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Impact of Street's Physical Elements on Walkability: a Case of Mawlawi Street in Sulaymaniyah, Iraq

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ABSTRACT

A pleasant walking environment is a precondition for living in a sustainable city. Appropriate street design can increase quality and quantity of walking. However, the adequacy and quality of physical elements as the most significant components of street can seriously affect walkability in the streets. The objective of this study was to critically assess the walkability level in terms of physical elements of Mawlawi Street, a famous commercial street located in the city center of Sulaymaniyah, Iraq. The qualitative research based on interview with locals, direct observation and quantitative research via questionnaire with pedestrians were conducted in this study. First, site observation was carried out through PEDS (Pedestrian Environment Data Scan) audit tool and the taking of photographs in order to observe the streetscape features. In this regard, four criteria as environment, pedestrian facility, road attributes, walking environment, and subjective assessment were considered as well serving the purpose of providing a broad direction about streetscape features. Then, a 5 point Likert scale questionnaire with pedestrians was conducted to triangulate the findings from observation. Later on, the findings were validated through an interview with locals regarding their subjective ideas about those criteria. The study showed that inadequate and poor quality of street's physical elements changed the street to an unsafe and uncomfortable environment for walking with weak and low level of street connectivity and accessibility for pedestrians.

1. Introduction

Walking is a part of most people's everyday routine. It is the simplest mode of transportation, and free, convenient, requires no equipment, and is encouraged as part of a healthy lifestyle (Forsyth, Hearst, Oakes, & Schmitz, 2008). It is an attractive mode of transport for experiencing an adjacent environment and interacting with society, which is not possible by transport modes (Wey & Chiu, 2013). Walking is also combined with other forms of transportation. Going from your car to your destination involves walking; accessing the nearest bus stop or train station involves walking (Lo, 2009). The way in which the environment is able to support and encourage walking is called walkability.

Walkability has effect on health, environmental, and economic benefits. According to Wey and Chiu (2013), traffic congestion and environmental pollution is emerging problems in many areas. Therefore, it was found that walking as a means of transport has positive implications towards solving those problems. However, the walking environment has continued to be ignored and until recently, relatively not enough research has been done on walking behavior in relation to the walking environment. Suitable street design can considerably enhance the quality and quantity of the walking environment. It is not only limited to the urban design qualities that may promote walking, but also the psychological aspect, such as the pleasure and enjoyment while walking. Physical elements are known as the principal components of street whose quality can have a significant influence on walking status in the streets. This paper takes Mawlawi Street, located in the city center of Sulaymaniyah within Iraq as a case study to assess in detail the walkability level in terms of physical elements in this famous commercial street.

2. Background of the study

2.1. Defining the Walkability

Walkability is emerging as a concept of new urbanism in planning as many communities are becoming less walkable due to increasing dependence on other transport modes except walking (Azmi & Karim, 2012). Walkability should be considered as it converges the different elements of urban design, namely, the structure, context, time, distance for users to make sense of the city. It is an evaluation of having knowledge about the reliability of an area for walking. Thus, Walkability is often described as a measure of how friendly an area is for pedestrians and typically accounts for the overall quality of walking conditions (Litman, 2003). Research done on walkability in the past have mainly focused on macro-scale variables such as population density and mixed land use and socioeconomic conditions of an area; nevertheless, an increasing body of research suggests that the built environment as well has a remarkable effect on walkability and the quality of the pedestrian environment (Saelens & Handy, 2008). The

walkability level can be influenced by the qualities associated with walkable environment; these include accessibility, environmental and social safety, aesthetically pleasing man-made and natural features, pedestrian amenities for comfort, and land use diversity (Brown, Werner, Amburgey, & Szalay, 2007). In addition, quality of footpaths, sidewalks or other pedestrian right-of-ways, and traffic and road conditions are significant factors in assessing the walkability level (Gehl, 2010). Finally, a walkable environment should be legible in order to provide a sense of orientation and visual comfort (Southworth, 2005).

2.2 Street as a walkable environment

Buildings, open spaces, streets and paths are significant urban elements in an urban district. The legibility and connectivity of these elements support ease of movement and accessibility of the pedestrians (Wall & Waterman, 2010). In addition to simply accommodating pedestrian movement, sidewalks and streets are recognized as the most prominent public spaces found in a city (J. Jacobs, 1961, p. 29, p.29). The word "street", based on Kostof (1992) description, constituted a road way, a pedestrian way, and flanking building. Street as an institution is an equally critical subject beyond its architectural identity, because every street has an economic function and social significance (Rykwert, 1986). Streets not only facilitate automobile movement, but also provide an environment for pedestrians that is inviting, safe, aesthetically pleasing, and accessible, as well as equipped with sufficient pedestrian amenities (Litman, 2003). The elements of a street along with the overall image of the streetscape contribute to the quality of the walking environment. In order to rebalance the functionality of street networks, individual streets need to be planned and designed with all users in mind. The complete streets movement takes a holistic approach to street design in an effort to produce streets that are safe, convenient, and inviting for drivers, bicyclists, public transit users, and pedestrians of all ages and abilities (LaPlante & McCann, 2008). Meanwhile, sidewalks and walkways are considered key components of pedestrian-friendly streets and should allow pedestrians to experience safety, accessibility, comfort, and efficient mobility when walking along them. Sidewalks are meant to be for pedestrian use. However, pedestrians must share this space with a long list of obstacles and street hardware, much of which is required for traffic control matters (Fruin, 1971).

