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Evaluation of users' satisfaction on pedestrian facilities using pair-wise comparison approach

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Abstract. Global climate change issues demand people of the world to change the way they live today. Thus, current cities need to be redeveloped towards less use of carbon in their day to day operations. Pedestrianized environment is one of the approaches used in reducing carbon foot print in cities. Heritage cities are the first to be looked into since they were built in the era in which motorized vehicles were minimal. Therefore, the research explores users' satisfaction on assessment of physical attributes of pedestrianization in Melaka Historical City, a UNESCO World Heritage Site. It aims to examine users' satisfaction on pedestrian facilities provided within the study area using pair wise questionnaire comparison approach. A survey of 200 respondents using random sampling was conducted in six different sites namely Jonker Street, Church Street, Kota Street, Goldsmith Street, Merdeka Street to Taming Sari Tower and Merdeka Street to River Cruise terminal. The survey consists of an assessment tool based on a nine-point scale of users' satisfaction level of pathway properties, zebra pedestrian crossing, street furniture, personal safety, adjacent to traffic flow, aesthetic and amenities. Analytical hierarchical process (AHP) was used to avoid any biasness in analyzing the data collected. Findings show that Merdeka Street to Taming Sari Tower as the street that scores the highest satisfaction level that fulfils all the required needs of a pedestrianized environment. Similar assessment elements can be used to evaluate existing streets in other cities and these criteria should also be used in planning for future cities.

1. Introduction

Global climate change that is taking place currently has urged many people to think of how they want to manage their lives today. Redevelopment of urban areas has moved towards using green approach. This could be in terms of building materials or the design of the development that involves a lot of trees as a cushion towards the extreme weather. Old cities on the other hand were designed without using high technology such as natural air circulation, walkable environment and less pollution. However, as time changes, development on these old cities was geared towards current demand such as installing air conditional units and making way towards motorized vehicles [22]. As a results, more CFCs are being emitted, roads are widened to make way for more motorized vehicles to pass through and aesthetic value of old cities are being altered and these cities lose their original value. However, with the rising price of fuel and depreciation of natural resources have make leaders all around the world to look into this matter seriously. Many leaders refer to the United Nations Conference on Environment and Development (UNCED) or the Rio Summit, Rio Conference and Earth Summit which took place in 1992 and the United Nations Conference on Sustainable Development held in Rio in 2012 as points of reference when making development plans for their countries. In addition, the Kyoto Protocol to the United Nations Framework Convention on Climate Change in 2010 further sets

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the binding obligations to reduce the emission of greenhouse gases. Since then many old cities which have sustainability elements in their designs are now being conserved and turned into tourists' destinations.

Nevertheless, tourism sector is also looking into climate change issues seriously. This could be seen in the first International Conference on Climate Change and Tourism in Djerba, Tunisia in 2003 which focuses on tourism adaptation in facing climate change [1,2]. This conference also acknowledged that tourism affects and being affected by climate change. In addition, this conference has led to Djerba Declaration, 2003 which acknowledged the complex interlink between tourism and climate change [1,2]. This is followed by Davos Declaration, 2007 which discuss further on strategies in mitigating interlink effects of climate change on and from tourism. These include formulating policies and promoting sustainable tourism [2].

Therefore, conserving old cities as tourists' destinations is the best strategy in sustaining the aesthetic value of the cities. Moreover these cities are very valuable. These cities are best appreciated through walking. Walking is much healthier and is more energy efficient [3]. Many studies have been carried out to evaluate walking condition using various approaches including qualitative and quantitative techniques. Therefore, this study carries out an analytical hierarchical process approach to evaluate pedestrians' level of satisfaction.

This paper is divided into five sections. First section is the introduction section. This is followed by discussion on the background of the study which comprises the literature review on pedestrian level of satisfaction and appreciation of heritage cities in section two. Methodology of this study is described in section three and followed by section four that elaborates on the results and discussion. Section five concludes the study.

