	
	offices/public agency	0	0	0	0	...	1	1	0	
	vacancies	0	0	0	0	...	1	0	0	
	greenspace	0	0	0	0	...	0	1	0	
	residence	0	1	1	1	...	0	0	1	
Public Component	Sidewalk	Sidewalk width>6m* (TP); >4m* (OIK)	1	0	0	0	...	1	0	1
		curbcuts	1	1	1	0	...	1	0	0
		Amenities	trash cans	0	0	0	0	...	0	1
		fence	1	0	0	0	...	1	0	0
	obstructions	electric poles/infra.	1	1	1	1	...	1	1	1
		sign poles	1	0	0	0	...	0	0	0
		motorcycle parking line	0	0	0	1	...	0	0	0
		fire hydrant	0	0	0	0	...	0	0	0
	landscape	trees	1	1	1	1	...	1	1	1
		awning	1	1	1	1	...	0	1	1

		balcony	0	1	1	1	...	0	0	1
		setback (1.2m*)	0	0	1	1	...	1	0	1
Street	width	>10.5m*	1	0	0	1	...	1	0	0
functions	signs	official signs	1	1	1	1	...	1	1	1
component		unofficial signs	0	1	1	1	...	1	1	1
		Store sign	1	1	1	1	...	0	1	1
	transportation	bus stop	0	0	0	0	...	0	0	0
		car parking area	0	0	0	0	...	0	0	0
		crossing pedestrian	1	0	1	1	...	0	1	0

*according to Da Nang Urban Planning Institute

Table 6.4 Score of categories of physical environment in streets.

	F1	F2	F3	F4
Retail + service	0.849	0.001	-0.064	0.201
Food spots	0.445	-0.119	0.217	0.033
recreational facilities	-0.410	0.160	0.457	0.054
offices/public agency	-0.498	0.030	-0.492	0.092
vacancies	-0.366	-0.106	0.215	-0.068
greenspace	-0.482	0.378	0.161	-0.060
residence	0.829	-0.111	0.174	-0.040
Sidewalk width>6m (TP); >4m (OIK)	-0.463	-0.547	-0.073	0.237
curb cuts	-0.451	-0.276	-0.227	0.298
trash cans	0.082	-0.525	-0.148	0.231
fence	-0.172	0.020	0.045	0.473
electric poles/infra.	-0.088	-0.014	-0.033	-0.450
sign poles	-0.091	-0.241	0.265	0.502
motorcycle parking line	-0.207	-0.703	-0.157	-0.018
fire hydrants	-0.487	-0.160	0.426	-0.175
trees	0.012	-0.176	0.269	0.026
awning	0.659	-0.136	0.112	-0.077
balcony	0.560	-0.394	0.150	-0.255
setback > 1.2m	-0.384	0.178	-0.062	-0.072
Street width >10.5m	-0.066	0.580	-0.143	0.168
official signs	-0.108	-0.529	-0.098	-0.255
unofficial signs	-0.350	-0.196	-0.236	-0.301
Store sign	0.852	0.018	0.035	0.007
bus stop	-0.221	0.052	0.058	-0.104
car parking area	-0.535	-0.148	0.649	-0.150

crossing lane	0.071	-0.001	0.504	0.291
Eigenvalue	23.320	9.046	4.673	3.202
Variability (%)	38.867	15.077	7.788	5.337
Cumulative %	38.867	53.944	61.732	67.069

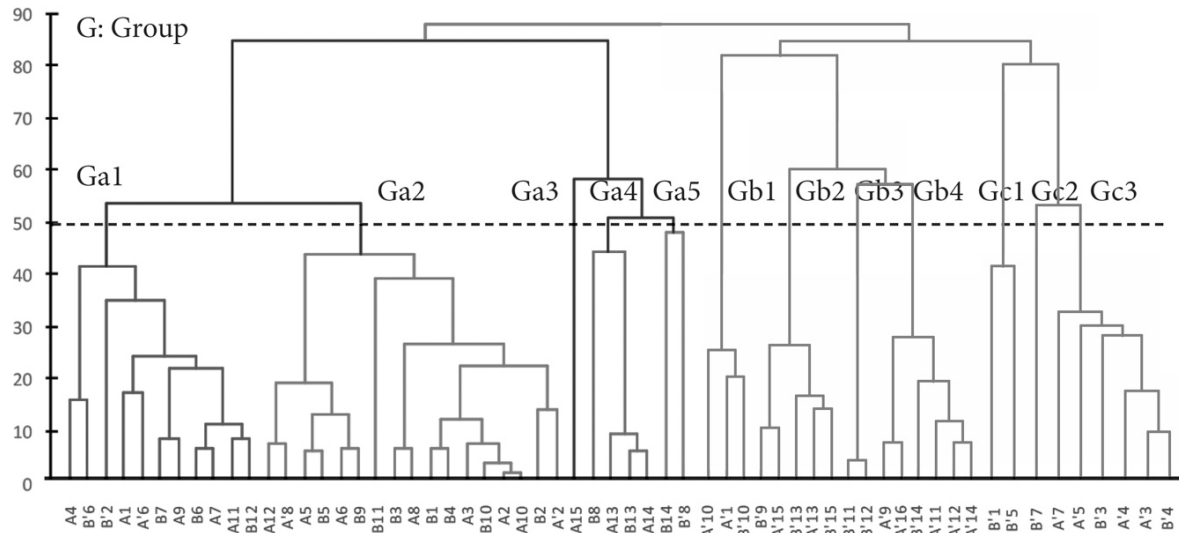


Figure 6.9 Section classification using cluster analysis.

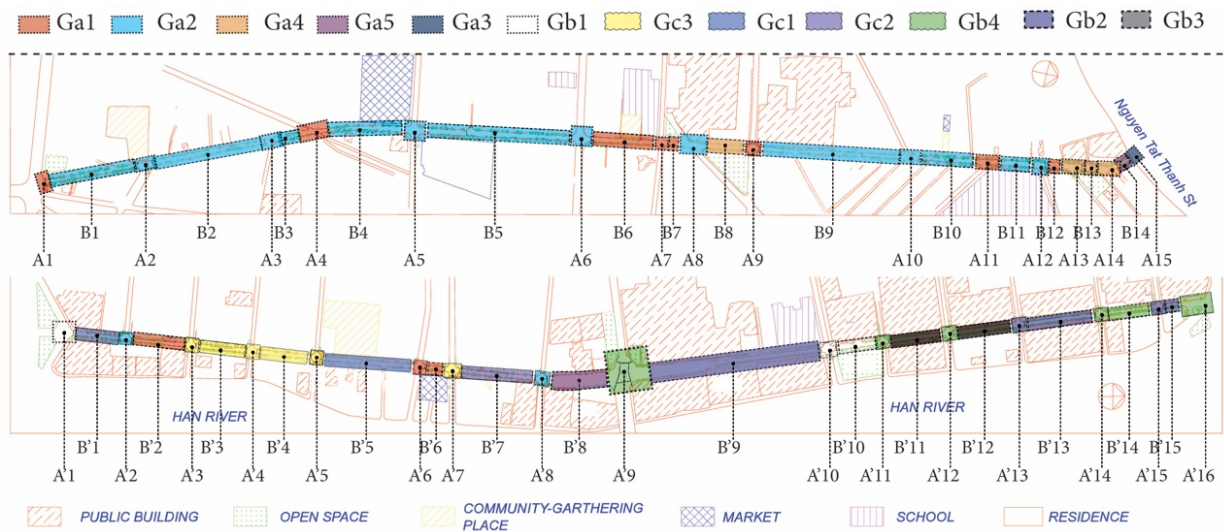


Figure 6.10 The distribution of sections in relation with 12 groups of environment space.

6.2.2 Distribution of User' Behaviors According to Different Groups of Street Space

User's behaviors along the street (60 sections) are categorized into 6 behavioral categories including 26 specific behaviors; the average frequency of each

behavior category in these sections is commonly reasoned as about 7%, hence the number of occurrences (over 7%) is considered as “high”. If the occurrence frequency of a certain behavior is over 7% in more than half of the sections, when focusing on one group of street space, the behavior in this group will be defined as “frequent”. With the same rule, if the frequency of a certain behavior is under 7% in all sections, when focusing on one group of street space, this behavior will be treated as “infrequent”.

Group Gc2 and Ga2 attracted most user’s behaviors with the high frequency in such behavioral category as [Accessibility] or [Trading], [Service/ Maintenance], [Relaxation], and [Others] which includes subgroups of crossing road, leaving/coming with motorcycle, leaving/coming without motorcycle, walking for destination, goods transaction mobility, cleaning, guarding, playing, reading, strolling, looking others, resting and drinking coffee. Meanwhile, Groups Gb1 and Ga3 were seen to discourage most human activities. Ga2 was observed to record neither highly frequent behaviors nor lowly frequent activities (Figure 6.11).

In short, analysis results indicate that the distribution of 26 specific behaviors is uneven in different group spaces. Also, it can be categorized into three typical

environmental behavior types that represent characteristics of each space for relevant physical settings. (Figure 6.12)



Figure 6.11 Distribution of Users’ Behaviors in 12 groups of space.

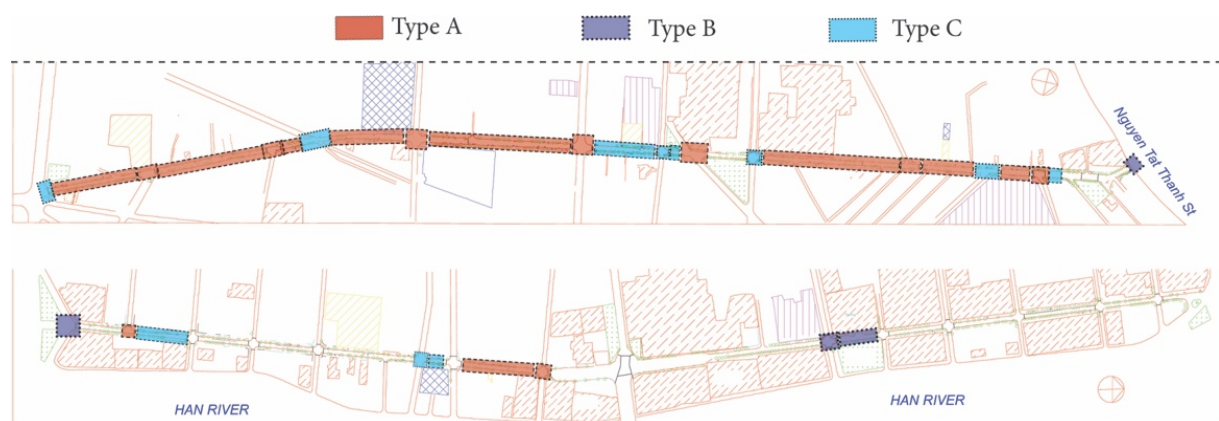


Figure 6.12 The distribution of three typical behavioral environment types on street space.

6.3 Summary and Discussion

6.3.1 Discussion of Relationship between User’ Behaviors and Physical Environment on Three Typical Environmental Behavior Patterns on Street Space

(1) Environmental behavior pattern discussion:

In Type A in which various frequent behaviors occurred and consisted of necessary/ optional/social activities such as [accessibility], [trading], [service/maintenance], [relaxation] and [Others] (Figure 11 and 13), the findings include:

Positive side: High level of Walkable & Accessible that benefited/ arose from wide pavement, setback/balcony, curb cuts and limited speed can provide space for various behaviors to strengthen connectivity and social interaction. The multifunction uses of the space benefited/ arose from various land use patterns such as shopping, public agency and residents; the various purposes encourages the diversity in a space to gather for various activities. Street Furniture that provided fundamental delineation of use such as parking line for motorcycle & car, tree bed and signage can create a space with high accessibility which is convenient for access and easy to navigate.

Negative side: High level of Walkable & Accessible: people tend to arbitrarily cross the road. This behavior can affect the transportation movements and become unsafe. Multifunction space: various activities and much access cause the congestion on the sidewalk. Street furniture such as parking line on pavement and roadside aggravates problems of congestion (pedestrian & transportation) as well as the resulting street parking obscures the urban vision.

In Type B where discouraged most human behaviors and activities (Figure 6.11 and 6.13), the findings include:

Positive side: Low level of Walkable & Accessible that arose from high volume of transportation and both disconnected sides of street, for example the tunnel here was separately set in both sides might mitigate pedestrian impacting vehicle use. Low level of Multifunction space that had poor land use patterns such as mainly public agency and vacancies can provide an unobstructed vision and appearance of neat organization. Street Furniture provided very fundamental

settings such as parking line for motorcycle & car, tree bed, and sign can create a space with high accessibility, which is convenient for access and easy to navigate. Negative side: Low level of Walkable & Accessible: people tend to abandon or isolate these spaces from each other. This can have negative effects on social interaction. Low level of Multifunction space: the main reason for discouraging human activities. Street furniture such as parking line on pavement and roadside is set up in some segments. But some without such furniture still does aggravate the problems of congestion (pedestrian & transportation) or obscure the urban vision, as there is no parking line in some cases, which means people can park anywhere.

In Type C where had neither frequent nor infrequent behaviors (Figure 6.13), the findings include:

Positive side: Medium level of Walkable & Accessible that arose from high volume of low speed transportation and narrow pavement can create a walkable space with various activities and enhance social interaction. High level of Multifunction space that had various land use patterns and various kinds of shop houses can attract various activities, promoting social interaction in cluster. Street Furniture that provided very fundamental settings such as parking line for motorcycle & car, tree bed, and sign can create a space with free access, which is convenient for access and easy to navigate.

Negative side: Medium level of Walkable & Accessible: due to narrow pavement and free access, people tend to do their activities everywhere as pavement or roadway. This causes congestion and accident. High level of Multifunction space: especially, trading activities encroached pedestrian paths and roadways. Street furniture such as parking line, tree strip on pavement and roadside is set up to aggravate the problems of congestion (pedestrian & transportation) as well as

obscure the urban vision. Moreover, the lack of mini trash bin is a reason for uncleanness.

In summary, the positives and negatives of the three street typologies are illustrated and clarified in Figure 6.14, which can be used as an input to improved designs for future streetscape proposals.



Figure 6.13 Characteristics of three typical types of environmental behaviors.

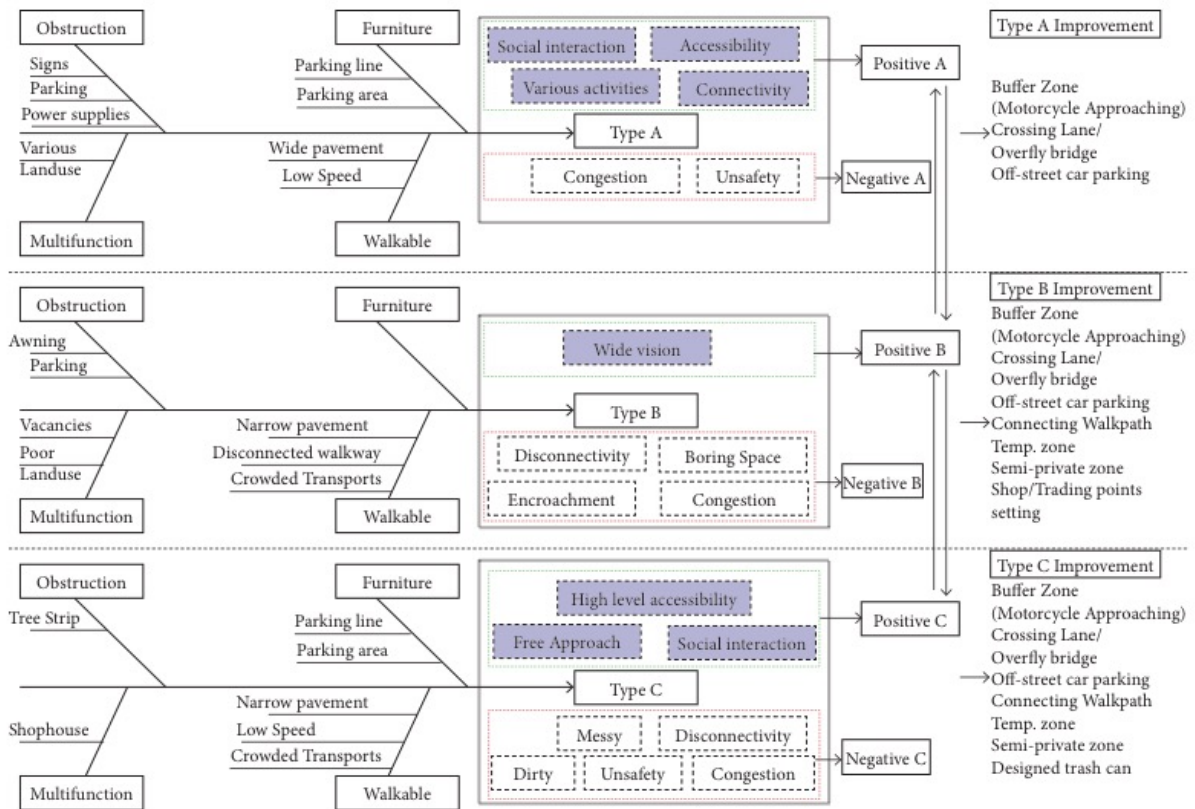


Figure 6.14 Cause and Effect diagram analysis between three typologies of street space and implications

(2)The implication of street improvement:

For A Type: To make streets accessible for people, improvements should be aimed to correct the problems in negative sides and remain the positive features (Figure 6.14 and 6.15). Firstly, providing proper buffer zones for motorcycle located between pavement and roadway for motorcycle and building the parking lots for car as well. Secondly, providing the suitable zebra crossing for pedestrians to connect both sides of street and create safer environment for users.

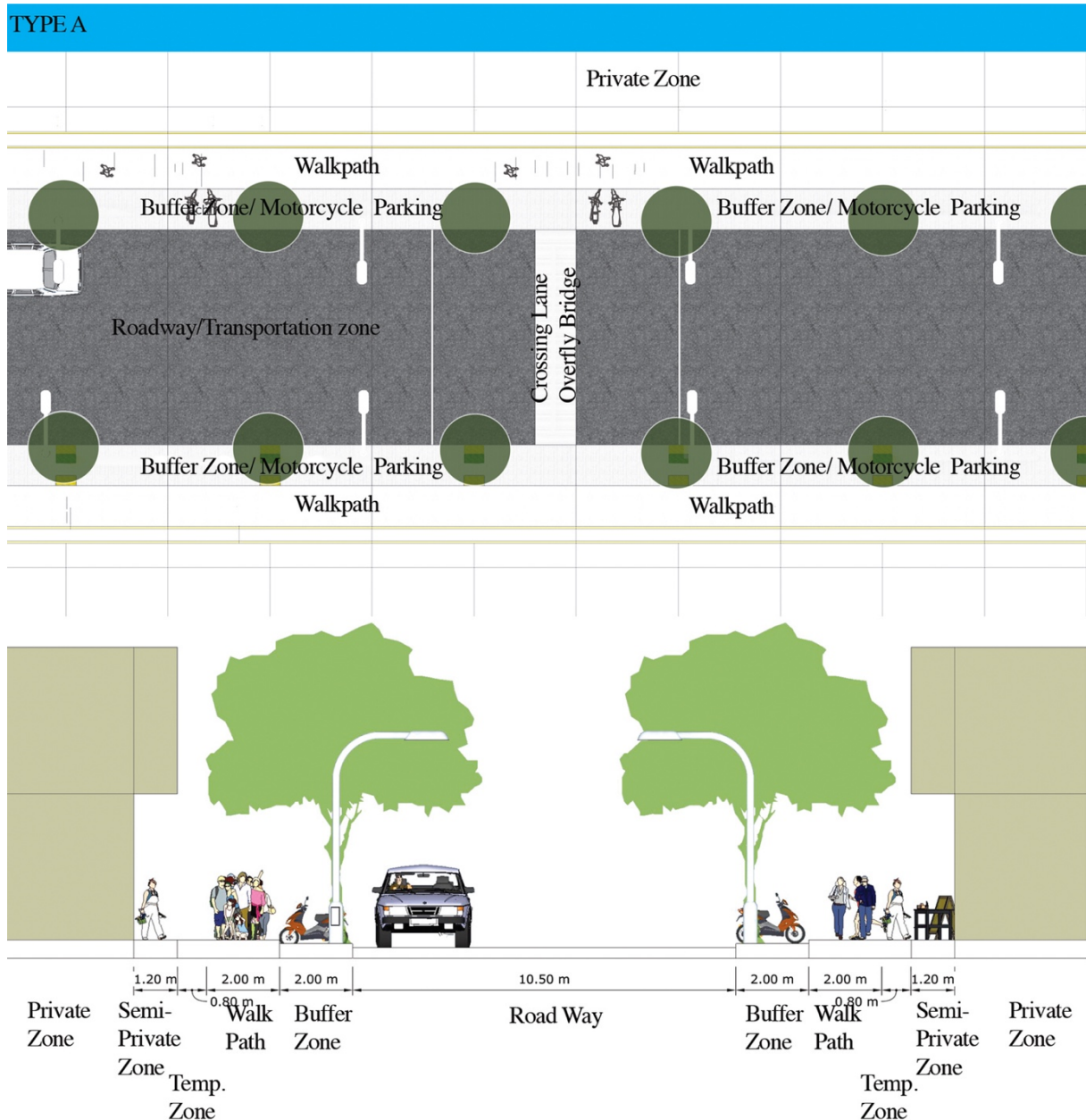


Figure 6.15 Type A improvement proposal

For B Type: To make streets accessible for people, the improvements above should be aimed to correct the problems identified in the negative & positive sides discussion (Figure 6.14 and 6.16). Firstly, reducing the speed and volume of transportation. Widening the pavement for human activities. Secondly, considering the provision of the safe connection line between both sides and blocks with high density of user's activities along the street. Thirdly, considering the provision of some specific "functions" such as setting up a space for

relaxation or parking purposes on pavement along segments occupied for public land use and vacancies. Fourthly, providing the buffer zones for motorized transportation.

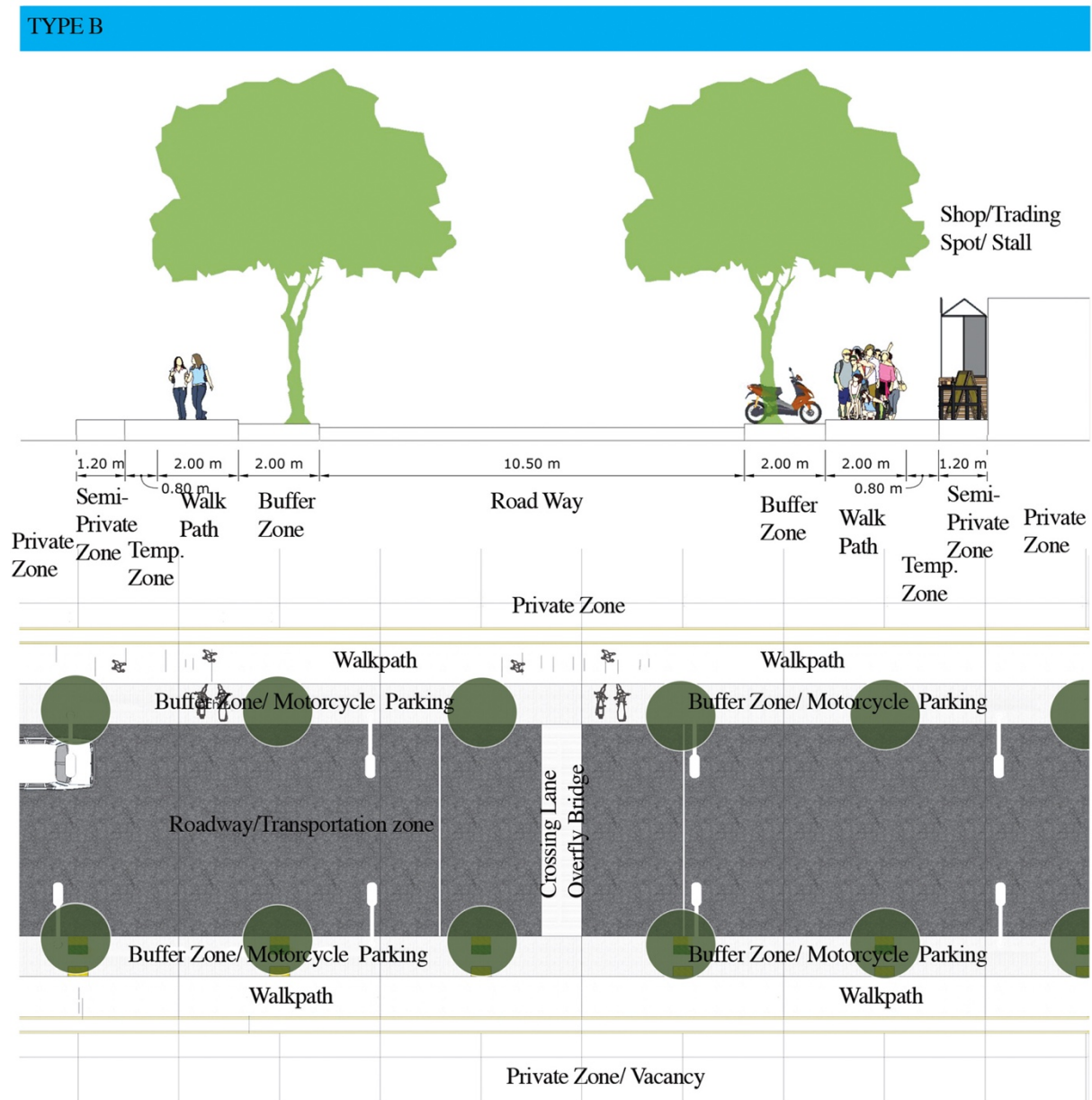


Figure 6.16 Type B improvement proposal

For C Type: To make streets accessible for people, the improvements should be aimed to (Figure 6.14 and 6.17). Firstly, widening the pavement for human activities. Secondly, applying the concept of sharing streets into permanent zone,

pedestrian zone, public use zone, access zone and transportation zone. Thirdly, considering the provision of the safe connection line between both sides and blocks with high density of user's activities along the street. Fourthly, providing street furniture such as bench and trash bin to serve the basic needs.

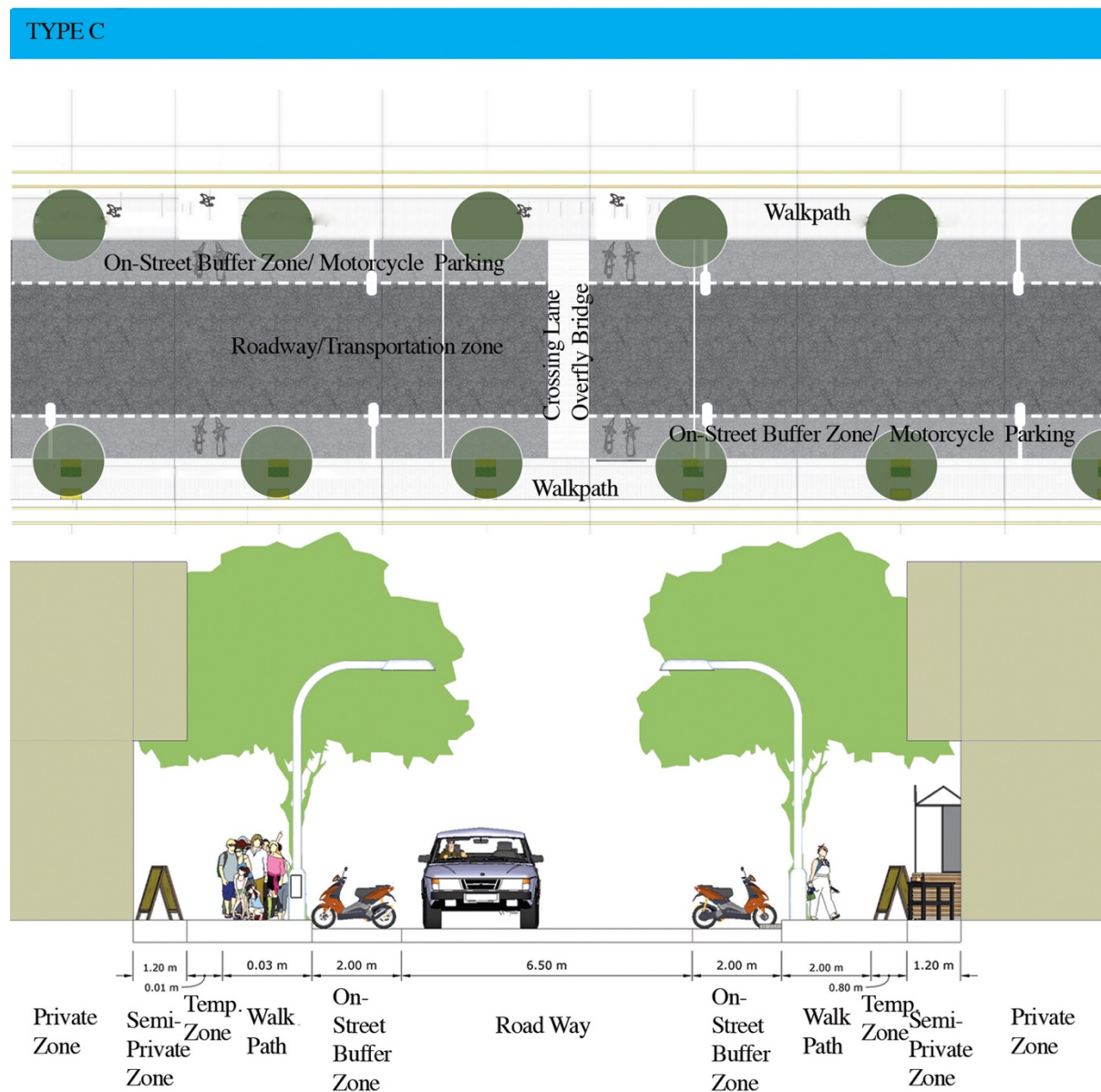


Figure 6.17 Type C improvement proposal

6.3.2 Managing Street Use

In this research, the meaning of maintaining activities can be seen in behavior settings of old streets which can be justification for positive impacts on daily life of human beings. Unimproved streets have low-quality environment conditions and narrow pavements with the lack of physical settings like street furniture, visual objects, bench, greenery strip and so on, compared with other improved streets. However, it is necessary to consider how to improve, manage and reasonably re-organize physical settings on the street during the process of street improvement. This study discovers that pavements are used for different purposes of residents, and also a medium space for human beings accessing their houses from roadsides and vice versa. Therefore, human activities in this space are often overlapped, especially some as leaving/coming with motorcycles, leaving/coming without motorcycles and walking to a particular destination. Nevertheless, it is necessary to consider the establishment of suitable space for motorbikes to avoid influencing activities on pavements. The current use of old streets also matches the research of Drummond (2000) on using street space of the Vietnamese as a public space for their leisure and daily activities and where there is little distinction made between “public” and “private” [11].

The theory of street sharing is widely used because of its potential in helping human to share street and pavement space with others. It is commonly understood that in the Vietnamese context this hypothesis is unlikely to be applicable, as landlords think that they are entitled to use part of pavements in front of their properties and allow no individual to use it for any purposes, except for temporary activities such as passing through their houses. The research findings however lead to a new hypothesis about the distribution of space and functions based on blocks in which function settings attract some certain activities. This helps the sharing of street space to become more effective, encourages movements along streets for people to enjoy and makes those travels become easily managed and

oriented. Now in Vietnam, the first step of the street distribution based on functions is also implemented by naming streets with the same functions, in which settings only attract some certain behaviors/ activities, and this helps to reduce pressure on street space that accommodate a variety of human activities. Also, the importance of the access to environmental behaviors that aim to research on streets can improve physical appearance and functions while human activities or cultures are still maintained, the society is strengthened and sustainably develops.

The findings that have contributed to this research still have possible limitations. Additional time allotted to the survey can determine if all street behaviors in different time frame and different patterns of behaviors can be identified; which can confirm if the previous sampling was sufficient. To enhance this factor, user's activities would be recorded by multiple video cameras at different areas for the whole day[34]. In addition, precisely using behavior mapping in street space and matching them with the map is time-intensive and requires skill to do well. The employment of GPS GIS will help to save time and improve the accuracy of this process[35, 36]. Human activities on streets can be affected by some factors as weather, seasons, gender, social conditions; the future research needs to classify their different behaviors in detail, and discover roles of those elements.

Upcoming studies can include a deeper analysis of human behaviors in street space that support the appearance of different behaviors and their interaction with motorized transportation movements. On the other hand, the expansion of research scope on human behaviors in some space that only supports certain behaviors and their connection with other forms of space with different functions in the same road is needed.

6.3.3 Summary

This chapter aims to understand user's behaviors and their relationships with physical environment along unimproved streets in Da Nang city, Vietnam. The following conclusions are drawn:

1) Six macro classifications of behaviors with 26 specific behaviors that form users' behaviors on Vietnamese street space were collected and analyzed. This helps to reveal how Vietnamese people use the street on a daily basis differently from citizens in other countries.

2) The dominant behavior type along the street space is "Accessibility". Specifically, the subdivision of "leaving/coming with motorcycle" was the most frequent specific behavior. This proves the very high demand of travelling from/to roadways to/from pavements; also, owing to the widespread use of motorbikes in Vietnam, more attention needs to be paid to providing appropriate space for the access of motorbike drivers from roadways to pavements and vice versa. The second most frequent behavior along the street is "walking for destination". In old street space, the demand of walking in a short distance is huge, so it is advisable to consider safe sidewalks for users.

3) On basis of PCA and CA, street space was categorized into 12 types of space that were illustrated by 4 common macro characteristics. These four factors may explain physical environment characteristics of street spaces as Multifunctional usage and Vision, Walking and Navigation, Recreation facility, and The Obstruction. These four factors should be seriously taken into consideration when designing/ enhancing or managing street space matched with users' behavior or activities.

4) Distribution of users' behaviors could be described by three street space types corresponding to usage patterns. Type A consists of group Gc2 that attracted most users' behaviors with high frequency. Type B consists of groups Ga3, Gb3 and Ga5 that were treated to discourage human activities in most behaviors. Type C contains Ga2 that was observed to contain neither frequent behaviors nor infrequent behaviors. The analysis of the relationship between

behaviors and environment on street point out the key for contributing to the street improvement in the near future in Vietnam and maybe useful to other developing Asian countries with a similar cultural context.

5) This section aims to discover different segments in the street where to form different patterns of use. This can lead to a hypothesis for urban planning and street environment split based on functions to serve particular activities. This study also indicates the precise locations of street sections which attract many kinds of highly frequent activities, to support further research on the interaction of behaviors and environment and suggest more specific solutions for street space design.

In this section, the relationship between classified physical environment of street space and users' behaviors is systematically explained, providing a theoretical basis for and improving/ developing processes to obtain proper street environment in the Vietnamese context. The goal of design and construction of effective street space should encourage activities in this space while minimizing conflicts with the operation of vehicles on roadways. This research discovers different segments in the street in which distinctive patterns of use are created. This can lead to a hypothesis for urban planning and street environment whose different areas are split based on functions for particular activities. In summary, user's behaviors and psychological needs should be taken into account in an objective, scientific and comprehensive way when urban environment planning and design are also examined.

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Chapter 7 COGNITION KNOWLEDGE ON STREET SPACE – UNIMPROVED AND IMPROVED STREETS FINDINGS

7.1 Introduction

7.1.1 Background

There is a growing concern for the quality of the public environment of cities, and substantial public and private resources have been devoted to enhancing urban open spaces in past decades. Open spaces are a vital environmental component of urban landscapes, providing the space that is appropriate for most common community activities [1, 2]. Urban open space provides various advantages by offering an environment that mitigates stress, promotes recovery from mental and physical health issues, and encourages an active lifestyle as compared to a sedentary lifestyle [1, 3, 4]. Urban open space also plays a significant role in creating social cohesions and interactions, fostering economic benefits from tourism, reducing diseases and health care costs, and improving the quality of life [1, 5-10].

Jacobs (1961) emphasized the importance of the usage of open space that can be considered a vital criterion for a successful place [11]. Indeed, usage, or livability, is a dimension often employed to measure the success of open space [12, 13]. An open space is not successful when it is empty or vandalized [13, 14]. Montgomery (1998) believed that active and vibrant urban spaces are associated with the knowledge of management, development, and design [15]. He referred to the terminology of urbanity to describe the city filled with activities, street life, and urban culture [15]. Designing, developing, and managing urban open spaces require the understanding of impacts on characteristics of urban spaces and their users. Buchanan (1988) believed that places are not just particular spaces with physical attributes, but they accommodate different activities and interactions that take place and provide an opportunity for using such places [16]. Recently, the advances in

quality of life research in urban area have developed an assessment framework with more informed, coherent and transparent evaluation system. This assessment model consists a plenty of variables involving multidiscipline e.g. health and safety, happiness, transportation and services, environment and surrounding spaces and biodiversity, and so on[17]. It contributes a theoretical framework for building a sustainable environment and enhancing quality of life. Accompanying these studies, in a quantitative approach, urban indicators e.g. green landscape, urban sprawl, fragmentation, spatiotemporal, and density are also proposed to diagnose urban transformation problems in the broad view angle[18].

As one of multifunctional spaces in a city, street space is common open space in a city that does not serve only as a traffic function that connects urban environment elements together, but also as a place for social interactions, community engagements, and daily activities such as trading, physical exercises, active travel, and private use [19-25]. Vietnamese contemporary society has been influenced by Western countries in constructing pseudo-public spaces [26]. Nevertheless, urban residents often tend to use streets and sidewalks for their leisure and perform daily habits [26]. By the pressure caused by urbanization, open-green space is decreasing rapidly in urban areas [27]. Local governments implement street space improvement as an affordable way to alleviate open space shortages [28].

The link between the physical and activity components of a place has been taken into consideration in open space design process[29]. Therefore, there is the importance of establishing an alternative framework to explore the relationship between physical settings and activity patterns within urban spaces[30]. This possibly provides key variables in building up the successful place and enhancing the quality of life in urban study disciplines. However, the conventional planning and designing of street space/ open space mainly rely on such objective quantitative regulars/variables as area, number of physical settings per capita, service radius, and

greenery ratio to measure the reachability/ accessibility of a certain place[31, 32]. These factors do not sufficiently complicate user's decision-making and the accessibility concept as a multi-dimensional construct[33]. For creating a successful/livable street, designers should respond to various needs of street space users, and it is important to acquire the full understanding of the accessibility concept, behavior settings, its related dimensions, and its role in affecting the street space use of inhabitants.

7.1.2 Theoretical Background and Previous Studies

There have been globally growing concerns regarding the open space development of cities. The relationship of humans and the environment in various aspects has been discovered by many scholars around the world. The field theory of Lewin (1943) stated that human behavior is the result of the interaction between people and their environment [34]. Similarly, Hillier (1989) stated that the environment is not the background of human activities but their nature; the environment is the mechanism in which human behavior is affected [35]. Behavior setting showed that the observable environment exists independent of the psychological processes of any particular individual [36]. He defined a behavior setting as a standing pattern of behavior synomorphic and circumjacent to the milieu [36]. A behavior setting includes a standing pattern of behavior that is tied to a particular place and occurs at regular intervals [37]. Barker (1968) emphasized that behavior setting is considered being a stable combination of human activities and the environment, and he also offered a behavior setting conceptual framework to examine the relationship between the environment and behaviors, encouraging the understanding of users' needs to be observed and surveillance in the daily living environment [36].

Accessibility concept has recently emerged as a multi-dimensional construct related to both physical and non-physical factors of environment that may explain the attractiveness of space to users. [38-40]. Although the distance and travel time are two conventional variables that regard accessibility as a function of geometric origin based on location theory and central place theory, the accessibility conceptualization has involved beyond the term of physically space dimension to include other important personal and social dimensions [39, 41-46]. Indeed, the term of socio-organizational aspect of accessibility/ reachability implies non-physical factors that constrain or enable the ability to use services or places in order to distinguish from the physically geographic aspects of accessibility/ reachability[41]. Other scholars put forward the comprehensive view of accessibility/ reachability that social dimensions and personal preferences combined be integrated with physically space dimensions to complete the entire picture of accessibility concept[42, 45-47]. Therefore, accessibility concept also refers to the reachability, convenience, and attractiveness of a place; that is, this concept can be seen as an ability to access to services of a certain place/ space rather than merely as a physical measure of its service radius[39, 46]. In other words, accessibility can be defined as how easily people can reach their desired space, accordingly the essential variable that influences the use of open space/ environment would be mentioned.

Users' perceptions toward urban open space such as street space that have been studied point out the multidimensional nature of the accessibility concept and behavior setting. Lang (1987) indicated four characteristics consisting of a recurrent activity, a particular layout of the environment, a congruent relationship between activity, and a specific time period that compose the behavior setting [48]. Wicker (1992) considered that a small-scale social system bounded by time and place and composed of people and physical objects can be seen as a behavior setting (Wicker 1992). Do (2018) stated that differences in time-space patterns caused by different

types of behaviors reveal various behavior setting patterns appearing along the street space [49]. It is clear that behavior setting analysis was used to investigate the comprehensive variables associated with people's activity and environment setting. Byrne and Wolch (2010) reckoned that users' perceptions of open space accessibility are closely related to users' characteristics and environment features; Wang (2015) empirically studied the integrated park accessibility between two comparable parks but different socioeconomic status [31]. The findings show the multidimensional nature of accessibility including both physical and non-physical dimensions that significantly contribute to open space users' cognition. Moreover, the cultural and socioeconomic differences of users also affect perceived open space usage and access that need further research specifically for each group[33]. Research findings of Wang (2015) showed that the socioeconomic variables significantly affect perceived open space access, while other studies address the difference between demography, culture context, and open space cognition and usage[40]. However, the findings only address the urban open space in Western context and developed countries.

Developed countries have studied urban open space and then obtained certain achievements that contribute to human wellbeing. Meanwhile, with dissimilar urban structures, economies, cultures, and societies, developing countries in Asia tend to base their development on existing achievements of Western nations [26]. In Vietnam, because of the shortages of open space in cities, authorities exploit the street space as the urban open space to fulfill inhabitants' needs [27, 50, 51]. The Western archives in open space design were set up to provide attractive and well-organized space for people. Unlike Western urban areas that are an attempt to revive activities on street space, Vietnam's counterpart is trying to meet human needs for complicated uses in the space [26]. Indeed, campaigns for the renovation and upgrading of urban street space are organized to serve human activities and

restructure street space uses in human scale and urban scale (i.e. adding street furniture, upgrading pavements, widening sidewalks, or providing visual objects). However, daily routines of Vietnamese people, in fact, enable the boundary between urban public and private space to be encroached [26, 52] (i.e. residents use up too much of public space for trading or private activities; they even encroach on pavements and roadways for those activities). In Vietnam, there is always a never-ending dispute between the government and residents or between citizens to gain control of the street space which has socioeconomic dimensions [53]. Consequently, street space is not simply a place for relaxation or traffic, but also economic activities [49, 54].

Also, studies based on the understanding of the relationship between an environment and users' activities have been conducted in developed countries to renovate and upgrade street space, while research on street space in Vietnam is mostly theoretical and based on subjective ideas or randomly collected opinions of foreign countries [55, 56]. A few studies on open street space were carried out in Vietnam by Do (2018) with the purpose of determining physical elements that caught users' attention along the street and revealed relationships between users' activities and street environment [28, 52]. This paper will provide further research to clarify street space users' behaviors associated with the surrounding environment on improved and unimproved street spaces to find qualities on urban streets in Vietnam that can contribute to and preserve the local identity and community.

7.1.3 Objective and Research Questions

This study was conducted on an improved street and an unimproved street in Da Nang, Vietnam that have equivalent and comparable features (i.e., length, population density, and urban context). This investigation aims to empirically examine how

street space is used and to compare the characteristics and problematic aspects of public open space in the contrasting types of streets. Specifically, this research explores and examines the difference in users' behaviors on two types of streets using place-centered behavioral mapping and visual encounter surveys. Furthermore, the difference in behavioral distribution according to street environments is also compared. This systematic observation provides a better opportunity to empirically understand which physical environment elements contribute to the usability of streets in Vietnam. The findings contribute to street improvements and enhancement of local daily activities in the studied city, other cities in Vietnam, and other developing countries with similar social context.

This study attempts to clarify the research questions by comparing results between two different streets. (1) Does the behavior setting patterns along street spaces differ between improved and unimproved streets? (2) What is the difference in the behavioral distribution corresponding to the environment between improved and unimproved streets? These findings contribute to the proposals, frameworks, and guidelines on street space improvement, management, and development to satisfy users' needs and support urban community sustainability and quality of life.

7.1.4 Materials and Methods

7.1.4.1 Street Sampling

Sampling the street candidates was conducted based on the basic of various screening survey and analysis done in chapter 5. In short, the screening survey was made using questionnaire survey and analysis to short out the appropriate street among large amount of street space in six districts of Da Nang city. 598 survey questionnaires were collected randomly from 14 and 87 years old ($M = 28.5$; $SD = 9.7$) and occupational diversity. According to the survey results, a total of 203

streets, were marked by inhabitants as either positive, 114 streets, or negative, 89 streets. According to street definition, 9 roads with movements of heavy vehicles are excluded out of candidate list. Then, based on extreme value analysis based on high ratings and purpose of the survey, the streets candidates were shortened (33 street spaces) and classified into two groups of improved and unimproved street space based on upgrading street space policy of local government, and eventually, two street spaces which consist of unimproved and improved one were chosen for this research (Figure 7.1). Table 7.1 illustrates the two study areas with its characteristics and it also describes the two streets which are comparable in terms of physical structures such as length, wide, land use, urban form, street type.