2. Background

Walking as mentioned earlier is the healthiest, cheapest and the most universal mode of transportation. With today's way of life in which people spend most of the time in door with their technological gadgets, walking will the best method for them to exercise. In addition, walking promotes zero carbon footprints and involves zero cost. Furthermore, walking is not limited to young people but also to the senior citizens, the disabled and young children. Therefore, a walkable environment must be provided to encourage people to walk more. This is where walkability concept plays a big role. Walkability refers to the quality of walking condition [4]. It encompasses the quality of pedestrian features including pathway conditions, safety, traffic speed and flow, comfort and convenience. Nevertheless some scholars may even include social space, motivation and activities particularly in cities with heritage built such as Talinn Old Town and King Street, Charleston [5-7]. Therefore, in order to measure walkability, pedestrian level of satisfaction is used evaluate users' perception on the related facilities provided.

Studies on pedestrian level of satisfaction have been done quite extensively using various methods [8-10] and are not limited to capacity-based model [11] but also a roadway-characteristic-based model [12-17]. The latter is geared towards pedestrian environment and facilities [9] which is the scope of this study. In addition, studies on pedestrian facilities are also not limited to quantitative method [18] but also qualitative approach. These early studies have become points of references in the current studies on pedestrian level of services.

Heritage cities as mentioned earlier were designed with walkability concept in mind. A walkability friendly environment is crucial in historical towns and cities which were built with minimal number of motor vehicles in mind [19,20]. Due to conservation and preservation guidelines, any new alteration to the current building structures and surroundings are prohibited [7,21,22]. With an increasing number of vehicles by the local and tourists annually, these historical towns and cities may not be able to sustain further. Therefore, promoting walkability is seen to be most appropriate in solving tourists' mobility issues in these historical areas. However, walkability is only possible if there is a provision for pedestrian pathways. Studies have shown that physical attributes influence walking [23-27]. These attributes include pathway quality, zebra crossing, street furniture, safety measures and adjacent traffic flow. Tourists may want to walk more to appreciate urban aesthetics of built heritage [7]. Promoting heritage trail with concerted effort will not only develop the said trail but also to make the trail exciting and memorable [19].

3. Methodology

This study uses questionnaire approach to collect its primary data. A total of 200 respondents using random sampling approach took part in this study. Respondents are mainly tourists. Locations of the survey are around tourists' places of interest in the core zone of Melaka Historical City Centre. Prior to the survey, secondary data were collected. These data include the attributes of the main streets in the study area and are stored in geographic information system (GIS) database.

This study took place in the core zone of Melaka (Malacca) Historical City, a UNESCO World Heritage Site. This part of the city was designated as one of the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Sites in 2008.

Respondents were asked to fill up a questionnaire that consists of evaluation of pathway, zebra crossing, street furniture, personal safety, adjacent traffic flow, aesthetic and amenities conditions. Table 1 shows the details of each element.

Table 1. Details of walkability elements.

	Elements	**Details**
Walkability elements	Pathway	Properties, design, quality, alleys, shade, lighting, user friendly, landscaping, maintenance, environment.
	Zebra crossing	Type, location, condition, access, waiting time at traffic lights, safety.
	Street furniture and signage	Street furniture and shade, placement of lamp post, board information, signage.
	Personal safety	Personal safety (day and night time), comfortable social space, fear of crime, fear of motorized vehicles, fear of stray animals.
	Adjacent to traffic flow	Traffic flow along pedestrian walkway, traffic conditions at pedestrian crossing, traffic control by authorities
	Aesthetic and amenities	Aesthetic, availability of amenities, dustbin, public toilet, public phone, place to rest (bench).

Evaluations are rated based on a Likert Scale of 1 to 9 with 1 very unsatisfied and 9 being very satisfied. This is consistent with nine point scale suggested by Saaty (2008). This scale is used to assign pair-wise comparisons of all elements at each level of the hierarchy of one to nine. The geometric approach is then used to combine the individual pair-wise comparison metrics (PCMs) to obtain the consensus from the entire data [28].

The pedestrian walkways that were evaluated are Church Street, Jonker Street, Kota Street, Merdeka Street to Taming Sari Tower, Merdeka Street to River Cruise terminal and Blacksmith/Goldsmith Street (Figure 1).