Figure 7.1 Locations of Danang city and street space samples

Table 7.1 Street space samples overview.

Street Name	Ong Ich Khiem	Le Duan
Street Type	Collector Streets	Collector Streets
Street Classification	Unimproved	Improved (launch in 1998)
Length	2.22 km	2.17 km
District	Hai Chau	Hai Chau
Width	10.5 m	15 m
Pavement Width	1-4 m	4-6 m

Landuse along the street	Residences, Commercial Buildings, Greenspace, Markets, School, Shop house, Administration Agency, Public building	Residences, Commercial Buildings, Greenspace, Markets, School, Shop house, Administration Agency, Public building
Setback	1.2 m	1.2 m

7.1.5 Outline of Investigation

The investigation was separated into two different batches:

(1) The first survey batch was conducted by (1) collecting users' behaviors using place-centered behavioral mapping (PcBM) and (2) collecting entire street environment and users' surrounding environment using visual encounter surveys (VES).

For collecting behavior setting patterns that occurred on the streets, all activities and environmental features including physical and non-physical features resulting from the impacts of physical settings were observed for three different time frames consisting of morning (6am-9am), noon (11am-2pm), and afternoon (4pm-7pm) on two weekdays and two weekends. This survey was divided into two stages. Firstly, the observation of current construction and kinds of physical settings on the streets was conducted and mapped out. Secondly, all users' street behaviors were recorded on the paper-based maps based on PcBM and VES. The place-centered behavioral mapping (PcBM) was used to make a graphical representation of the study location, divided into different segments. The observation contains photographs or time-lapse recordings of behaviors and positions of people in each segment. This type of observation is considered more suitable for the study of a particular physical space [57]. Visual Encounter Survey (VES) method, formalized by Campbell & Christman (1982), was used to document the presence of individuals to provide both

quantitative and qualitative data. [58]. Researchers walked through a designated area for a prescribed time and performed a visual observation. Observation of the physical environment and users' behaviors on the two streets was conducted as follows: (1) For OIK St, observation was conducted on May 4th (Friday) and May 5th (Saturday) using VES method that requires observers to walk along the street to collect all data regarding current situation of street environment such as physical setting, audio, and scent (Figure 3). Behavior mapping was collected by PcBM on two weekends and two weekdays: May 12th (Saturday), May 19th (Saturday), May 15th (Tuesday), and May 17th (Thursday) in 2018 that recorded all users' behaviors in physical, social, and stationary terms; (2) For LD St, the same aforementioned observations were carried out on January 7th (Monday), January 8th (Tuesday), January 10th (Thursday), January 13th (Sunday), January 14th (Monday), and January 19th (Saturday) in 2019. Participants in one certain activity were considered as an activity unit.

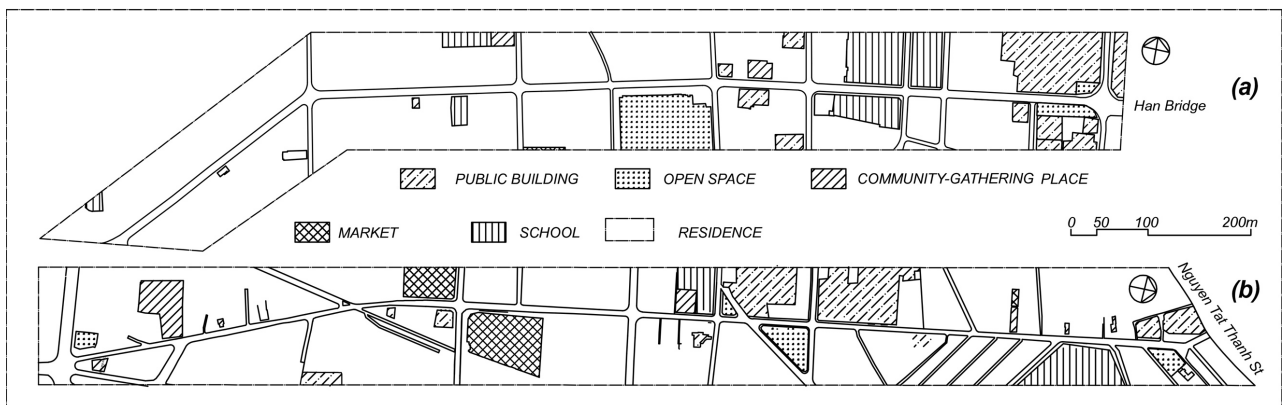


Figure 7.2 Investigation route in two street spaces: (a) investigation path on Le Duan St; (b) investigation path on Ong Ich Khiem St.

(2) The second investigation batch aims at grasping the user's cognition. The variables in the multi-dimension model were operationalized using psychometric scaling and 5-point Likert scales (i.e., from 1 to 5 represent strongly disagree to

strongly agree respectively). This investigation batch was conducted after the first batch done with analysis data and findings. The survey instruments were developed based on the information which extracted from the first batch of behavior setting investigation including physical, personal and social dimensions. The survey scale and questions to measure the physical and non-physical variables are designed and detailed in Table 7.2. Moreover, the demographic profiles of respondents are also collected and briefly described in table 7.3.

Table 7.2 Brief statements used to grasp users' perceived street space accessibility

Main categories	Sub-categories	Measures
Overall perception	Perceived accessibility/ satisfaction	“Please rate your overall accessibility/ satisfaction of using the street”
	Perceived physical environment accessibility/ satisfaction	Please rate your overall accessibility/ satisfaction of physical environment of the street
	Perceived socio-personal accessibility/ satisfaction	Are there any socio-personal point that encourage/make me visit this place?
Physical dimension	Walkability	“I can easily walk along this street” and “The walk on the pavement/sidewalk is a pleasant experience”
	Navigation	“I can easily find way/ navigate on this street” and “The sign is understandable”
	Multifunction	“How would you rate your overall the variety of function on this street?”
	Vision	“I can easily see through and over the street” and “the street space is open”
	Obstruction	“The pavement is free” and “The walkpath is in order/tidy”
	Public Amenities	“There are a sufficient number of street amenities such as street furniture in this street. There are sufficient area of parking lots in my neighborhood. There are sufficient area of motorcycle parking for this street”
	Connectability	“Is it hard for me to cross the street or to pass other blocks?”
	Permeability	“How would you rate your overall the transparency of the façade or the fence on this street?”
	Natural Proximity	“How would you rate your overall the greenery on this street?”
Shading	“I feel comfortable when stay on this street under the sunlight due to being covered and shading”	

	Street stalls/ food spot	“I can easily find the food spot on this street” and “Eating on the pavement/sidewalk is an interesting experience”
Personal dimension	Proximity	“This streets/ place is close to where I live and I familiar with it”
	Cleanness/ tidiness	“The dirt, pollution, garbage is the main problem of this of this street/place”
	Information of places	Sum of rating for significant measures: “I am aware of this street/ place and its facilities in my neighborhood. I know where this place is located in my neighborhood and how to get here. I have good knowledge on this place in my neighborhood. I am aware of the activities/ shops/ stores/ interested points in this streets/ place. I have good knowledge on changes to activities and programs held in the street/ place”
	Accessibility (distance/ travel time)	“How far would you estimate the travel distance is from your house to this place?”
	Active lifestyle	“I prefer outdoor climate to staying indoors. Outdoor exercise is an important part of my life. I would love to look other people’s activities”
	Make profits	“Visiting and using street space in my neighborhood for owning money”
	Safety	Sum of rating for significant measures: “I am concerned with my personal safety when I travel along this street. I feel unsafe when visiting this place. There are people participating in illegal activities (e.g., beggar, theft) around this place or street space. This place is regularly patrolled by police. This street is a place with high crime at night. Homeless or vagrant people are frequent in this place”
Social dimension	Shared activities	“This street is attractive to me because I can do my favorite activities with other people of shared interest (e.g., chatting, looking other people)”
	Event/Art/Culture groups	“This street/ place is attractive to me if there are people from my cultural background. This place is attractive to me if there are some special events”

Social Interaction

Sum of rating for significant measures:

“Most people in my neighborhood are friendly. Most people in my neighborhood are trustworthy.

Residents in my neighborhoods share similar interest. Residents in my neighborhoods help each other.

I feel a strong connection with the neighborhood”

The same survey questions, which were developed using the sequential development model [59] used to ask users in both streets for the respondent's perceived usability/ accessibility toward three domains including the overall perceived accessibility, physical perceived accessibility, and socio-personal perceived accessibility. The survey questionnaires were prepared in English and translated into Vietnamese and dispatched for pilot-surveyed with participants that included local residents, research experts, and practical/empirical designers (See Appendix 4). The data will be tested for reliability and validity by using Cronbach's alpha that indicates a higher level of internal consistency[60].

Table 7.3 The variables that using to grasp correspondents' demographic

Variable	Measure
Sex	Male
	Female
Age	25>=age;
	26>=age>=55;
	56<=age
Birth Place	Danang city
	Other
Residence place	Within this street
	Other streets
Length of residence	Less than 1 year
	1-5 years
	>= 5 years
Home ownership	Rent
	Own
Annual average income per capita	>=66,7millionVND*
	< 66,7millionVND
Car Ownership	Yes
	No

*: ~2870\$/person (2018)

7.1.6 Data Processing

7.1.6.1 User's Behavior Findings and Street Environment Division

User's behaviors were determined based on their action within personal environment and then the behavior categories were classified based on behavior setting that used in chapter 6. Because the physical environment and users' behavior are indissolubly connected as the nature of behavior setting theory[36, 61, 62], the street environment characteristics can be divided into sections (figure 7.3) that accommodates residents' behaviors. Among various sections divided, two main kinds of sections included: The A (OIK St) and C (LD St) categories which imply the space where two or more streets intersect (excluding small alleys as they do not attract non-motorized traffic movement); The B (OIK St) and D (LD St) types refer to segments where houses are on both sides of the street. The typical segments of each type are illustrated in Figure 6.6 (Chapter 6).

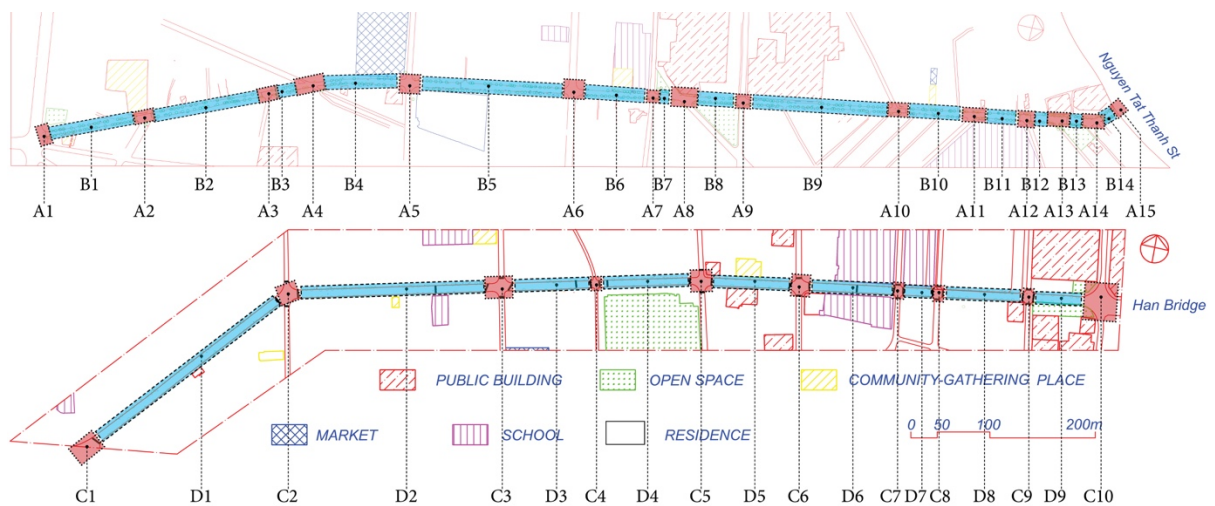


Figure 7.3 Street sections division of Ong Ich Khiem St and Le Duan St: (a) A & C sections - intersection spaces; (b) B & D sections (middle street segment)– unit front houses in both side.

7.1.6.2 Study of Environment-Behavior Relation Patterns

The principal component analysis (PCA), which is a dimension-reduction tool, was applied to reduce a large set of variables to a small set that still contains most of the information in the large set [63]. It is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables. The results of a PCA are normally discussed in terms of component scores or factor scores (the transformed variable values corresponding to a particular data point), and loadings (the weight by which each standardized original variable should be multiplied to get the component score)[64]. Hence, by applying this method, the physical environment of each section of the street was clarified. Then, a cluster analysis (CA) was conducted to classify different categories of space based on its physical characteristics [65, 66]. Cluster analysis is the task of grouping a set of objects in such a way that objects in the same group are more similar to each other than to those in other groups. Finally, a comparative analysis was conducted between different kinds of space and various behaviors to comprehend the distribution of behavior within the street environment and the difference between improved and unimproved streets.

7.1.6.3 Study Participants and Perceived Access by Demographic Profiles

The descriptive statistical analyses of demographic profiles conducted from questionnaire survey data can identify whether user's perception on using both kinds of streets (improved and unimproved streets) differs by various demographic groups. Survey participants were asked about their perceived access to each street spaces. The analysis results help to examine the difference in perceived street environment

usage between various demographic groups within and between each kind of street by combined results for two kinds of street.

7.1.6.4 Relationship between Perceived Accessibility/ Usability and Physical Dimension

This analysis result can illustrate the association between physical environment, personal and social dimensions and perceived usability/ accessibility to the street. Responses from questions related to physical dimension and accessibility/ usability were compared for difference between the actual choice and mode preference using cross-tabulations and Chi-square statistics for each street.

7.1.6.5 Assessing the Importance among Physical, Personal and Socio Dimension of Accessibility

To examine which variables are a more important predictor of using/ accessing street space, a two-factor regression analysis was conducted. Responses to the overall assessment question of perceived accessibility/ satisfaction were used as the dependent variable in analysis model with the independent variables including the physical and socio-personal dimensions which affect the usage of street space. Three isolated regression models for each street were examined, one combined model for all respondents and one model for each income group. The results then were compared between two streets.

7.1.6.6 Comprehensive Regression Model

To examine which variables contribute the strongest predictors of perceived usability/ accessibility, a comprehensive regression model for the overall perceived

accessibility/ usability question and a regression model for each hypothesized accessibility dimension including physical and socio-personal. In the comprehensive model, the overall perception question regarding to the accessibility/ satisfaction was regressed against the total of 21 independent exploratory variables of street space usability/accessibility. Three separate overall accessibility models using data from each street: one for each income group and one for all combined respondents. Beyond, two additional regression models were generated for each hypothesized usability/accessibility dimension that consists of physical and socio-personal. The 21 variables were grouped into two categories: physical, socio and personal. The physical dimensions consist of 11 variables, while the socio personal dimensions contain 10 items.

The first regression model (model 1) used perceived physical accessibility/ satisfaction as the dependent variable, regressing against the 11 physical elements as independent variables. The second model (model 2) used Perceived socio-personal accessibility/ satisfaction as the dependent variable, regressing against 10 socio-personal elements as independent variables. These models were calculated for each street respectively and results had been compared each other.

7.2 The Behavioral Environment Variations on Unimproved and Improved Street Spaces

7.2.1 The Difference in User's Behaviors

7.2.1.1 Users' Behavior Findings

All users' behaviors along both types of streets were detected and classified into six main categories including 26 subcategories (Figure 6.7). There was no difference in the categories of behaviors between the two types of streets.

The accessibility category includes behaviors defined as physical activities in reaching a destination by hoof, motorized vehicle, or non-motorized vehicle. This category consists of 3 subcategories: (1) “crossing road” is the act of going across the other side of the street regardless of being allowed to or not; (2) “walking for destination” is the act of moving along the street on the sidewalk or roadway by hoof; (3) “coming/leaving with motorcycle/without motorcycle” is the act of moving onto the sidewalk from traffic movement on the road or vice versa.

The group of trading behaviors consists of 4 subcategories: (1) “fixed food transaction” refers to trading of food at a fixed location on the sidewalk; (2) “food transaction mobility” refers to mobile trading of food along the sidewalk or roadside; (3) “goods transaction fixed” refers to trading of consumer goods or unprocessed food at a fixed location on the sidewalk; and (4) “goods transaction mobility” refers to the trading of consumer goods or unprocessed food along the sidewalk or roadside.

The idling category includes behaviors defined as an inactive state or a state of non-movement. This category consists of four subcategories: (1) “waiting for crossing road” is the act of waiting for a red traffic light turning to green in the zebra crossing before crossing the road; (2) “waiting for others” is the act of temporarily stopping to wait for another person; (3) “waiting for the bus” is the act of waiting for a bus, usually at a bus stop; and (4) “waiting for customers” is the act of sitting on the sidewalk for a long time to welcome customers.

The service/maintenance category includes behaviors defined as acts of supporting, serving, or preserving a condition or situation, or the state of being preserved. This category consists of five subcategories: (1) “cleaning” is the act of making the sidewalk clean, especially in front of users’ houses or shops; (2) “commercial preparation” is the act of arranging and displaying goods for sale; (3) “guarding” is the act of setting up chairs in front of users’ houses or shops and

observing customers to prevent theft; (4) “public maintenance” is the act of environmental workers taking care of plants along streets or collecting litter; and (5) “repairing” is the act of providing repair services.

The relaxation category includes behaviors defined as a state of being free from tension and anxiety. This category consists of 6 subcategories: (1) “playing” is a range of intrinsically motivated activities by children or adults for self-amusement; (2) “reading” is the act of reading newspapers, books, or other electronic devices; (3) “strolling” is the act of walking in a leisurely or idle manner; (4) “looking others” is the act of people watching; (5) “resting” is the act of taking naps on chairs, motorbikes, or taxis; and (6) “chatting” is the act of gathering by group for informal conversation.

The others category consists of three subcategories: (1) “inquiring” is the act of asking or communicating with others for information; (2) “eating” and (3) “drinking” are acts of eating or drinking at tables and chairs by food and beverage vendors.

7.2.1.2 Quantities of Users’ Behavior Units

The total of users’ behavior units recorded within four observation days on OIK St and LD St was 2389 and 2177 units respectively (Table 7.4). In general, [Accessibility] behaviors occurred the most frequently and was the dominant behavior on both streets. The frequency of [Accessibility] behaviors on LD St was higher than on OIK St. The frequency of [Service/Maintenance] behaviors on LD St was slightly higher than on OIK St. In contrast, the frequency of [Trading], [Idling], and [Others] behaviors on OIK St was higher than on LD St. Notably, the frequency of [Relaxation] behaviors were relatively the same on both streets (Figure 7.4).

Table 7.4 Quantizing occurrence frequency of users' behavior units.

Behavioral Category	Specific Behaviors	Behavior frequency in Ong Ich Khiem St	Behavior frequency in Tran Phu St	Total
Accessibility	crossing road	62	63	125
	leaving/coming with motorcycle	421	549	970
	leaving/coming without motorcycle	146	173	319
	walking for destination	204	209	413
Trading	food transaction fixed	66	5	71
	goods transaction fixed	25	11	36
	food transaction mobility	78	17	95
	goods transaction mobility	51	35	86
Idling	waiting for crossing road	46	23	69
	waiting for others	225	150	375
	waiting for the bus	4	25	29
	waiting for customers	70	36	106
Service/Maintenance	cleaning	73	50	123
	commercial preparation	57	26	83
	guarding	46	196	242
	public maintenance	20	14	34
Relaxation	repairing	51	26	77
	playing	21	27	48
	reading	75	67	142
	strolling	72	86	158
	looking others	210	180	390
	resting	29	39	68
Others	chatting	50	66	116
	eating	89	21	110
	inquiring	76	47	123
	drinking	122	36	158

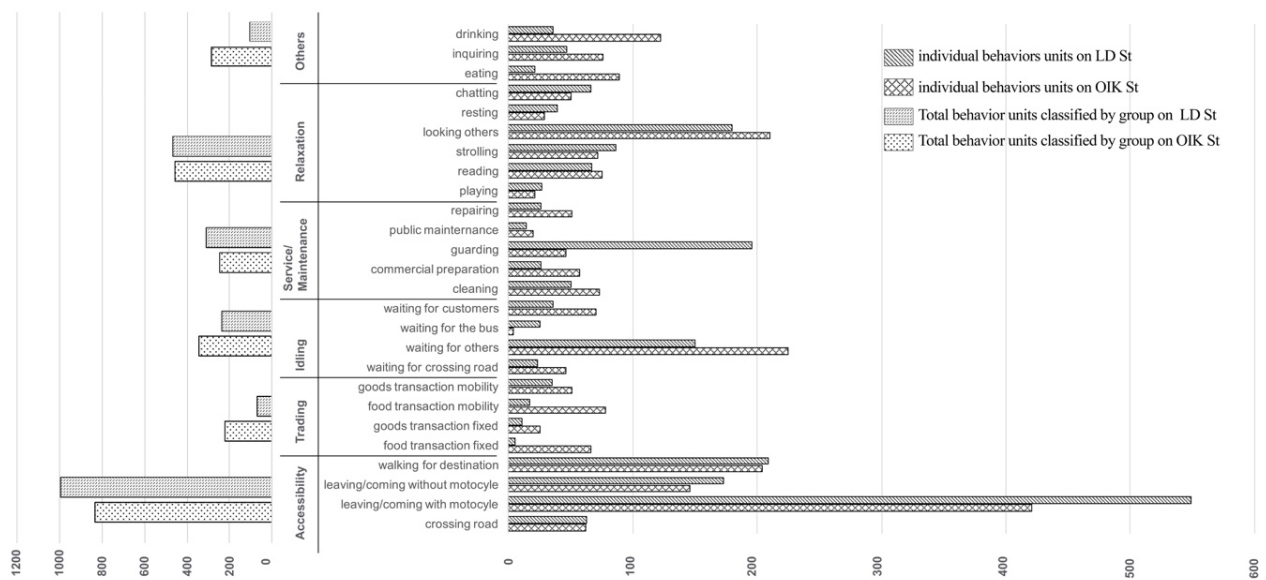


Figure 7.4 A comparison of occurrence frequency of users' behavior between two streets. (Unit: occurrence frequency)

More specifically, in the subcategories, the highest behavior frequency was [leaving/coming without motorcycle], which accounted for 421 times on OIK St and 549 times on LD St respectively (Table 7.4). In general, the differences between the two streets are as follows: (1) [crossing road], [walking for destination], and [playing] were relatively the same on both streets; (2) [leaving/coming with/without motorcycle], [guarding], [strolling], [resting], [chatting], [waiting for the bus] dominated on LD St; and (3) all other behaviors dominated on OIK St, most notably, [trading], [idling] excluding [waiting for the bus], [service/maintenance] excluding [guarding] and [looking at others], and [others] (Figure 7.4).