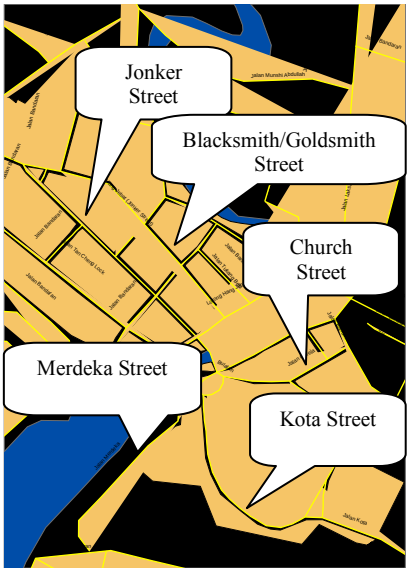


Figure 1. Map of selected streets in the core zone of Melaka Historical City, a UNESCO World Heritage Site.

Each of these streets has attributes that reflects the walkability condition (Table 2). Spatial and attributes data were obtained from paper based tourist's maps and field work observation. The latter was carried out to rectify the features placed on the maps. Geographic information database was developed based on these data. As mentioned earlier, pair-wise comparison technique is used to determine which entity is preferred most between given entities. Prior to this procedure, questionnaire survey results produced by using statistical analysis were generated. The results were then analyzed using analytical hierarchical process (AHP) analysis technique.

Table 2. Details of streets' attributes.

Street	Attributes
Church Street	4 meter walkway is provided for two ways pedestrian flow. Trishaw operators use the one third of the walkway to park their vehicles.
Jonker Street	1.5 meter walkway is provided for two ways pedestrian flow. A lot of activities along the street Adjacent to busy traffic flow.
Kota Street	1.5 meter walkway is provided for one way pedestrian flow at each side of the street.
Merdeka Street to Taming Sari Tower	4 meter walkway is provided for two ways pedestrian flow. Wide space is designated for pedestrian. Natural shades are provided A lot of activities along the street Adjacent to busy traffic flow.
Merdeka Street to River Cruise terminal	1.5 meter walkway is provided for two ways pedestrian flow. Adjacent to busy traffic flow
Goldsmith Street	1.5 meter walkway is provided for two ways pedestrian flow. Adjacent to busy traffic flow.

4. Results and Discussion

Findings show Merdeka Street to Taming Sari Tower ranked first in users' evaluation of ideal score (1.000). This is followed by Jonker Street (0.792131), Merdeka Street to River Cruise terminal (0.695956), Church Street (0.589214), Blacksmith/Goldsmith (0.458969) and finally Kota Street (0.409748). The details of the results are shown in Table 3. These findings reflect the conditions of the pedestrians' facilities provided along these streets.

Table 3. Analytical hierarchical process (AHP) Scores.

	Street Name	Ideals	Normal	Raw
A1	Merdeka Street to Taming Sari Tower	1.000000	0.253420	0.084473
A2	Jonker Street	0.792131	0.200742	0.066914
A3	Merdeka Street to River Cruise terminal	0.695956	0.176369	0.058790
A4	Church Street	0.589214	0.149319	0.049773
A5	Blacksmith/Goldsmith	0.458969	0.116312	0.038771
A6	Kota Street	0.409748	0.103838	0.034613

The selected street, Merdeka Street to Taming Sari Tower, has many attributes that are able to satisfy users. These include, comfort and convenience, activities to participate, safety from crime and traffic and natural shades among others. On the other hand, at Kota Street, a user has to compete with motorized vehicles, trishaw and bicycles. Although there are a lot of heritage built to be viewed, the absence of comfort and convenience, safety and shade reduces the level of user's satisfaction. This is consistent by studies carried out previously by [14].

5. Conclusion

The findings of this study outline the criteria that are needed in fulfilling all the required needs of a pedestrianized environment. Although this study only concentrates on heritage cities, providing a pedestrian friendly environment goes across the urban planning discipline. This study has contributed to the current studies using the roadway-characteristic-based model as another method of user's evaluation on pedestrian facilities. In the midst of the global climate change crisis, creating a carbon

free environment is demanded. Therefore, similar assessment elements can be used to evaluate existing streets in other cities and these criteria should also be used in planning for future cities.

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