As can be seen on Figure 7.5, the highest frequency of behaviors on the two streets were unveiled by section. Most noticeably, most of the high frequent behaviors occurred in the middle street segments. Specifically, on LD St, seven sections dominated with high occurrence frequency of behavior: D1, D2, D3, D4, D5, D6, and D8 with 562, 453, 131, 155, 158, 125, 132 times respectively (the

overall average behavior frequency is 104.7 times); on OIK St, 7 sections also dominated with high occurrence frequency of behavior: B1, B2, B4, B5, B6, B9, and B10 with 242, 239, 230, 505, 156, 232, and 93 times respectively (the overall average behavior frequency is 82.4 times).

Meanwhile, the diversity of behaviors appearing in all sections of both streets were found as follows: On LD St, section D1 had the widest range of behavior with 25 kinds of behavior, while section D2 was second with 24; and D3 and D8 were third with 22; On OIK St, section B4 had the full range of 26 kinds of behavior, while section B5 was second with 25; and B2 was third with 24. On average, the diversity of behavior appearing on OIK St is higher than on LD St with 15 and 14 kinds of behavior respectively (Figure 7.5).



Figure 7.5 The sections with high occurrence frequency and high level of diversity of behavior on two streets.

7.2.1.3 Environment Characteristics Analysis

Physical environment characteristics of the two streets and their sidewalks were also recorded and denoted by “1” and “0” for their presence and absence,

respectively (Table 7.5). The characteristics of street environment were processed by principal component analysis (PCA) and cluster analysis (CA) using SPSS to unveil the physical environment features along the streets.

Table 7.5 Characteristics of physical environment on two streets.

Street			Ong Ich Khiem St					Le Duan St			
Section			A1	B1	A2	B2	...	C1	D1	...	C10
Commercial/ private component	Retail + service		1	1	1	1	...	1	1	...	0
	Food spots		0	1	1	1	...	0	1	...	0
	Recreational facilities		0	0	0	0	...	0	0	...	0
	Offices/public agency		0	0	0	0	...	0	1	...	1
	Vacancies		0	0	0	0	...	0	0	...	0
	Greenspace		0	0	0	0	...	0	0	...	1
	Residence		0	1	1	1	...	1	1	...	0
Public Component	Sidewalk	Width>6m* (LD);	1	0	0	0			1		0
		>4m* (OIK)					...	1		...	
		Curbcuts	1	1	1	0	...	1	1	...	1
	Amenities	Trash cans	0	0	0	0	...	0	0	...	1
		Fence	1	0	0	0	...	0	1	...	0
	obstructions	Electric poles/infra.	1	1	1	1	...	0	0	...	0
		Sign poles	1	0	0	0	...	1	1	...	1
		Motorcycle parking	0	0	0	1	
		line						0	1		1
	landscape	Trees	1	1	1	1	...	1	1	...	1
		Awning	1	1	1	1	...	0	1	...	1
		Balcony	0	1	1	1	...	0	1	...	0
		Setback > 1.2m*	0	0	1	1	...	1	1	...	1
Street functions component	width	>15m* (LD St);	1	0	0	1	
		>10.5m* (OIK St)						0	0		1
	signs	Official signs	1	1	1	1	...	0	1	...	1
		Unofficial signs	0	1	1	1	...	0	1	...	0
		Store sign	1	1	1	1	...	1	1	...	1

transportation	Bus stop	0	0	0	0	...	1	1	...	1
	Car parking area	0	0	0	0	...	0	1	...	0
	Crossing Pedestrian	1	0	1	1	...	0	1	...	0

*according to Da Nang Urban Planning Institute.

The results show that the cumulative contribution rate is over 75% (OIK St) and 73% (LD St) respectively. The main characteristics of the streets were explained in five axes that can be seen in Table 7.6 and Table 7.7.

Table 7.6 Score of categories of physical environment in Ong Ich Khiem street.

	Component				
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5
Store sign	.959	.003	.036	-.012	.117
Retail service	.959	.003	.036	-.012	.117
Residence	.818	.159	-.051	-.076	-.337
Awning	.747	.084	.042	-.246	.169
Balcony	.324	.843	.100	-.244	.051
Greenspace	.114	-.840	-.266	.164	.138
Vacancies	-.246	-.800	-.233	-.280	.166
Official signs	-.113	.589	-.314	.019	.129
Public agency	.169	-.059	.840	-.065	.058
Setback	-.231	.086	.797	.014	-.067
Bus stop	.085	.319	.618	-.155	-.048
Street width	-.095	-.121	.076	.860	-.005
Crossing/ pedestrian way	-.151	.040	-.358	.785	.137
Trash cans	-.039	.055	-.238	.001	.864
Unofficial signs	.280	-.158	.297	.130	.628
Eigenvalue	3.954	2.671	1.972	1.478	1.254
Variance %	26.361	17.810	13.146	9.850	8.363
Cumulative %	26.361	44.170	57.316	67.166	75.529

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Table 7.7 Score of categories of physical environment in Le Duan street.

	Component				
	Axis 1	Axis 2	Axis 3	Axis 4	Axis 5
Setback	.834	-.178	.083	-.135	-.060
Fence	.798	.003	.033	.181	-.041
Sign poles	.685	-.039	.047	-.373	.330
Public agency	.555	-.450	.238	.398	.084
Retail service	-.006	.860	.204	-.049	.139
Residence	-.173	.844	-.052	.248	-.005
Greenspace	.167	-.531	.116	-.495	-.273
Trees	-.040	-.148	.849	.057	.174
Bus stop	.173	.181	.812	.064	-.096
Recreational facilities	.106	.083	.582	-.476	.051
Sidewalk	.053	.182	.051	.881	.064
Food spots	.239	.186	.023	-.127	.815
Awning	-.147	.008	.079	.240	.789
Eigenvalue	3.009	2.318	1.656	1.376	1.173
Variance %	23.149	17.833	12.739	10.585	9.024
Cumulative %	23.149	40.982	53.721	64.306	73.330

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Differences between the physical features on both streets are as follows: On OIK street, the eigenvalues of the 1st axis indicates the shop-house relationship and shading by the presence of store signs, retail services, residences, and awnings. The 2nd axis indicates degree of openness by the presence of balconies, greenspaces, vacancies, and official signs. The 3rd axis indicates accessibility of the sidewalk by the presence of public agencies, setbacks, and bus stops. The 4th axis indicates the degree of connection due to the prominence of street width and crossings/pedestrian ways. The 5th axis indicates level of tidiness of the street environment by the presence of trash cans and unofficial signs. On LD street, the eigenvalues of the 1st axis indicates accessibility and permeability of the sidewalk by the presence of

setbacks, fences, sign poles, and public agencies. The 2nd axis indicates the shop-house relationship and proximity to nature by the presence of retail services, residences, and greenspaces. The 3rd axis indicates the degree of cover and relaxation of street space by the presence of trees, bus stops, and recreational facilities. The 4th axis indicates walking paths and related paths by the presence of sidewalks. The 5th axis indicates street stall characteristics by the presence of food spots and awnings.

To some extent, the two streets had all the qualities and features through ten axes (five axes for OIK St, and five axes for LD St). Although there are different environmental characteristics between the two streets, both share two factors: shop-house relationship and sidewalk accessibility and permeability. In contrast, the two streets differ as follows: On OIK St, the degree of vision/openness, connection, and tidiness were distinctive characteristics. On LD St, the degree of cover and relaxation of street space, walking paths and related paths, and street stalls were considered distinctive characteristics. In order to further understand the differences in street environment characteristics, cluster analysis was conducted to group sections with the same qualities and features. On OIK St, the sections can be classified into four types, while on LD St, the sections can be classified into three types (Figure 7.6).

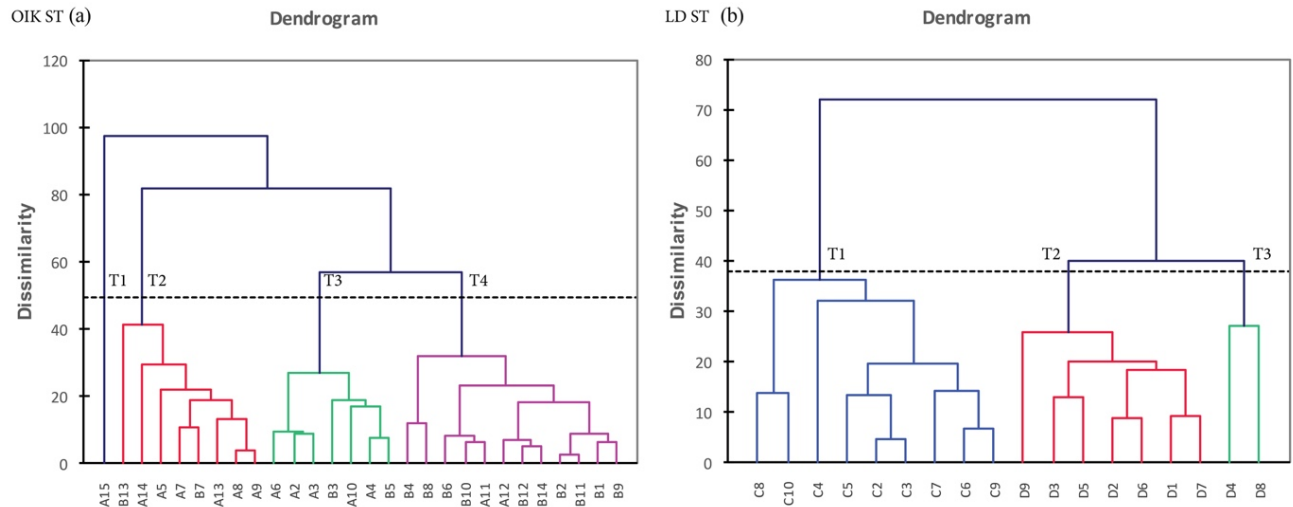


Figure 7.6 Section classification using cluster analysis.

7.2.1.4 The Correlation between Uses' Behaviors and Street Environment between Two Kinds of Street

Users' behaviors along all sections of the two streets (29 sections for OIK St and 19 sections for LD St) were categorized into six main categories including 26 subcategories of behaviors. The average occurrence frequency of each kind of behavior in the sections is commonly reasoned as about 15% (OIK St) or 23% (LD St). Hence, behaviors with occurrence frequency higher than 15% (OIK St) or 23% (LD St) are considered "frequent". If the occurrence frequency of a certain behavior group is over 15% (OIK St) or 23% (LD St) in more than half of the sections when focusing on one type of street space, the behavior group will be defined as "frequent". Following the same logic, conversely, if the frequency of a certain behavior group is under 15% (OIK St) or 23% (LD St) in all sections when focusing on one type of street space, the behavior group will be defined as "infrequent".

As can be seen on Figure 10, in general, trading behaviors such as food or goods transactions were prominent in OIK street. In contrast, idling, service/maintenance, and relaxation behaviors were prominent on LD street. Specifically, on OIK street,

T4 attracted the most users' behaviors with high frequency in trading. T1 discouraged the most users' behaviors. T2 and T3 neither attracted nor discouraged users' behaviors (Figure 7.7(a)). On LD street, T'1 attracted the most users' behaviors with high frequency in idling, service/maintenance, and relaxation. T'3 discouraged most users' behaviors. T'2 neither attracted nor discouraged users' behaviors (Figure 7.7(b)). In short, statistical results indicate that the distribution of all users' behaviors on street space is unequal in different types of space and can be grouped into three typical environment-behavior relationship patterns (Figure 7.7 and Figure 7.8).

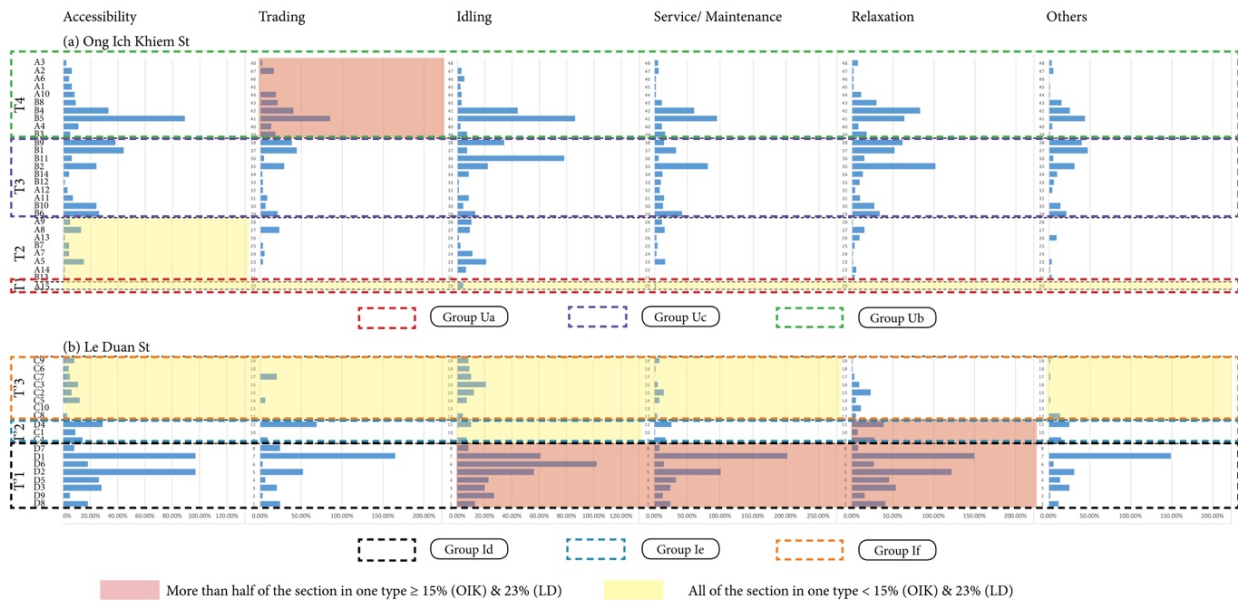


Figure 7.7 Distribution of users' behaviors in different typologies of space.

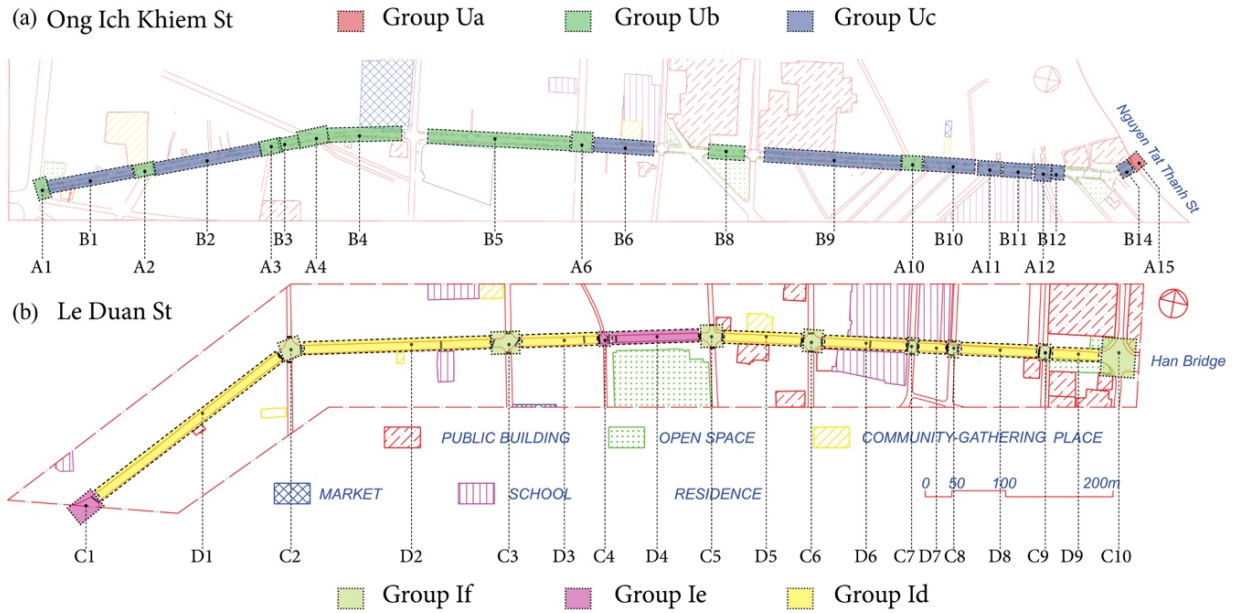


Figure 7.8 Three typical environment-behavior relationship patterns in street space: (a) OIK St; (b) LD St.

7.2.2 The Changes in User's Cognition/Perception

For providing the entire picture of users' cognition/ perception analysis processes. The analysis diagram was showed in Figure 7.9.

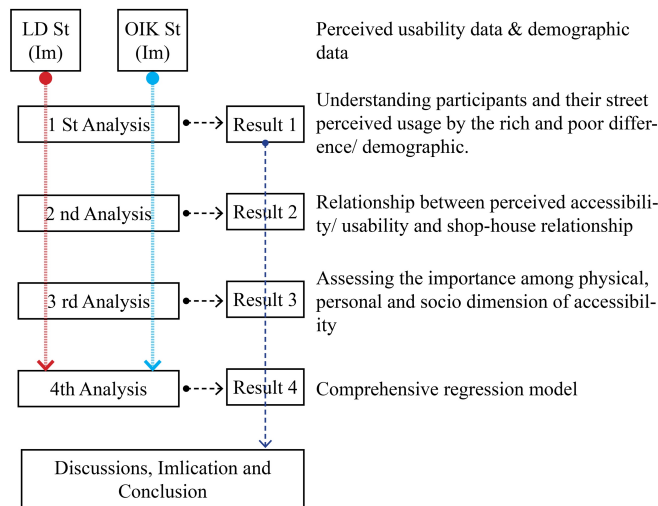


Figure 7.9 Overall analysis diagram and objectives

7.2.2.1 Understanding Participants and Their Street Perceived Usage by Income Difference.

The representativeness of the unimproved and improved street samples was examined by comparing (1) comparing the respondents' demographic with the census data of Da Nang city; (2) comparing the socio-demographic features of users in the lower and higher income group within two streets. (Figure 7.10)

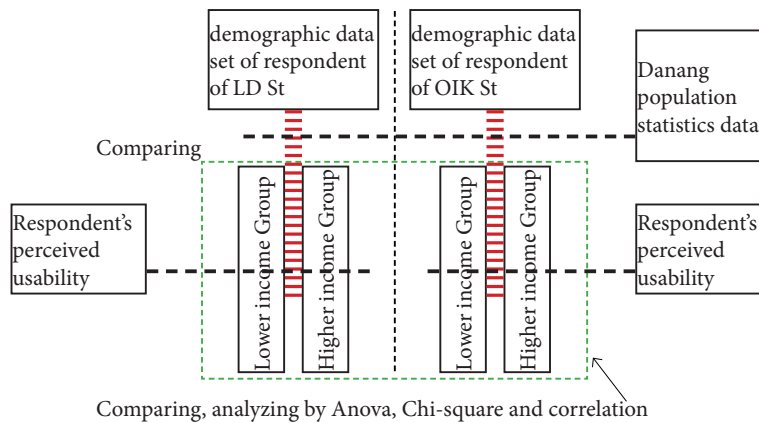


Figure 7.10 Specific analysis diagram for understanding participants and their street perceived usage.

Table 7.8 provides the demographic profile of respondents. The socio-demographic results of two streets' users indicate general consistency with Danang population statistics data instead of percentage of people with higher and lower income due to the unavailable of this variable.

Table 7.8 Survey respondents' socio-demographic overview: Le Duan St and Ong Ich Khiem St

Variable (%)		Le Duan St (Improved)				Ong Ich Khiem St (Unimproved)			
		Overall (N=175)	Low income (N=43)	High income (N=132)	p value	Overall (N=179)	Low income (N=24)	High income (N=155)	p value
Sex	Male	55.4	62.8	53.0	0.263	53.1	45.8	54.2	0.445
	Female	44.6	37.2	47.0		46.9	54.2	45.8	
Age	<= 25	48.6	30.2	54.5	0.022	49.2	29.2	52.3	0.030
	26-55	41.1	55.8	36.4		41.9	66.7	38.1	
	>=56	10.3	14.0	9.1		8.9	4.2	9.7	
Birth Place	Danang city	52.6	48.8	53.8	0.572	49.7	70.8	46.5	0.026
	Other	47.4	51.2	46.2		50.3	29.2	53.5	
Residence Place	Within this street	41.7	58.1	36.4	0.012	59.2	79.2	56.1	0.033
	Other street	58.3	41.9	63.6		40.8	20.8	43.9	
Length of residence	Mean		34.9	34.8	0.091		41.7	30.3	0.161
	<=1 year	13.7	11.6	14.4		11.7	8.3	12.3	
	1-5 years	46.9	34.9	50.8		55.3	41.7	57.4	
	>=5 years	39.4	53.5	34.8	33.0	50.0	30.3		
Homeowner	Rent	43.4	34.9	46.2	0.193	54.2	37.5	56.8	0.78
	Own	56.6	65.1	53.8		45.8	62.5	43.2	
	>= 66.7 million* VND	24.6				13.4			

Annual average			
income per	<=66.7 milion	75.4	86.6
capita	VND		

*~2870\$/person (2018)

When comparing the socio-demographic features of users in the lower and higher income group within two streets. There are three points as follows:

(a) As can be seen on the table 1, when the two income groups of each street were compared, there was some similarities on demographic in LD street, such as Age, Birth Place, Length of Residence. However, it also showed a high level of discrepancies/ differences in demographic variables between income groups within two streets. In LD St, the difference found in Sex, Residence Place, Homeowner; whilst, in OIK St, most of demographic variables is significant discrepancy, e.g. Birth Place, Residence Place, Homeowner, Sex, Age, Length of Residence.

(b) To examine the potential influence of socio-demographic variables on perceived usability, various analyses including Anova (for quantitative and qualitative variables), Chi-square test (for qualitative variables), and correlation (Quantitative variables) were conducted. There were no significant relationships found between these variables:

- On Le Duan Street, there is no relationship between the Gender, Place of birth, Length of residence and Homeowner in the low income and high-income groups (due to Chi-square's value $p > 5\%$). The results also show that there is a linkage between age and residence place between the low-income group and high income on LD St. The age group from 26 to 55 accounts for the majority of the low-income group on LD St, while the age group under 25 accounts for a high proportion in the high-income group. About the residence place, the respondents with higher income live outside LD St is the majority.

- On OIK St, Gender, Length of Residence and Homeowner between two income groups are not correlated (due to Chi-square's value $p \gg 5\%$). The results show that there is a relationship between Age, Birthplace and Residence place between the low-income group and high income. Similarity of LD st, the age group from 26 to

55 accounts for the majority of the low-income group, while the age group under 25 accounts for a high proportion in the high-income income group. About the residence place, there is no disparity of residence in and outside Ong Ich Khiem St for the high-income group, but in those who live on OIK St, it accounts for a high proportion in the lower income group (79.2% compared to people living on other streets)

(c) The analysis result showed significant differences between income groups in two kinds of street. A significantly fewer respondents with lower income owned the house than their higher income counterparts.

- When streets averages were compared, it can be seen, most of socio-demographic indexes of respondents is in a high level of similarity within two streets. But there were some significant discrepancies, LD St respondents reported a significantly higher average percentage of homeowner (56.6%) than OIK St (45.8%). A similar result was also found for higher income variable with 24.6% of LD St and 13.4% of OIK St. Whilst, average residence place of respondent reported staying within LD St (41.7%) is lower than OIK St (59.2%).

7.2.2.2 Comparison of Perceived Usability between Two Kinds of Street.

Comparing access to the street space or the ease of respondents using the street between two streets (improved and unimproved) see Figure 7.11. About 35.2 % of OIK St respondents reported “very easy/ ease” or “easy/ ease” access/ use to the street, compared to 49.7% of LD St’s users. (see table 7.9).

Perceived street access/ usage between income groups was also compared. The table 7.9 showed that perceived access/usage between income groups on OIK St is not much different. However, it can be seen that the perceived access evaluation of the lower income group on the OIK St was “easy/ ease” than the higher income

group with 20.8 % and 10.3% respectively; On LD St, Similarity, perceived access between income groups on the LD St is also not different. Meanwhile, the higher income group feels perceived access easier than the lower income group using in the same street environment with 17.4% compared to 16.3% respectively.

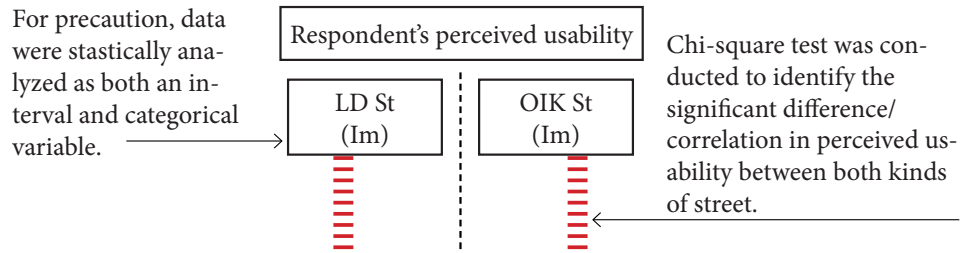


Figure 7.11 Specific comparative analysis diagram for testing perceived usability/ accessibility.

Table 7.9 Perceived accessibility to street space by income groups in Le Duan St and Ong Ich Khiem St

		Group mean	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
OIK St (a)	Lower income	3.54	4.2%	8.3%	37.5%	29.2%	20.8%
	Higher Income	3.19	3.2%	18.1%	45.8%	22.6%	10.3%
	Allrespondents	3.23	3.4%	16.8%	44.7%	23.5%	11.7%
LD St (b)	Lower income	3.21	11.6%	9.3%	41.9%	20.9%	16.3%
	Higher Income	3.38	11.4%	10.6%	24.2%	36.4%	17.4%
	Allrespondents	3.34	11.4%	10.3%	28.6%	32.6%	17.1%

(a) Mean difference between two income groups is not statistically significant at the 0.01 level (sig. = 0.098, $p < 0.01$).

(b) Mean difference between two income groups is not statistically significant at the 0.01 level (sig. = 0.427, $p < 0.01$).

7.2.2.3 Relationship between Perceived Accessibility/ Usability and Travel Distance Cognition.

Relationship between current travel distance and perceived access/ usability was compared between the two cities (Figure 7.12). It contributes to understanding the difference in the relationship between current travel distance and perceived access/ usability to the streets. This can contribute to the hypothesis of the relationship between land-use/ residence-shophouse distance and street usability/ accessibility. However, for this testing, there is no correlation between travel distance and perceived access in both street due to $P > 5\%$ (Table 7.10).

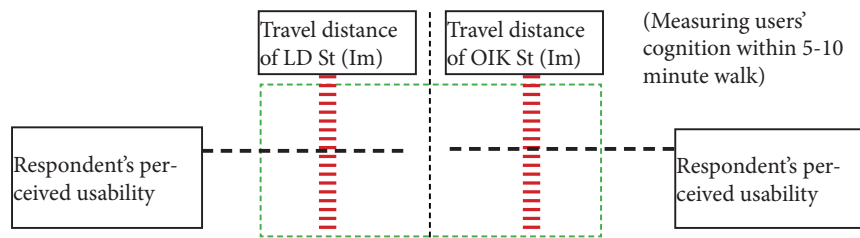


Figure 7.12 Specific travel distance-perceived usability testing relationship diagram.

Table 7.10 Relationship between travel distance cognition and perceived accessibility: Le Duan St and Ong Ich Khiem st

			Perceived access		p
			Easy	Not easy	
OIK St (a)	Travel Distance	Near	31.9%	68.1%	0.101
		Far	45.5%	54.5%	
	Total	35.2%	64.8%		
LD St (b)	Perception	Near	78.6%	21.4%	p = 0.933
		Far	79.2%	20.8%	
	Total	78.9%	21.1%		

7.2.2.4 Influence of Physical and Socio-Personal Dimensions on Street-Perceived Usability/ Accessibility

The analyses results can contribute to understanding whether or not physical, socio-personal dimensions can predictors of perceived usage/ access in different income group and both kinds of the street. The analysis process diagram was briefly explained in Figure 7.13.

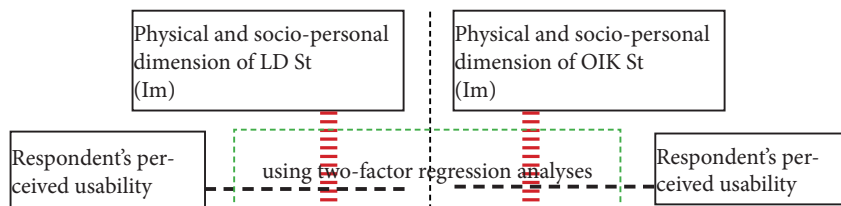


Figure 7.13 Three perceived accessibility dimensions analysis diagram.

Results from the two-factor regression analyses are showed in table below. Six regression models (three for each street) were statistically significant ($p < 0.01$).

As can be seen on the regression models for all respondents and the higher income group, both accessibility/ usability dimensions were statistically significance in predicting perceived access/ usage.

+ On the OIK St: Perceived physical accessibility factors and Perceived socio-personal accessibility are all involved in perceived access/usage of people in the high-income group. These two factors explain 29.2% of the change of perceived access/ usage. For lower income group, only perceived physical accessibility factor has a statistically significant effect on perceived access/ usage (Beta=0.756, sig. = 0.000). This factor explains 62.8% of the change of perceived usage. In general, when all respondents surveyed on the OIK St, the results show that the two-

perceived physical accessibility and perceived socio-personal accessibility factors all participate in overall perceived accessibility/ usability

+ In LD St: Low-income group shows the same result as in OIK St. Only perceived physical accessibility factor affects perceived access/ usage in the low-income group. In the high-income group, perceived socio-personal accessibility has the strongest influence on perceived accessibility/ usability (Beta = 0.422, sig. = 0.000). In general, when all respondents surveyed on the LD St, the results show 2 perceived factors. physical accessibility and Perceived socio-personal accessibility are all involved in perceived accessibility's variables.

Results of analysing the effects of perceived physical accessibility and perceived socio-personal accessibility on overall perceived accessibility/ usability on Le Duan St and Ong Ich Khiem St show that: perceived physical accessibility has a greater impact than perceived socio-personal accessibility on overall perceived accessibility/ usability.

To sum up, perceived physical accessibility can better explain the potential of perceived using street space in both streets.

Table 7.11 Regression models of two accessibility dimensions to perceived access to street space in Ong Ich Khiem St and Le Duan St.

		Perceived physical accessibility	Perceived socio-personal accessibility	R	Adjusted R	F
OIK St	Lower income	0.756**	0.1544(ns)	.661	.628	20.43**
	Higher Income	0.450**	0.208*	.301	.292	32.79**
	All respondents	0.496**	0.203*	.348	.341	47.02**
LD St	Lower income	0.427*	0.292(ns)	.406	.377	13.69**
	Higher Income	0.377**	0.422**	.510	.502	67.09**
	All respondents	0.394**	0.389**	.484	.478	80.81**

(**) p < 1%

(*) $p < 5\%$; (ns) : not significant

7.2.2.5 The Physical and Non-Physical Variables Affecting Perceived Access/ Usage of Street

Five regression models for each street was conducted via three tasks and related input parameters (figure 7.14). Results from the multivariate regression analyses are reported in Table 7.12. Three for testing overall accessibility/ usability models with higher, lower income group and all respondents-col 1; one model for testing physical accessibility/ usability with all respondents-col 2; and one more model for testing socio-personal usability against all respondents- col 3.

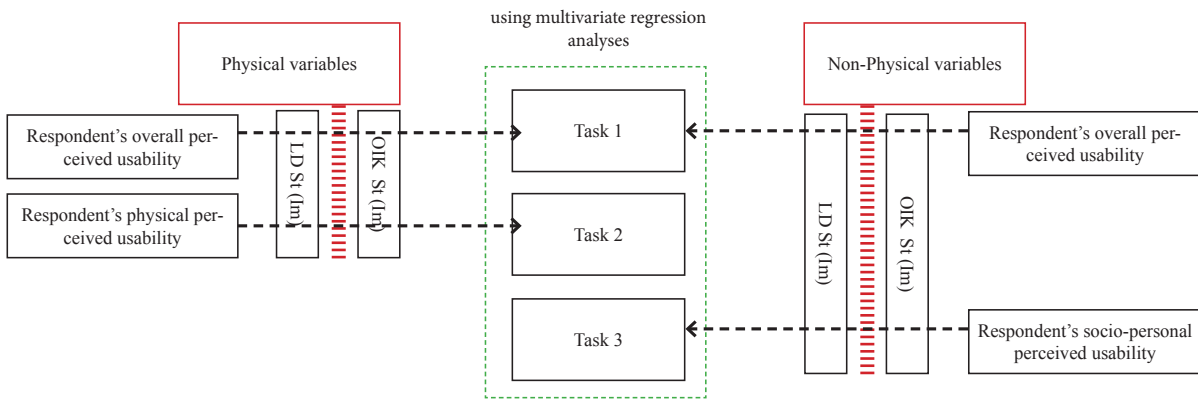


Figure 7.14 Comprehensive regression model analysis diagram.

Table 7.12 Regression models for three measures of perceived accessibility

Variables	Overall accessibility (against all Vars) Col.1						Physical access. (against Physical Vars) Col.2		Socio-personal access. (against non-physical Vars) Col.3	
	OIK St			LD St			OIK St	LD St	OIK St	LD St
	Hi.	Lo.	All Resp't	Hi.	Lo.	All Resp't	All Resp't	All Resp't	All Resp't	All Resp't
	Income	Income		Income	Income					
Walkability	.097	2.67**	.189	0.244**	.392	0.250**	0.224**	0.462**		
Navigation	0.236**	0.778**	0.225**	0.398**	.107	0.373**	.026	.026		
Multifunction	-.021	-0.782**	.032	-.082	.233	-.008	0.173**	.058		
Vision	.025	.381	-.041	0.192**	.119	0.162**	.117	0.164**		
Obstruction	.190	-5.18**	.155	-.042	-.517	-.168	.168	.068		
Publicamenities	.075	2.32**	.027	.121	-.103	.124	0.198**	-.038		
Connectability	-.089	1.51**	-.071	-.031	.373	.056	.033	0.154**		
Permeability	-.054	-2.58**	.003	.087	.195	.148	.016	-.017		
Shading	.209	-2.12**	.158	.042	.092	-.012	-.122	-.031		
Streetstall	-.140	-3.39**	-.158	.113	.142	.101	.016	-.009		
Naturalproximity	.028	2.45**	-.004	-0.199**	-.094	-.114			-.034	-.038
Cleanness	.149	-0.634**	.075	-0.248**	-.098	-0.194**			0.215**	-.014
Informationofplace	-.008	-.116	.060	.126	-.075	.060			.046	0.269**
Accessibility	.068	2.55**	-.006	-.079	.221	.018			-.097	.027
Act. lifestyle	-.014	.021	.018	.044	-.159	-.022			0.234**	.112
Makeprofit	-.057	-.373	-.068	.002	-.179	-.034			-.011	-.028

Safety	0.259**	-0.606**	.125	-.135	.099	-.058		.028	-.090	
Sharedactivities	.036	1.54**	-.042	-.045	.219	.017		-.104	.091	
Eventgroup	-.009	-.001	.127	-.005	.399	.090		0.302**	0.240**	
Socialinteractio	.111	1.11**	.072	.110	-.296	-.002		.066	.113	
n										
R	0.351	0.994	0.327	0.631	0.596	0.508	0.404	0.449	.253	.426
R2 adj	25.5%	95.6%	24.1%	56.4%	22.9%	44.4%	36.8%	41.5%	20.9%	37.1%
F	3.63**	25.70**	3.83**	9.424**	1.629 (ns)	7.90**	11.378**	13.28**	5.7**	7.79**

** : $p < 0.01$

Generally, most regression models were statistically significant ($p < 0.01$).

The first models of LD St were stronger explaining more overall variance in perceived usability ($R^2 = 44.4\%$) compared to OIK St ($R^2 = 24.1\%$). Overall, the street usability/ accessibility model fits better in LD St context than OIK St.

The physical accessibility/ usability models (OIK St: 36.8% and LD St: 41.5%) were generally stronger than the non-physical accessibility/ usability models (OIK St: 20.9% and LD St: 37.1%).

Further, the general accessibility models indicate that variables from both the physical and non-physical dimensions significantly influence overall perceived access to the streets. When examining the significance of individual variables, physical variables explained more of the difference in R^2 values between the two models in both streets.

(1) First Model (Column1)

On OIK Street

* In High-income group: Navigation and safety elements affect overall perceived accessibility.

* In Low-income group: Walkability, Navigation, public amenities, connectability, natural proximity, accessibility, shared activities, social interaction have a positive impact on the overall perceived accessibility ($\beta > 0$ and sig. $< 5\%$). Meanwhile, factors like multifunction, obstruction, permeability, shading, street stalls, cleanness, safety negatively affect overall perceived accessibility.

* For all respondent: Navigation elements that are directly proportional to overall perceived accessibility.

On LD Street

* In High-income group: The elements of walkability, navigation, vision are directly proportional to on overall perceived accessibility to the street space. Meanwhile, natural proximity, cleanness has counteracted on overall perceived accessibility. It

can be seen, greenery problems on the street, the dirt, pollution air, and garbage are problems that hinder the overall accessibility/ usability of people participating in street activities.

* In low-income group: The low-income model on Le Duan street is not statistically significant because sig of $F = 0.135 > 5\%$. The elements of the low-income group model cannot be used to estimate the overall perceived accessibility to this street.

* All respondents: elements of walkability, navigation, vision that affect directly proportional to overall perceived accessibility. Meanwhile, the cleanness has counteracted on overall perceived accessibility.

(2) Second Model (Column2)

For the physical accessibility model, the results from Table 7 show that the walkability, multifunction and public amenities factors affect the physical perceived accessibility of people on Ong Ich Khiem St with a 5% significance level (sig <0.05). These three factors explain 36.8% of the change in physical perceived accessibility on OIK St. Walkability factor (Beta = 0.224, sig. = 0.011) has the strongest influence on physical perceived accessibility to the street.

Meanwhile, walkability, vision factors and connectability impact on the physical perceived accessibility of people on Le Duan St at 5% significance level (sig <0.05). In this model, the walkability factor (beta = 0.462, sig. = 0.000) has the strongest effect on physical perceived accessibility. These three factors explain 41.5% of the change in physical perceived accessibility of people on Le Duan Street. It can be seen that walkability has the strongest impact on Physical accessibility on both Le Duan and Ong Ich Khiem St. The predictive model of physical perceived accessibility on Le Duan Street is better than Ong Ich Khiem (because of $R^2 \text{ adj} = 41.5\%$).

(3) Third Model (Column 3)

Socio-personal accessibility (Against Non-Physical Variables)

For the socio-personal accessibility model, it shows that the cleanness, active lifestyle and event/art/culture elements that affect socio-personal perceived accessibility of people on Ong Ich Khiem St with a 5% significance level (sig <0.05). These 3 factors explain 20.9% of changes in socio-personal perceived accessibility to the street. The event elements (beta = 0.302, sig. = 0.001) has the strongest effect on socio-personal perceived accessibility on OIK St.

Meanwhile, information of place and event group factors impact socio-personal perceived accessibility to the street on Le Duan St at 5% of significance level (sig <0.05). In this model, the information of place element (beta = 0.269, sig. = 0.028) has the strongest effect on socio-personal perceived accessibility. These two factors explain 37.1% of changes in socio-personal perceived accessibility of people on Le Duan St. There are differences in the impact level of non-physical elements on socio-personal perceived accessibility on both streets. The event factor has a strong impact on OIK St while the information of place factor is strongly impacting on Le Duan Street. Besides, the event element all affects socio-personal perceived accessibility in both streets. The prediction model regarding socio-personal perceived accessibility on Le Duan St is better than Ong Ich Khiem St (because of R² adj = 37.1%)

In summary, the results indicate that both physical and nonphysical factors significantly contribute to perceived street space usage, with physical variables more important in explaining the variance in street space usage/ access. The physical models were the strongest and most consistent for groups from different street environments and behavior settings. Nevertheless, the significance of non-physical and physical variables differed between kinds of street and income groups. In particular, obstruction, street stall, walkability, multifunction, vision was important physical variables for difference in streets and income groups. Whilst, pavement's

approachability/accessibility, cleanness, safety, shared activities, social interaction were important non-physical variables for groups from different street context.

7.3 Discussion

7.3.1 The Difference Between Environment-Behavior Patterns on Two Kinds of Street

Further analysis was conducted to interpret the difference between the two kinds of street in three typical environment-behavior patterns explained in Figure 7.9.

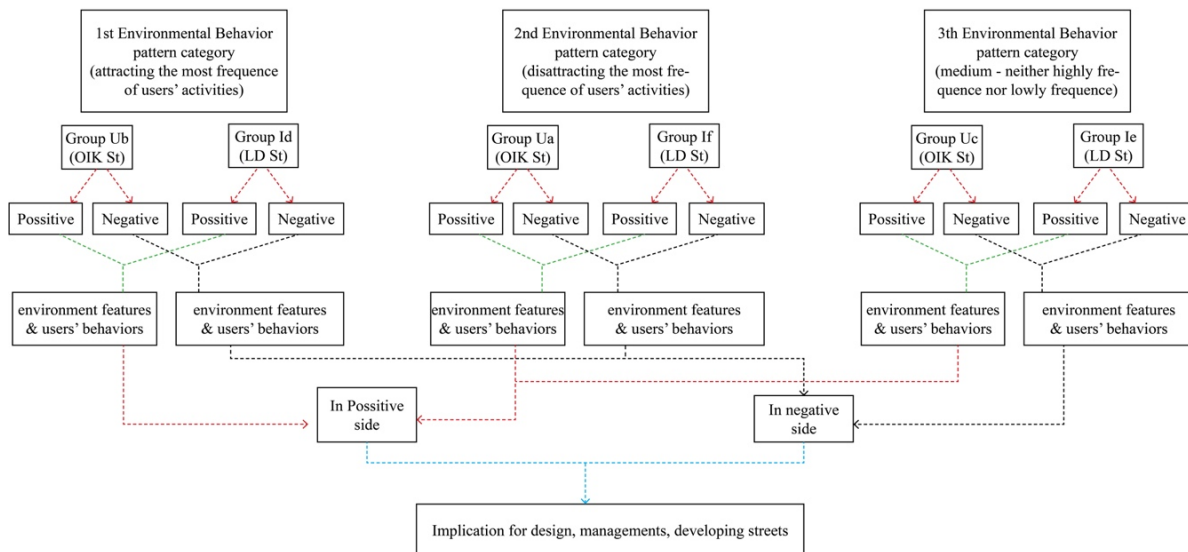


Figure 7.15 Results interpretation diagram and further analysis for discussion

7.3.1.1 The Environmental Behavior Pattern Attracting The Highest Frequency of Users' Behaviors (The 1st Pattern)

The first environmental behavior pattern attracts the highest frequency of users' behaviors. Trading behavior was the most frequent behavior occurring on OIK St, while idling, service/maintenance, and relaxation behaviors were the most frequent behaviors occurring on LD St (Figure 7.7). Both streets have similar and different

environmental features that lead to the difference in behavior distribution discussed herein (Figure 7.7 and 7.10).

(The physical environment assessment based on the PCA score)



Figure 7.16 Characteristics of the first typical types of environmental behaviors.

(1) Similar features: level of shop-house connection on land-use (or shop-house functional division) and sidewalk accessibility/permeability

Positive aspects: On OIK St, these features promote trading behaviors. On LD St, these features encourage relaxation, recreation, and idling behaviors. They also reduce human movement on the sidewalks.

Negative aspects: On OIK St, these features contribute to sidewalk and traffic congestion due to the need for moving between residences to shops and vice versa. On LD St, these features discourage social interaction between neighbors and local

trading activities. The high degree of sidewalk accessibility/permeability also leads to parking on the roadside, which obstructs vision and affects accessibility behaviors.

(2) Different features: degree of openness, connection, and tidiness on OIK St; degree of cover and relaxation facilities, walking paths and related paths, and street stalls on LD St

Positive aspects: On OIK St, the low degree of openness promotes social integration due to narrowing personal space. The medium degree of connection and tidiness contributes to increasing human movements that lead to social interaction and trading activities. On LD St, the medium degree of cover, walking paths, and relaxation facilities such as canopies, shading, benches, and green spaces contribute to the frequent occurrence of idling and relaxation behaviors. The low distribution of street stalls removes chaos on the sidewalks.

Negative aspects: On OIK St, the low degree of openness contributes to sidewalk and traffic congestion due to insufficient space for various concurrent activities. The medium degree of connection and tidiness contributes to increasing pedestrian crossings. On LD St, the frequency of accessibility behaviors is modest despite the medium degree of cover, walking paths, and relaxation facilities. The medium degree of cover may be a reason for discouraging walking activities.

7.3.1.2 Environmental Behavior Pattern Discouraging The Most Frequency of Users' Behaviors (The 2nd Pattern)

The second environmental behavior pattern discourages the highest frequency of users' behaviors. Both streets have similar and different environmental features that lead to the difference in behavior distribution discussed herein (Figure 7.7 and 7.11).

(The physical environment assessment based on the PCA score)



Figure 7.17 Characteristics of the second typical types of environmental behaviors.

(1) Similar features: level of shop-house connection on land-use (or shop-house functional division) and sidewalk accessibility/permeability

Positive aspects: On OIK St, these features reduce human movement on the sidewalks due to the great distances between residences and shops (about more than a 5-minute walk or 500 m walking [67]). On LD St, these features allow residents to conduct business in front of their own house. The low degree of sidewalk accessibility/permeability promotes safety due to unobstructed view. Indeed, high level of accessibility leads to the roadway and sidewalk obstruction caused by freely parking on-street and on-sidewalks.

Negative aspects: On OIK St, these features discourage most behaviors due to the lack of residents. Here, the only commercial activity is a hotel and a restaurant closed off by fence. Narrow sidewalks and high volume of transportation cause low accessibility of space. On LD St, the medium degree of shop-house connection discourages social interaction of neighbors and local trading activities to some extent. The low degree of sidewalk accessibility/permeability constrains accessibility behaviors.

(2) Different features: degree of openness, connection, and tidiness on OIK St; degree of cover and relaxation facilities, walking paths and related paths, and street stalls on LD St

Positive aspects: On OIK St, the high degree of openness provides a wider vision for relaxation behaviors due to the street's connection with a big road. The low degree of connection promotes tidiness and reduces sidewalk congestion. On LD St, the medium degree of cover, walking paths, and relaxation facilities such as canopies, tree shading, and benches contribute to the frequent occurrence of relaxation behaviors. The low distribution of street stalls removes chaos on the sidewalks.

Negative aspects: On OIK St, the high degree of openness discourages users' behaviors due to oppressive sunlight. The low degree of connection causes pedestrians to put themselves in danger by walking on the roadway instead of sidewalks. On LD St, although there is a medium degree of cover, walking paths, and relaxation facilities, it is not enough to attract idling behaviors. The low distribution of street stalls makes the space boring.

7.3.1.3 Neutral Environmental Behavior Pattern that is Neither Frequent nor Infrequent (The 3rd Pattern)


The third environmental behavior pattern neither attracts nor discourages users' behaviors. On OIK St, most of the behaviors were neither frequent nor infrequent. However, on LD St, there were some frequent behaviors (relaxation) and infrequent behaviors (idling). Both streets have similar and different environmental features that lead to the difference in behavior distribution discussed herein (Figure 7.7 and 7.12).

(The physical environment assessment based on the PCA score)

Shop-house relationship	Degree of Vision/openness	Pavement Accessibility & Permeability	Degree of Connection	Degree of Tidy
High	High	Medium	Medium	Medium

Pavement Accessibility & Permeability	Shop-house relationship & nature proximity	Degree of cover and relaxation facility	Walkpath & related	Street stalls
High	Low	Medium	Medium	Medium

Group Uc (OIK St)



High level in Shop-house connection
 Positive: - Convenience for participating in street space for various activities such as accessibility, relaxations and others.
 Negative: - Creating the chaotic on the pavements, congestion and unsafety for traffic movements

Medium level of accessibility & permeability
 Positive: - Promoting various activities such as idling, trading, accessibility.
 Negative: - Increasing the cause of congestion on the pavement and conflicts between the shopowners and visitors.

The high degree of openness/vision.
 Positive: - Attracting potential of relaxation and idling activities.
 Negative: lack of greenery and visual objects

Medium degree of connection and tidy
 Positive: - Promoting the walking on the sidewalks and being comfortable other activities
 Negative: - Because the limited sidewalk width, the accessibility of homeowner/shopowner may be affected

Group Ic (LD St)



High level of accessibility & permeability
 Positive: - Promoting accessibility behaviors such as arriving/ coming sidewalk, encouraging trading activity such as fixed trading activities.
 Negative: - Creating the obstruction and congestion on the sidewalk and roadside by parking. There are conflicts between shopowners and visitors on accessibility behaviors.

Low level in Shop-house connection
 Positive: - Making the pavement more tidy and clean. Removing other activities such as eating/drinking on the pavement
 Negative: - A large amount of accessibility such as coming and arriving or parking needs to be processed.

Medium degree of cover, relaxation facility and walk path.
 Positive: - Encouraging idling and relaxation behaviors due to shading and landscape/visual view.
 Negative: - The vision obstruction should be considered on the road and pavements

Medium degree of Street stalls
 Positive: - Creating the livable and speciality by small stalls on the pavements. And convenience for travellers to get something on their ways. Promote individual household income
 Negative: - Creating the obstruction on the sidewalks and roadway occurred when people accessing.

Figure 7.18 Characteristics of the third typical types of environmental behaviors.

(1) Similar features: level of shop-house connection on land-use (or shop-house functional division) and sidewalk accessibility/permeability

Positive aspects: On both OIK St and LD St, these features are conducive for activities of daily living and business and contribute to accessibility, trading, and idling behaviors.

Negative aspects: On both OIK St and LD St, these features create sidewalk and roadway obstructions due to various overlapping and concurrent activities. On LD St, the low degree of shop-house connection makes the sidewalks boring when shops are closed. It also reduces trading behaviors to some extent and discourages social interaction of neighbors.

(2) Different features: degree of openness, connection, and tidiness on OIK St; degree of cover and relaxation facilities, walking paths and related paths, and street stalls on LD St

Positive aspects: On OIK St, the high degree of openness provides a wider vision for relaxation behaviors. The medium degree of connection and tidiness attracts accessibility, trading, and relaxation behaviors. On LD St, the medium degree of cover provides a wider vision for trading and idling behaviors. The medium degree of walking paths and relaxation facilities such as canopies, tree shading, and benches contribute to the frequent occurrence of relaxation behaviors. The medium distribution of street stalls maintains the order of the street space.

Negative aspects: On OIK St, the high degree of openness permits oppressive sunlight that discourages trading, relaxation, and idling behaviors. The medium level of connection and tidiness discourages accessibility, trading, and relaxation behaviors. On LD St, there is a lack of trading and idling activities despite the medium degree of cover, walking paths, relaxation facilities, and street stalls.

7.3.1.4 Suggestions for Each Environment-Behavior Pattern

The degree of shop-house connection on land-use (or shop-house functional division) is an important factor for facilitating business activities and consumer behaviors. The degree of sidewalk accessibility/permeability is an important factor for providing adequate space for safe and easy access to sidewalks. The degree of openness, connection, and tidiness is an important factor for encouraging social interaction. The degree of cover, walking paths, and relaxation facilities is an important factor for providing comfort from harsh weather elements and other negative conditions. Finally, a systematic distribution of street stalls should be considered for enhancing and preserving local identity and customs.

(1) For street sections in the 1st pattern: Improvement of the street space for sections in the 1st pattern should consider the impacts of sidewalk and traffic congestion. Such congestion obstructs vision and creates dangerous conditions to discourage many kinds of users' behaviors. Therefore, a separate buffer zone adjacent to the sidewalk and off-street parking spaces should be established. On-street vehicle parking should be prohibited and lines limiting public, semi-public, and private use of sidewalks should be enforced.

(2) For street sections in the 2nd pattern: Improvement of the street space for sections in the 2nd pattern should consider increasing the population density of users. Therefore, more residential and commercial properties should be erected to attract more users. Additionally, open space should be utilized more efficiently and restrictions on traffic speed and volume should be implemented.

(3) For street sections in the 3rd pattern: Improvement of the street space for sections in the 3rd pattern should consider aesthetic enhancements to encourage more social interaction and relaxation and idling behaviors. Therefore, properly selected street furnishings should be strategically placed to provide comfort and safety and create a sense of local identity.

7.3.1.5 Further Discussion

This research found differences in the occurrence frequency and distribution of users' behaviors on an improved street versus an unimproved street. However, regardless of the quality of street space, each street had both positive and negative characteristics that affect users' behaviors. Therefore, street improvement and management should consider enhancing positive characteristics and mitigating negative characteristics of street spaces in eight environmental attributes: (1) shop-house relationship and nature proximity; (2) sidewalk accessibility and permeability; (3) degree of openness; (4) degree of connection; (5) degree of tidiness; (6) degree of cover and relaxation facilities; (7) degree of walking paths and related paths; and (8) distribution of street stalls. This analysis is analogous to the research of Christopher Alexander in seeking language patterns to build a living environment with tangible and intangible qualities that provides positive interaction in community [68-71].

The findings also show that trading activities attract people to participate in and be engaged in the community on unimproved streets. This is a key factor that needs to be preserved and refined in the renovation process to provide a new street space with a richness of cultural identity and variety of human activities. This is consistent with the studies of Drummond (2000), Espina (2018), and Babiano (2007), which found an emphasis on the need to use street space in the daily lives of locals in Asian developing countries [26, 49, 72]. It also confirms the perspective in economic pavement existing in Vietnamese cities [54].

In order to facilitate various activities in the new urban context with a variety of motor vehicles, especially motorcycles, streets need to provide a buffer space that provides a physical setting to encourage accessibility and temporary idling behaviors. Because street space is limited, the application of street space sharing

theory to build a buffer zone for different activities changed during different time periods to serve various activities including relaxation activities as well as access and profit-making activities such as trading and maintenance service [49, 52].

One of the significant elements that affects users' movements along the street which contributes to the potential of social interactions is land-use form. Indeed, there is little difference in land-use form or residence and shop relationship on unimproved and improved streets. On the unimproved street, because of a long history of development, the environmental conditions are currently low quality and out of date. Some people tend to move away to find better places to live. Others live in residential areas settled behind front land lots adjacent to street spaces; however, they still return daily for work. These streets are active during the day and deserted at night. However, stronger community cohesion was found on these streets as evidenced by the diversity of users' behaviors. In contrast, the shop-houses on the improved street were mainly planned for housing but were eventually exploited for profit-making activities. The house is separated for two functions, residence and business. Landlords rent the business zone to other businesspeople. They keep to the living zone and rarely appear in the business zone or sidewalks because the sidewalk is the most important area for business activities in Vietnamese cities. Gradually, the relationship between neighbors disintegrate. Tenants stay in another place and exploit the rent zone for business. Hence, the street space becomes a space for accommodating strangers' activities.

Necessary activities such as accessibility, parking, and waiting for someone or something usually occur on these streets. A small number of optional activities occur in arranged recreational facilities such as green spaces, benches, and canopies, but without social interaction. These findings implicate the role of walking distance of residents from residence to working place in creating a living environment on the street. This feature was also discovered by Mehaffy (2015) in his research about the

concept of neighborhood units initiated by Clarence Perry (1920) regarding walkable distances in 5 and 10- minute walking thresholds that affect users' accessibility toward open space [67]. These research findings posit a new hypothesis about the relationship between land-use pattern related to residence-shop connection and neighbors' relationship affecting the diversity and occurrence of user's behaviors on streets in necessary, optional, and social activities, and contribute to reducing vehicle transportation on streets. This can help broaden the scope of street space improvement and city planning to contribute to the sustainable development of communities in nations using streets as multifunctional spaces as Vietnam.

This research has possible limitations. Broadening the time frame would enable the collection of more users' behaviors. To this end, users' behaviors could be recorded by multiple video cameras set up in various places for the entire day [73]. Additionally, behavior mapping and coding requires time and skill. The application of GPS and GIS could improve the ease and accuracy of data collection and analysis [74, 75]. Moreover, this comparative study neglects aspects of nature such as weather and season as well as the social conditions of the two kinds of street. Indeed, the difference in demographics of the users, especially the rich and poor differentiation, on both streets influences users' behaviors and their perceived accessibility. Upcoming studies can conduct further survey of users' perceptions regarding accessibility or usability of street space including tangible and intangible elements.

7.3.2 Users' Cognition Responding Different Street Environments

This section supports the validity of an integrated street usability/accessibility model including both physical and non-physical factors.

The model was empirically examined in two kinds of unimproved and improved street with different environment features. The findings indicate that both physical and socio-personal factors significantly contribute to self-reported street access or usage in both physical settings and contexts, supporting the hypothesis that the accessibility or usability concept is a complex, multi-dimensional construct. Three hypothesized dimensions in the model were supported. Further, the physical dimension provides the most important element of the user's perceived accessibility or usability in both different street settings, with walkability, navigation and vision characteristics of the street space providing the strongest predictor variables. The socio-personal dimensions of access are weaker than physical variables, with cleanliness feature are reported by people being the most important predictor variables.

Le Duan St's users perceive higher levels of using street compared to Ong Ich Khiem St residents. However, participating into the street is more frequent in OIK St than LD st. This may be explained by the reasons of land-use form and residence-shop house relationship that has been discussed in the first part finding of this chapter involving users' behavior and environment relation aspects. This section also attempts to test the relationship between perceived accessibility and self-reported travel distance, however, there is no correlation between both variables due to the insignificance in statistical analysis.

Owing to the distinction between different social classes in Vietnam, this phenomenon leads to differences in perceptions of users and their behaviors specifically in street use manners. The analysis was conducted according to lower-income and higher-income group people. These groups were defined and classified based on annual average income per capita statistic from the government. Therefore, this study focus aims at clarifying the difference in the awareness of higher and lower-income groups in street space usage. This can contribute to developing a street

space for everyone regardless of their financial conditions, and then create social justice.

Regarding to relationship between income and street access/usage, there is an interesting finding between both kinds of street and income group. The lower income groups in OIK St are likely to report higher levels of street access/ usage and appear more vulnerable to variations in most of the physical and non-physical settings on unimproved street. While on LD St, the higher income groups come a higher proportion in street access/usage and affected by some elements involving physical and personal dimension e.g. walkability, navigation, vision, natural proximity and cleanness.

This section provides support for treating usage/access to urban street space and public spaces as a social justice issue. Many designed and improved streets with higher quality and completed facility were unevenly provided in urban areas. Some main streets being adjacent to higher income neighborhoods and communities were given priority for improving and upgrading facilities. In contrast to this, the lower income residence areas being adjacent to streets subject to lower quality and degraded facilities. The same phenomenon occurred in public space distribution within urban area was also recently raised by many scholars[76-79]. In addition, in Vietnamese context, most of recent improvement and development of street based on the method, approach, and knowledge deriving from developed countries with higher income.

These findings indicated that the lower income people reporting significantly much access to the street space than their higher income counterparts and the number of lower income people slightly decreases when the quality of street space is enhanced. It means currently improving the street space will not necessarily result in increased street access/usage, especially, the lower income. Perceived street usage is affected by a combination of both physical and non-physical variables that differ

by population group and the specific context of the street setting, reinforcing the demand for targeted social research that can identify diverse community needs for more efficient public service delivery at a local realm.

Further, the findings indicated that lower income people tended to use street space more than high-income ones. The former was also more affected by various factors on streets than the latter in unimproved streets. The possible explanation for this is in unimproved streets with a long history, most residents in neighborhood got used to their daily routines on pavements; their activities were mostly associated with small business in limited living conditions[26]. They felt satisfied to do their daily activities in this space rather than strange and unfamiliar improved streets[80]. Meanwhile, due to Vietnam's weather and environment, swelteringly hot days, air pollution and noise pollution, high-income individuals often chose another space (e.g. supermarkets, cafeshops or shopping malls) for their recreational and shopping activities instead of doing ones on pavements

The environmental justice component of street access/ usage has a wider meaning than simple physical availability of urban street and also includes the level of wealth. Indeed, in the improved street space, physical settings are upgraded and more pieces of street furniture are added; this place gathers most stores and cafes with higher rent, so low-income people mostly never visit this place. Higher income group is influenced by walkability, navigation, vision, natural proximity and cleanness variables. Therefore, in order to improve potential activities of low income individuals in improved streets, it is needed to provide a wider range of types of commercial service and serve more groups, e.g. street stall with affordable price.

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Chapter 8 CONCLUSIONS

8.1 Conclusions

Street improvement is one of affordable approaches for overcoming scarcity of public open space in Vietnamese urban area that can contribute to enhancing quality of life by providing street furniture and physical setting e.g. bench, canopy, greenery, upgrading quality of pavements, widening sidewalks and so on to engage in active lifestyles, transportation, effectively increasing pedestrians' movements, promoting non-motorized traffic. Street improvement may also play a significant role in making street order and tidier, removing conflicts of interest between parties (travelers, residents, authority) on the street, contributing social cohesion by enhancing more eyes on the street, hence, creating a lively community.

In regard to the current situation of street, each street space that whether is improved or unimproved also contains the positive and negative aspects. In addition, as each kind of street reflects its own characteristics that may influence users' behaviors in various manners.¹

This study conducted to reach a variety of conclusion through each section of the research, and the final conclusion and their relationship are summarized in Figure 8.1. By this study, the current situation and various aspects and characteristics of street space were disclosed in both positive and negative sides. Three viewpoints were identified that contributes to fill the gaps of current street space conditions. And finally, the main idea approaches were proposed may contribute to better improvement of the street space in Vietnam.

The first viewpoint's objective is to pay attention to users' concerns toward the physical setting of street. As it was noticed that the category of physical setting in the street provided does not meet what passengers pay attention to. In addition, the findings show that the street can be classified into different level of improvement

that attracted different user's concerns. Therefore, the improvement should consider this aspect to save street improvement budgets and effectively enforcement.

The second viewpoint's objective is to address the conservation of behaviors involving culturally and locally on both kinds of the street. As many activities appeared on the street to be considered negative by authority and manager, this has led to the banning campaigns using pavement for some commercial activities e.g. street stall. In this case, the development of an on-sidewalk commercial specific zone for each street segment or rearrangement of the pavement to provide the walk path and gathering point wider enough for accommodating passengers and street vendors at the same time. For satisfying users' need on accessibility/ approachability onto the sidewalks, a buffer zone should be provided.

The third viewpoint's objective aims at filling the gaps in usage equity. The physical and non-physical improvement and design should consider between various income and demographical group.

By doing so, several approaches have been proposed that may work together to achieve the overall effects. The first approach works on street space design and planning instructions. This first proposal related to the recommendation/ suggestions for design and planning, it is a handbook of street improvement and development. This handbook may provide knowledge and guideline for designers and planners by several regulations and suggestions that manages various aspects related to design and planning for street space in both improved and unimproved conditions. Because the regulation can be solved by various design approaches, hence, the handbook is necessary for controlling the design ideas get on the main backbone of the theoretical framework by providing illustrations for easy reference and imagine.

The second approach works on the aspect of management. The environmental improvement of the street is beyond the simple physical availability including the dimension of management. It aims to be efficient tools for authorities and may benefit various parties related to sidewalk managements. This handbook helps to maintain and operate the usage on the street and its sidewalks. It also keeps the behaviour settings operate smoothly and restricts unintended arising. In addition, the management handbook that works as a reference for managers, parties, authorities may contribute to the efficient usage of the street space and sidewalks, increases the quality of life in communities. The absence of specific regulations or weakness in enforcement for street space allows residents to freely use the pavement and street space for their private purpose. The current management and enforcement seems ineffective due to unreasonable and inadequate force of deterrence.

The third approach focuses on cognitional and educational improvement in building a better environment. Community awareness is the essential dimension for improvement that seems to be neglected. Indeed, without this aspect, it will not be possible to successfully implement and enhance the quality of life that binding by street space management regulations. Therefore, educating sense and manner of street use as well as the role of managers in improving and respecting the public territory on the street is an important first step for improvement.

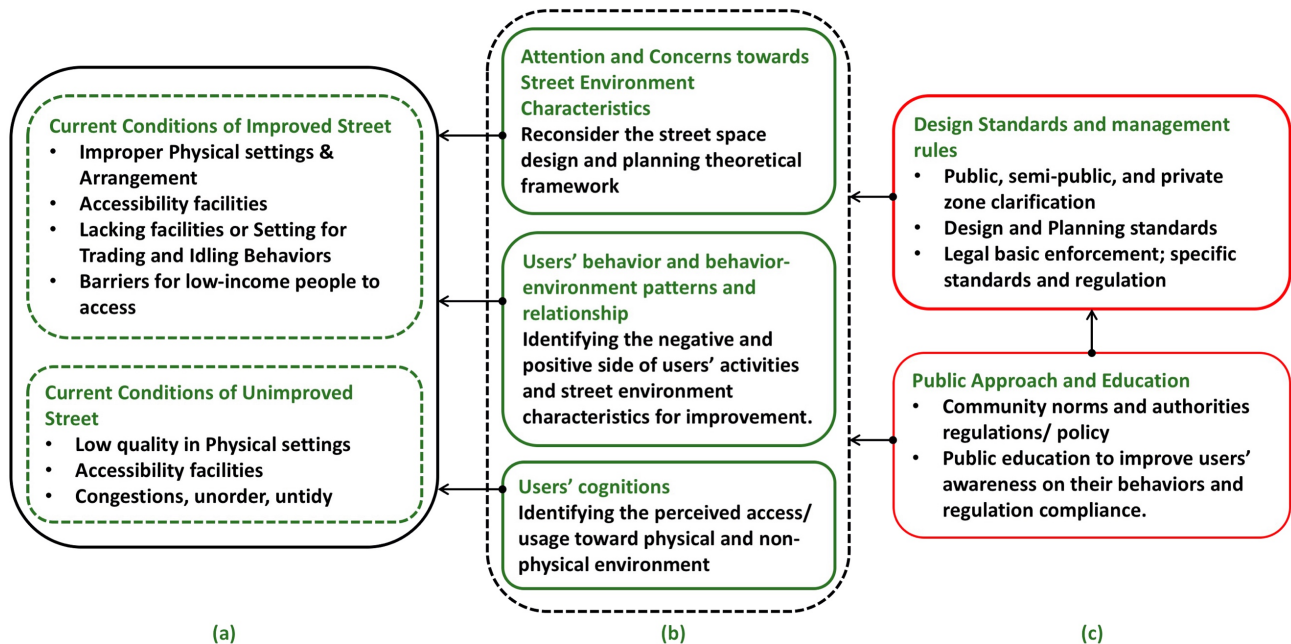


Figure 8.1 Entire picture of conclusion and proposals and its relationship: (a) Current conditions of street space; (b) Improvement viewpoint; (c) Improvement approaches.

8.2 Proposals

According to the comprehensive conclusions, three approaches including design and planning regulation, managements and education works together to achieve more potential effective. Hence, the suggestions and proposals were designed based on these three approaches (Figure 8.2). The first proposal aims at developing the handbooks of Street design and planning based on Environment Behavior Study. On one hand, the second one focuses on designing the handbooks of street space management. On another hand, establishing the various associations and neighbourhood information system is considered the third proposal. These three proposals are related, hence, it may much more effective when operating together and overlap assisting.

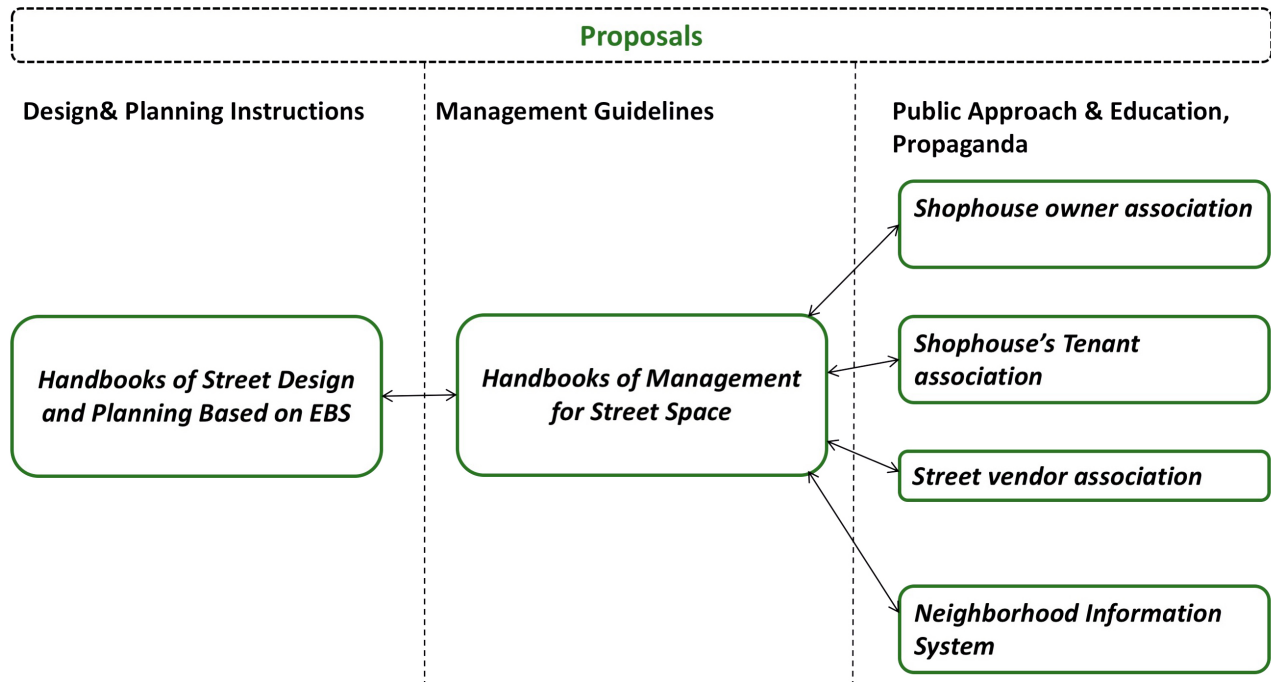


Figure 8.2 Street improvement developed suggestions, proposals and its relationship.

8.2.1 The Proposal for Design and Planning

Although various positive and negative physical factors are found in two kinds of streets, the improvement needs to focus on increasing the former and minimizing the latter during the process of urban design and planning. This Street Design and Planning Handbook provides an essential mindset and principles that transfers into designing streets through various elements contributing the universally accessible and providing the standards for various categories of streets and usages (Figure 8.3).

This handbook proposes the new approach to classifying the street environment based on environment-behavior pattern. Several regulations binding various aspects of physical elements and specific design concepts that can be applied to current street space e.g. street physical settings, safety and universal elements, street intersection zone, buffer and commercial zone, connecting pathway, spatial and functional

arrangements. It contributes to enhance the physical conditions of street space and its sidewalks, to provide better quality for inhabitants in respecting the local culture of community. Moreover, the process design recommendations are also highlighted that navigates designers and authorities in street space development strategy (Figure 8.4 and 8.5). Figure 8.6 shows the relationship between each chapter that may provide better navigation and clarification for using this handbook.

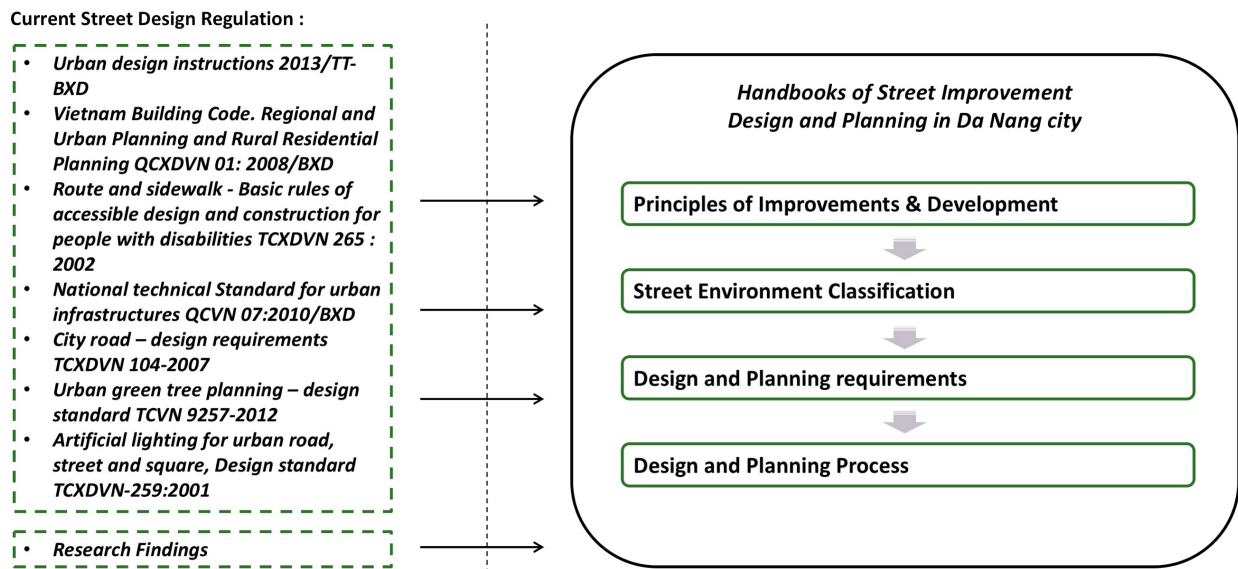


Figure 8.3 Main Contents of Street Design and Planning Handbook and its initialization

Chapter 1: Principles of urban street Improvements & Development

- 1) Streets are Public Domain, Open Space
- 2) Streets are a Multi function space
- 3) Streets are the profit-making place
- 4) Safety and universality
- 5) Affordability
- 6) Flexibility
- 7) Equity
- 8) Act quickly

Chapter 2: Environment-Behavior Typologies of Street Space

The basis for proposed Environment-Behavior typology in Da Nang Street Space: Typology is designed considering the existing Environment-Behavior pattern based on research findings. Proposed typology is thus every type of street may have different functions, different spatial characteristic, activities and thus different design requirements. (Six Patterns)

Chapter 3: Street Physical Settings

Sidewalks, Walkpath, Motorcycle Parking, Bus Stop, Greenery, Street furniture..

Chapter 4: Street Intersection

Planning and Design of intersection, Intersection design for pedestrian, Intersection design for cyclists, Intersection design for vehicles, compact intersections.

Chapter 5: Safety Elements and Universal Elements

Pedestrian Crossings, Traffic calming Measures, Speed humps, traffic signals, medians, railings, lightings, street signs, navigation signs, advertisements...

Chapter 6: Horizontal Zones and spatial arrangements

The planning and development of street space are encouraged with a variety of land uses. It means building social function clusters and options on street sidewalks to reduce the concentration of activities on the same road segment at a certain time

Chapter 7: Buffer Zones

Proposed the Buffer zones concept for individuals to access pavements to tackle jams triggered by the parking of motorbikes, concurrently to resolve conflicts between landlords and non-residents.

Chapter 8: Commercial Zones

Respect local identity values, trading activities on pavements should be kept rather than being eliminated by providing night markets or specific space in each city block for fixed trading activities.

Chapter 9: Connecting pathway

The pathway connecting blocks should provided on each city block e.g. viaduct, overfly bridge, tunnels, so on, ensure the safety of pedestrians..

Chapter 10: Street Improvement Design and Development process

Road and sidewalks inventory, surveys, identify environment-behavior patterns, actual design and integration of existing elements, right of way overlay, stakeholder consultation.

Figure 8.4 The proposals of design and planning handbook outline for street space development



Buffer Zone	Walkpath	Semi-public	Private
For accessibility, it is allotted on the sidewalks with entrance ramp, separated by DGL, minimum 2m at least. Allow the commercial zone.	For pedestrian movements, Minimum 2m at least, with disability lane	Allow shop owner temp.use for trading 0.8 m	shop owner can arrange stuffs for trading and daily activities 2m

Figure 8.5 An illustration example of spatial and functional layout including buffer zone concepts, wathpath zone, semi- public and private zone on sidewalk extracted from street space design and planning handbook

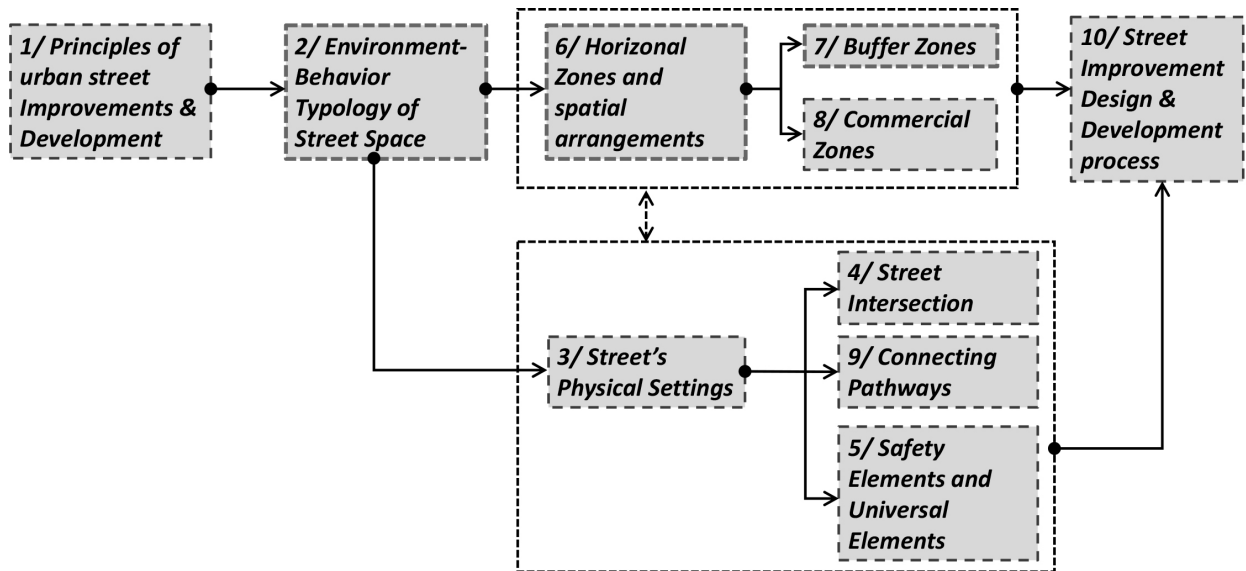


Figure 8.6 Design and Planning Handbook structure and relationship diagram

Most notably, the street space typology proposed based research findings that including two different dimensions including environment and users' activities. It is a novelty of street typology classification in comparison with that currently classified based on only one dimension regards the environment. This section proposes the detail including characteristics description of each street space typology and existing conditions that contribute to identifying different spatial typology on the same street (Figure 8.7).

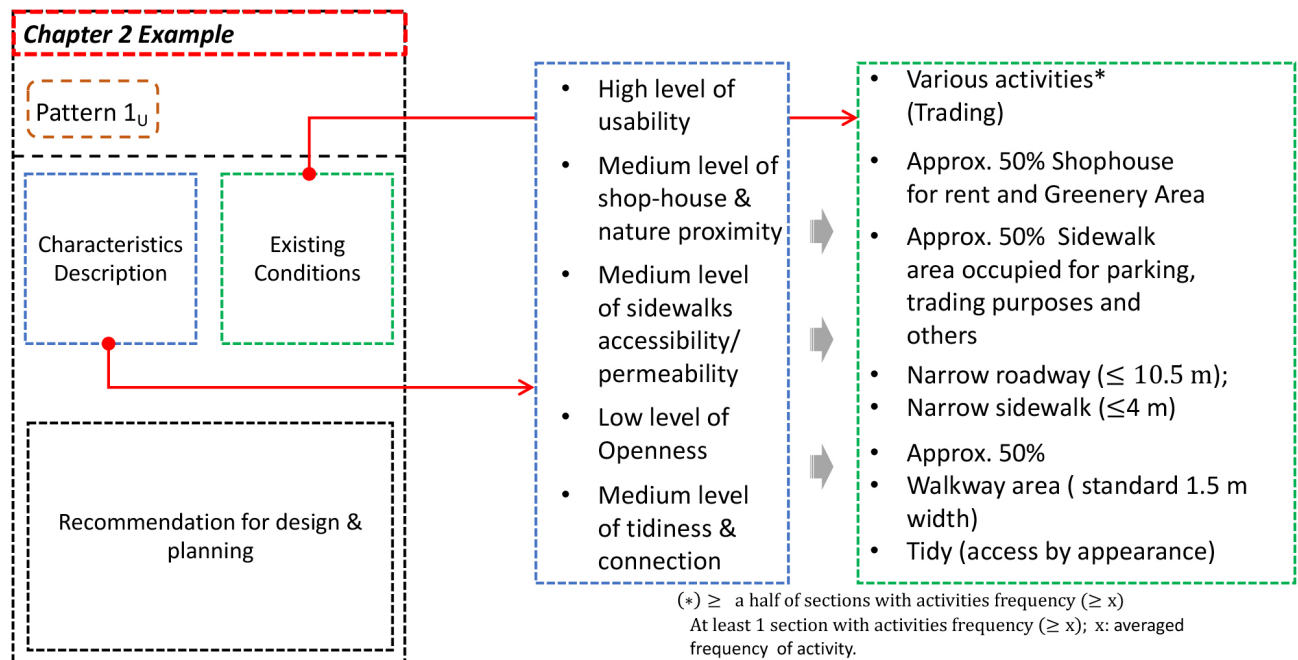


Figure 8.7 Street typology example with information and explanation.

Moreover, the concept of buffer zone was emphasised and explained in figure 8.8. This concept is not a novelty in city planning and ecological landscape field. However, on the street space, this concept was inserted that creates a component contributing to various benefits:(1) the buffer zone helps protect and separate non-motorized movement on the sidewalks out of the motorized movement on the roadway; (2) providing a transition area for activities or functions that need the connection to traffic movements. By reorganizing the order and zone on the sidewalk

based on the usage nature of residents, the street will have come the highly successful place in the urban area of Vietnam.

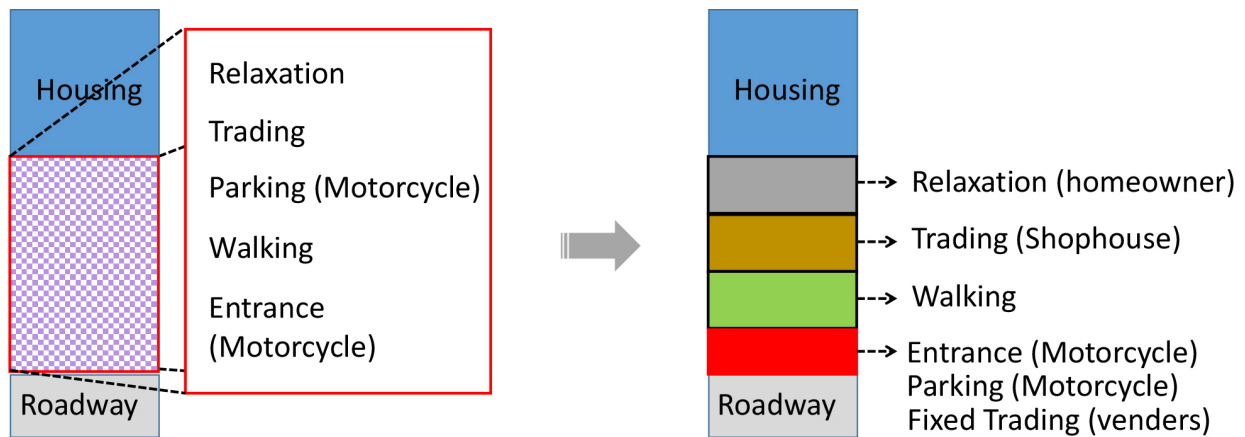


Figure 8.8 The difference in the spatial arrangement, function and the role of buffer zone and other zones between current street and proposed streets.

8.2.2 The Proposal for Managements

Current management enforces trading activities restriction that aims at mitigating the chaotics on street space. However, various activities that occurred on the street are a sign of a successful place. Moreover, activities have become an attractive factor that contributes to the economic growth of the city via trading/ commercial hubs or points. Apart from mentioned urban planning and design solutions, management plays an important role to help activities take place on sidewalks without any impacts on main functions of serving pedestrians. Indeed, mobile street trading activities are more difficultly managed due to its mobile characteristics. With rudimentary and short-lived selling facilities, mobile street trading is not suitable for a city with the good quality of life. In order to do this, the handbook of street managements should be published to propose various regulations for operating the street usage especially sidewalks and making it to become a unified and consistent component. Four main contents were developed based on the current street management regulation and research findings including the management principles, usage and maintenance management, and a new policy for the implementation forces (Figure 8.9). This

handbook includes 4 main chapters and various sub-section that have a close relationship with each other. Figure 8.10 discloses handbook structure and its relationship that contributes to the comprehensive picture of management work.

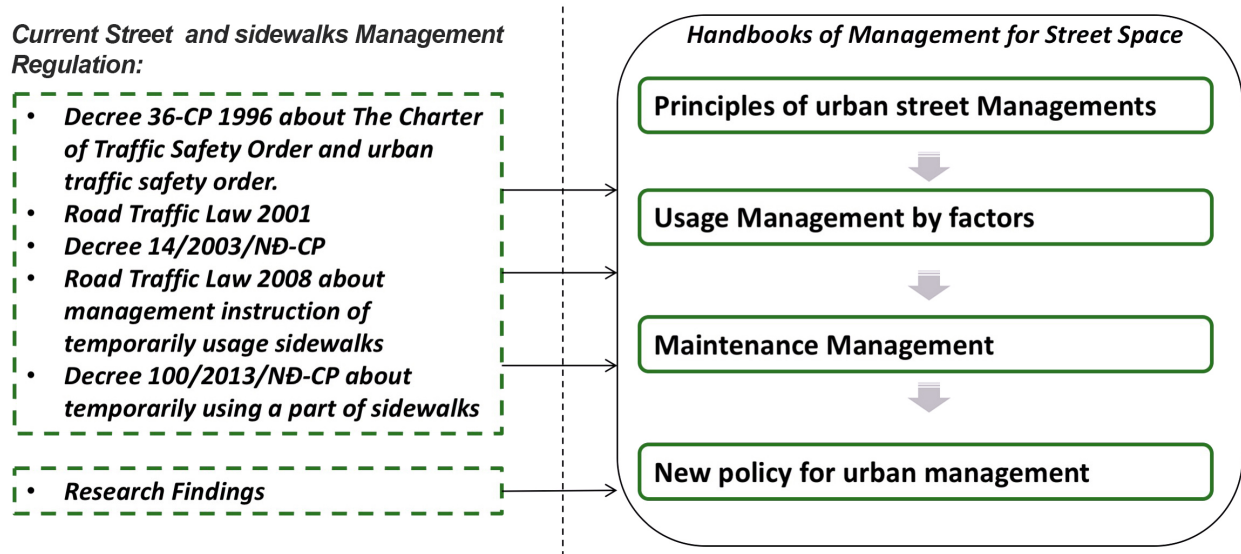


Figure 8.9 The main idea of proposals of street space management handbook

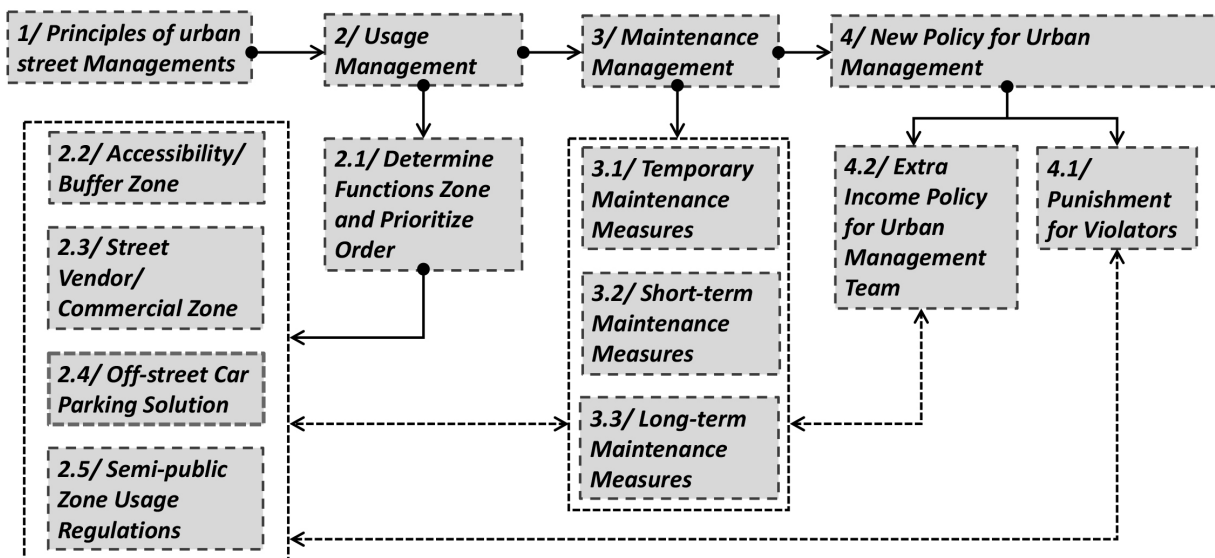


Figure 8.10 Management handbook structure and relationship diagram

Apart from those activities, it is needed to impose strict punishment for violators; if not, the management hardly brings desirable outcomes. Figure 8.11 and 8.12 provide further explanation of each chapter and an example of off-street car parking proposed management.

Chapter 1: Principles of urban street Managements

- 1) Convenience and Safety for Traffic
- 2) Accessibility
- 3) Provide prioritize to pedestrians
- 4) Safety and universality
- 5) Multi functions
- 6) Respect commercial activities
- 7) Coverability

Chapter 2: Usage Management

The street space usage management was proposed in order to provide the knowledge and easy access to authorities and managers and related agencies

Determine Functions Zone and Prioritize Order on sidewalks

Based on design guidelines, regulations, and actual state of street space, clearly delimitating the private, semi-public, walkpath, buffer zone by drawing lines or different ground level.

Accessibility/ Buffer Zone

Buffer Zone is a space in adjacent to roadway, based on the sidewalk width, the

buffer zone is delimitated on-street (sidewalks ≤ 4 m) or on-sidewalks (sidewalks ≥ 6 m). For sidewalks ≤ 4 m, Prohibited on-street car parking, and reduce traffic volume. Prohibited obstruction, encroachments. Provide the permeability.

Street Vendor/ Commercial Zone

Determine the sidewalk appropriate for street vendors and commercial zone, it is also considered about the medium traffic volume, markets, public spaces, residence areas.

Off-street car parking

The off-street car parking need a private-public cooperation

model. It needs a set of criteria for selecting parking enterprises, building a agencies to control and handle violations, develop the rental fee frame based on each place. Supervise the implementation of enterprises, propose forms of handling for violating agencies.

Semi-public Zone Usage Regulations

Proposed the solution to control and handle violations, supervise the implementation of shophouse owners or tenants. Regulating sanctions for violations of acts of encroachment outside the area allowed trading.

Traffic volume

Proposed the speed limit, by different time frame. Coordinate with relevant authorities.

Chapter 3: Maintenance Management

This chapter summarizes the common repair and seasonal maintenance practices for pedestrian facilities based on research conducted for the guide.

Temporary Maintenance Measures

Temporary repair measures may include wedging or patching a sidewalk with asphalt or a quick-mix cement and others. The temporary repair should alleviate the most hazardous concerns until a more permanent repair is performed later.

Short-term Maintenance Measures

Several maintenance techniques will last one to five years for sidewalks and paths including patching, wedging, grinding and horizontal cutting, overlays and so on.

Chapter 4: New policy for urban management teams

Create an open mechanism for extra grants to collaborators, operating equipment

Figure 8.11 The proposals of management handbook outline



Figure 8.12 An illustration example of off-street car parking on management policy extracted from management handbook

8.2.3 The Proposal for Public Approach and Education

The awareness of users is a truly essential factor, even more crucial than policies and regulations. Therefore, propagation and mobilization activities should be promoted in the improvement. Apart from those activities, it is needed to emphasize the role of management and punishment regulation for violators; if not, the frequent undertaking of propagation and mobilization activities hardly brings desirable outcomes.

The last proposal is about the formation of various associations. It aims at protecting and gather various components related to using street and sidewalks. It also an efficient tool for education, propaganda for various users on compliance with the regulations, in awareness of their rights and obligations. Moreover, the Users' information systems help to connect them together, sharing the information and well navigating these components jointing in these association. This proposal may work more effectively together and users' information systems (Figure 8.13).

The formation of shophouse owner association may support owner's right, obligations related to the use of various zone on the sidewalk that make the street become more tidy and order, remove the conflictions.

Shophouse's Tenant association, This association help protect and gather shophouse's tenants, it help the shophouse's tenant have a closer relationship with neighborhoods and provide the knowledge about the right and regulation compliance given by rental residences.

Regarding to street vendor association, it is the same function as street vendor association, it plays a role of knowledge providers, this proposal may benefit various authorities related to manage street vendors and trading activities on sidewalks.

Neighborhood & Users' Information System, this system, may provide easy access to neighborhood information system for users to navigate the functions, activities and place on the streets. It may provide the interaction potentials between users', commuters and locals.

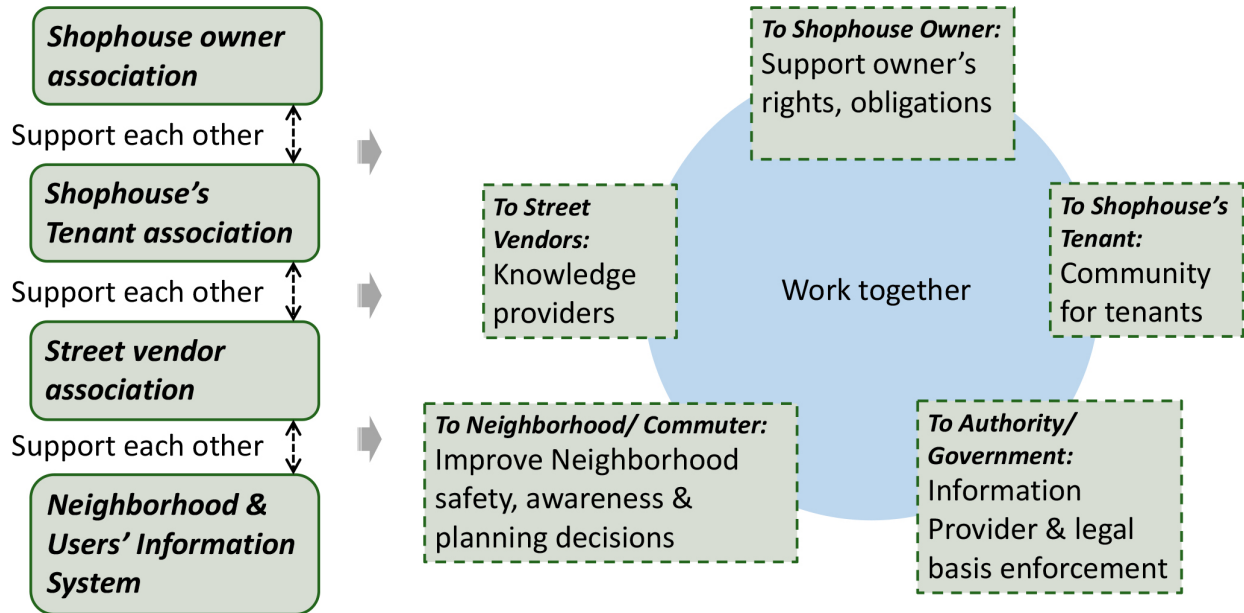


Figure 8.13 Education and Public Approach and its relationship

8.3 Future Work

Street improvement lead to social interaction and active transportation have been studied from an individual perspective rather than an ecological perspective. This study utilized an ecological psychology approach to identify the relationship between street improvement and users' behaviors contributing to social interaction and quality of life. This study has developed street improvement outcomes, however, it still remain some limitations that need to consider on prospective studies (Figure 8.14).

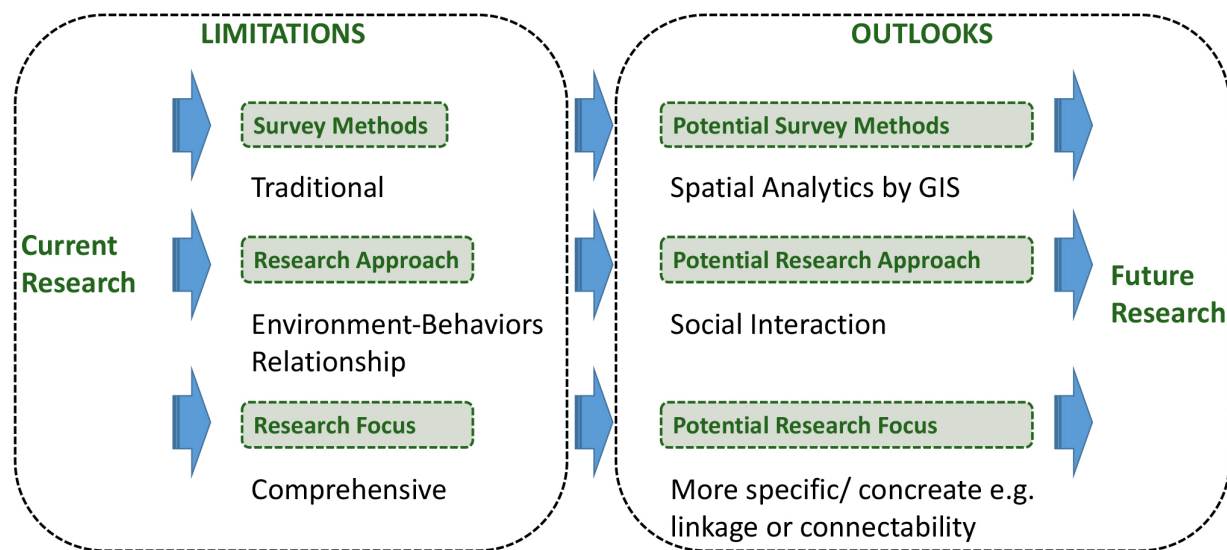


Figure 8.14 Current limitation and research outlook relationship diagram

Because of the exploratory nature of this study, survey was not practical because it would limit the scope of information needed to fully understand the influences of improvement on user's behavior. A future study could implement a survey instrument to quantify the outcomes. Additionally, further research could include more in-depth analyses on the influences of traffic volume on user's behavior to provide further insight into the outcomes Appleyard's seminal investigation.

Different urban contexts may contribute different results. These analyses may include identifying the types and nature of user's behaviors in response to surroundings and whether the street improvement would have an effect. However, for quantifying the social interaction, the collision potential of various users or behaviors on these streets should be conducted on the future works. For example, how many collisions involved pedestrians or residents? whether the street improvement play a role in these collisions or not?

The further investigation involving pavements accessibility/approachability behavior should also be conducted. It also includes how crosswalks or linking paths affect user behavior to determine how the texture, dimensions, and location

influence pedestrian, driver behavior. The primary methodology used in this study, semi-structured interviews, should be utilized in settings where other streets have been improved.

The multidimensional street accessibility/ usability illustrated in this study provides a cross-contextual framework to help urban planners better comprehend the complexity of street use to identify pathways for increasing street life that promote lively urban lifestyles. Future research should determine whether the commercial dimension or economic sidewalks concepts, applies to specific urban contexts or unimproved streets. In addition, the increased spatial analytical capabilities offered by geographic information systems (GIS) enable the design and evaluation of more complex street space use models that can incorporate greater heterogeneity in individual behaviour in alternative physical urban settings. Future usability research should incorporate the findings from this study to develop individual-based simulation models that predict how changes in the design and structure of street space and surroundings, in combination with socio-personal parameters, affect street use.

APPENDICES

Appendix 1: Semi-structured questionnaire was designed to sort out the candidate street spaces (In Vietnamese)

Nghiên cứu Sự tương tác giữa Không gian công cộng đường phố và Con người nhằm giúp cho sự phát triển các không gian giải trí, công cộng ở Thành Phố Đà Nẵng. Cảm ơn bạn đã bỏ chút thời gian quý giá giúp hoàn thành tờ điều tra nghiên cứu này.

Nơi ở hiện tại: Quận _____ Tuổi: _____ Nghề nghiệp: _____

1/ Theo quan điểm của bạn, yếu tố gì làm nên một không gian đường phố đẹp, thu hút hoặc hợp lý ?

- Môi trường thiên nhiên (như cây xanh, bóng mát..vv)
- Các tiện nghi ngơi vui chơi giải trí (như ghế ngồi, quảng trường, mặt nước, bãi cỏ.vv)
- Giao thông tích cực (như lối đi bộ trên vỉa hè, đường dành cho xe đạp..vv)
- Nghệ thuật công cộng, điểm nhấn cảnh quan (như là tượng nghệ thuật, nghệ thuật thị giác)
- Hàng quán vỉa hè
- Sự an toàn
- Yếu tố khác (cụ thể) _____
- Không biết

2/ Vui lòng giới thiệu tên một vài con đường bạn thích và lí do bạn thích chúng

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____

3/ Theo quan điểm của bạn, điều gì làm nên một không gian đường nhằm chân, không hấp dẫn ?

- Môi trường ô nhiễm (ôn, bụi, rác..vv)
- Không có tiện nghi giải trí (như ghế ngồi, quảng trường, mặt nước, bãi cỏ.vv)
- Không có giao thông tích cực (như lối đi bộ trên vỉa hè, đường dành cho xe đạp..vv)
- Không có nghệ thuật công cộng, điểm nhấn cảnh quan (tượng nghệ thuật, nghệ thuật thị giác)
- Không có hàng quán vỉa hè
- Không an toàn
- Yếu tố khác (cụ thể) _____
- Không biết

4/ Vui lòng giới thiệu tên một vài con đường không thích và lí do bạn không thích chúng

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____

Appendix 2: Capture Evaluation Method survey's report card example (in Vietnamese)



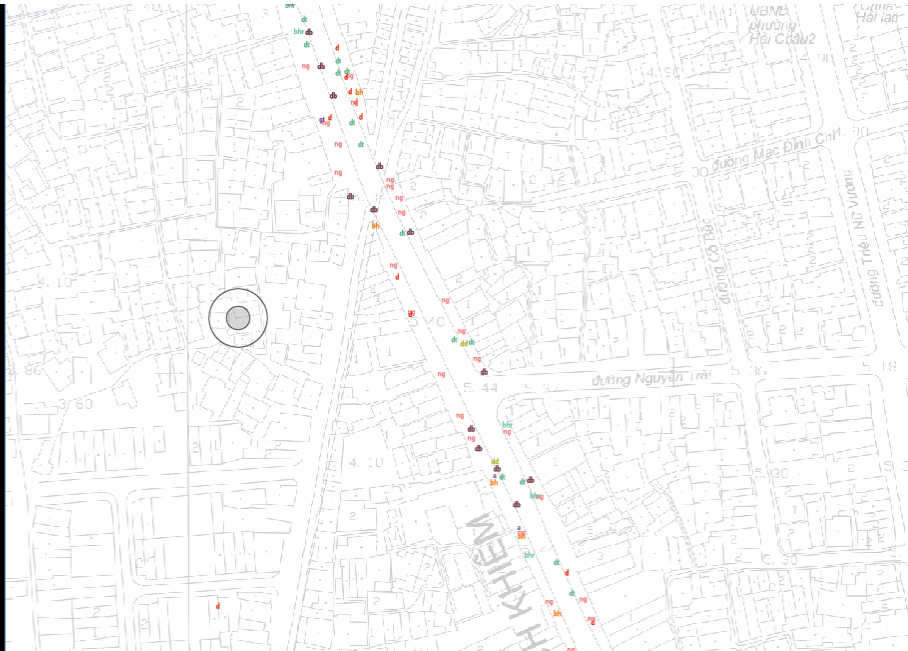
Tên người chụp: Dương Ngọc Anh Vĩ, ngày chụp: 06/09/2017
Tên đường: 2/9, vị trí số: 1, số khung ảnh: 1

Đánh giá
Tiêu cực/ Tích cực

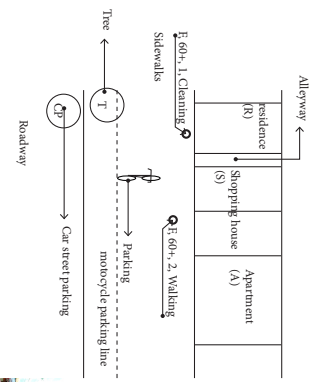
- vỉa hè rộng tạo cảm giác thoải mái
 - Cây xanh cao lớn, tán rộng, nhiều bóng mát tạo cảm giác dễ chịu khi đi bộ trên vỉa hè
 - Số lượng xe máy nhiều sắp xếp không có trật tự, để cả trên vỉa hè và dưới lòng đường tạo cảm giác lộn xộn
 - Con người tham gia các hoạt động mua và bán trên vỉa hè mang lại sự sinh động cho đường phố
- => Vỉa hè là nơi diễn ra các hoạt động mua bán mang lại sự sinh động cho đường phố nhưng việc thiếu ý thức trong việc sử dụng dẫn đến tình trạng lộn xộn, vỉa hè bị chiếm dụng hoàn toàn

Appendix 3: Survey processes (1) Behavior Mapping; (2) Physical Environment Survey.

a	Eating
bh	selling
bhr	street peddling
d	standing
db	walking
dd	cleaning
dr	reading
dt	Temp. Parking
dx	Parking
gt	communicating
k	other
mh	Buying
n	lying
ng	Sitting
pv	servering
sc	repairing
tb	Sighseeing
tg	relaxing
th	setting out
u	Drinking
vn	housework



(1)



PHYSICAL MEASURE- OBSERVATION SURVEY (FIRSTLY)

Walking along the street and Survey, describing and coding the environment setting along each possible according to environment setting. And

PHYSICAL MEASURE- OBSERVATION SURVEY (SECONDLY)

- Walking along the street and Survey, describing and coding the environment setting as much as possible according to environment setting. And



classify into 3 main types of outdoor activities as follows:

1) Physical (exercise: walking, jogging,), Work: business work, business server, Play: playing hopscotch,) and Kinetic: walking while playing with a toy)

2) Social (standing/sitting and walking with some one, sitting with others while drinking coffee, playing chess)

3) Stationary (standing/sitting somewhere while watching others, walking with dog,)

* The same people participate into one certain activity will considered as one activity unit.

- Determining age, male or female and count.

(2)



Appendix 4: A sample of 5-point Likert scales questionnaires example (In Vietnamese)

Nghiên cứu không gian đường phố
Tháng 4, 2019

Tên đường: Ông Ich Khiêm
Thành phố Đà Nẵng, Việt Nam

BẢNG CÂU HỎI NGHIÊN CỨU KHÔNG GIAN ĐƯỜNG PHỐ

Giới tính:
Nam Nữ

Tuổi:
≤ 25 26-55 ≥ 56

Nơi sinh:
Thành phố Đà Nẵng Khác

Nơi cư ngụ:
Đường phố này hoặc lân cận Con đường khác

Thời gian cư ngụ:
Dưới 1 năm 1-5 năm Trên 5 năm

Tình trạng nhà ở:
Nhà thuê Chính chủ

Thu nhập bình quân hằng năm:
Nhiều hơn 66 triệu Ít hơn 66 triệu

Đánh giá tổng thể:

Vui lòng đánh giá mức độ hài lòng hoặc mức độ dễ chịu khi sử dụng đường phố này. 1 3 4 5

Vui lòng đánh giá mức độ hài lòng hoặc mức độ dễ chịu của bạn đối với môi trường vật lý (như thùng rác, trạm xe buýt, cây cối, bảng hiệu, gạch lót vỉa hè, lối đi bộ, chỗ đỗ xe máy, ô tô...ghế ngồi..vv) được thiết lập trong đường phố này. 1 3 4 5

Tôi đến và sử dụng con đường này vì có các yếu tố văn hoá xã hội hấp dẫn diễn ra ở đây. Tôi đến con đường này vì đó là thói quen sinh hoạt cá nhân của tôi. (vui lòng đánh giá theo mức độ)

Tôi đến và sử dụng con đường này vì có các yếu tố văn hoá xã hội hấp dẫn diễn ra ở đây.	1	2	<input checked="" type="checkbox"/>	4	5
Tôi đến con đường này vì đó là thói quen sinh hoạt cá nhân của tôi.	4	2	3	<input checked="" type="checkbox"/>	5

Đánh giá các yếu tố vật lý và phi vật lý

Đánh giá theo mức độ từ 1 (rất không đồng ý) đến 5 (cực kỳ đồng ý)

Tôi có thể dễ dàng đi bộ dọc theo con đường này	<input checked="" type="checkbox"/>	2	3	4	5
Đi bộ trên vỉa hè là một trải nghiệm thú vị và dễ chịu	<input checked="" type="checkbox"/>	2	3	4	5
Tôi có thể dễ dàng tìm đường/ và định hướng khi đi trên đường này	1	2	3	<input checked="" type="checkbox"/>	5
Các bảng hiệu chỉ dẫn trên đường rõ ràng và dễ hiểu	1	2	3	<input checked="" type="checkbox"/>	5
Bạn đánh giá như thế nào về tính đa dạng trong chức năng sử dụng của đường này. (Ví dụ như đầy đủ các loại cửa hiệu, công ty, giải trí, quán xá mà tôi không cần phải đi nơi khác)	1	2	<input checked="" type="checkbox"/>	4	5
Khi ngồi trên vỉa hè hoặc trong nhà, tôi có thể dễ dàng nhìn qua phía bên kia đường mà không bị che khuất tầm nhìn.	1	2	<input checked="" type="checkbox"/>	4	5

Không gian đường phố mở rộng, thông thoáng	1	2	3	4	5
Via hè thông thoáng, trồng cây	1	2	3	4	5
Lối đi bộ gọn gàng, không bị lấn chiếm	1	2	3	4	5
Đường phố có đầy đủ tiện nghi (như ghế ngồi, thùng rác ven vỉa hè, mái che nắng, cây cỏ, đồ trang trí thẩm mỹ...vv).	1	2	3	4	5
Có đủ điện tích đậu xe ô tô trên đường này	1	2	3	4	5
Có đủ điện tích đậu xe máy trên đường này	1	2	3	4	5
Khó cho tôi khi băng qua bên kia đường hoặc vượt qua các ô phố khác dọc theo con đường?	1	2	3	4	5
Bạn đánh giá mức tầm thấp/ mức nhìn xuyên qua của mặt đứng hoặc hàng rào (nếu có) dọc 2 bên đường như thế nào?	1	2	3	4	5
Bạn đánh giá như thế nào về mức cây cỏ được trồng trên đường này?	1	2	3	4	5
Tôi cảm thấy thoải mái khi thực hiện các hoạt động trên đường này dưới trời nắng vì được che nắng.	1	2	3	4	5
Ăn uống trên vỉa hè là trải nghiệm thú vị	1	2	3	4	5
Dễ dàng tìm thấy điểm ăn uống hoặc nơi bán đồ ăn.	1	2	3	4	5
Con đường này gần nơi tôi ở và tôi quen thuộc với nó	1	2	3	4	5
Bụi bẩn, ô nhiễm, rác thải là vấn đề chính của con đường này	1	2	3	4	5
Tôi biết nơi này nằm ở đâu trong khu phố của tôi và tôi biết làm thế nào để đến đây	1	2	3	4	5
Tôi hiểu rất rõ về con đường này	1	2	3	4	5
Tôi biết những hoạt động/ shops/ cửa hàng/ các điểm thú vị trên đường này	1	2	3	4	5
Tôi biết rất rõ về sự thay đổi, giờ hoạt động của những điểm hấp dẫn trên đường này	1	2	3	4	5
Đánh giá như thế nào về mức độ dễ dàng hoặc khoảng cách di chuyển từ nhà bạn đến nơi này bằng phương tiện thường dùng của bạn 1 (rất dễ/ gần) đến 5 (rất khó/ xa)	1	2	3	4	5
Tôi thích khí hậu ngoài trời	1	2	3	4	5
Tập thể dục ngoài trời phần quan trọng trong cuộc sống của tôi	1	2	3	4	5
Tôi thích ngắm nhìn những hoạt động của mọi người	1	2	3	4	5
Tôi đến và sử dụng không gian đường phố này để mua sắm	1	2	3	4	5
Tôi lo lắng và quan tâm đến sự an toàn của cá nhân khi đi dọc trên đường này	1	2	3	4	5
Cảm thấy không an toàn khi đi dạo ở nơi này	1	2	3	4	5

Có các hoạt động phi pháp xảy ra trên con đường này (như ăn xin, trộm cắp...)	1	2	3	4	5
Công an thường xuyên tuần tra, kiểm tra trên đường này	1	2	3	4	5
Con đường này là nơi có tội phạm cao vào ban đêm	1	2	3	4	5
Người vô gia cư hoặc người lang thang thường xuyên ở nơi này	1	2	3	4	5
Đường này thu hút tôi vì tôi có thể làm điều tôi thích với người cùng sở thích với mình(tán gẫu, kết bạn, ngắm nhìn người trên phố...)	1	2	3	4	5
Nơi này thu hút tôi nếu có nhiều người cùng nền tảng văn hóa (cùng quê, đồng hương) hoặc đồng nghiệp (bạn làm giống công việc nhau).	1	2	3	4	5
Nơi này thu hút tôi nếu có nhiều sự kiện đặc biệt, thú vị.	1	2	3	4	5
Hầu hết mọi người trong khu phố của tôi rất thân thiện	1	2	3	4	5
Mọi người trong khu phố là đáng tin cậy	1	2	3	4	5
Cư dân trong khu phố tôi ở có cùng sở thích với tôi	1	2	3	4	5
Cư dân trong khu phố biết giúp đỡ lẫn nhau	1	2	3	4	5
Tôi cảm thấy có sự liên kết/ gắn bó mạnh mẽ giữa tôi và cộng đồng trong khu phố này.	1	2	3	4	5