2.3 Principles regarding walkable street

Past reviews and newer studies often identify that several built environment characteristics have significant relationships with walking activity. These criteria are called the design criteria or characteristics of the built environment in walkable communities. They can be grouped as:

***Connectivity**:* A connected street is a physical and physiological network that offers multiple routing options for a diverse range of activities, resources, services and places, encouraging physical activity (Jackson, 2009). Connectivity comprehensively refers to straight paths and also shorter distances in order to reach the desired destinations (Saelens & Handy, 2008). In addition, connectivity includes continuity that occurs by adjacency and connection with other types of transportation. The city can be connected very well by continuous sidewalks without gaps and short blocks. Also the street can connect to the surrounding public transportation network (Jackson, 2009).Thus, a contracted street is more pedestrian-friendly (Southworth & Ben-Joseph, 2003).

***Safety**:* is considered important within the pedestrian network for people of different ages from dangers of the crime and traffic. Pedestrian safety can be considered as the most advanced and implicit feature of walkability (Southworth, 2005). Walking trips are enhanced by safer places. People who can identify the convenient and safe places have a high tendency for walking, about 41.5% more than individuals who are not informed about those places (Powell, Martin, & Chowdhury, 2003).

***Accessibility**:* An accessible place is capable of being used by people of all ages and mobility levels. Universal access should be addressed in the design of all transportation modes, public spaces and connections (A. B. Jacobs, 1993). Pedestrians in such environment consider getting to their destinations or transit nodes easier and quicker and people place demands on better quality walkways as well. The walking characteristics include compact land use, wider paths, rub-cut ramps, tactile strips, and on-slip tiles. Proximity to potential destination related issues are a major discourse in most studies done on accessibility. Five reviews show adequate evidence to deduce that more walking can be achieved with accessibility based on distance to destinations (Handy, Boarnet, Ewing, & Killingsworth, 2002).

***Comfort**:* Walking should not be a burden. In deriving the best walking experience, factors such as comfort, aesthetics of the environment and others have a role to play. In developed countries, active pursuit is given to characteristics such as streetscape beautification, landscaping, etc. (Leow, 2008). A comfortable place is an environment where the form and the capacity of streets and public spaces match the pattern of human behaviors, providing a sense of ease and enabling a feeling of personal safety (A. B. Jacobs, 1993).

***Convenient**:* A convenient place is a location with clear image and legibility. The area is easy to understand, providing a sense of being near-at-hand with visual cues and physical directness to a pedestrian's most essential need. Way finding is known as circulation of certain pedestrian as well as vehicle movement in a complicated environment by serving landmarks, maps, and signs. An appropriate way finding system can easily support users to meet an environment positively and also encourage visitors to choose the proper way (Giles-Corti, Kelty, Zubrick, & Villanueva, 2009).

***Engaging**:* An engaging place is a visually rich aesthetic setting with interrelated parts, providing a sense of contentment and enabling both formal and informal forms of social exchange. Several contributing factors lead to the positive experiences along a street from the treatment of building facades, spacing of trees, lighting, quality of benches and cafe space on wide sidewalks. Even trash bins add to the experience along the street (Giles-Corti et al., 2009).

***Vibrant**:* A vibrant place is an area pulsating with life, vigor and activity. Many of these attractions are referenced in the implementation framework along with recommendations on how to support and enhance the holistic pedestrian experience along the routes to each destination (Giles-Corti et al., 2009). Therefore, principles related to walkable street can be classified in many ways with all attempts used in describing the same characteristics. To promote walking, more factors are needed to be considered. This study focused on comfort, safety, accessibility, and connectivity as the major factors.

2.4 Physical elements that influence quality of pedestrian environment

The qualities of the built environment thought to have an effect on walkability include the physical features (road width, sidewalk width, street furniture, urban amenities) and the intangible characteristics (human scale, degree of enclosure, level of cleanliness, transparency) (Saelens & Handy, 2008). For the rest of the paper, physical elements

of built environment were considered. These elements work to provide an environment conducive to pedestrian travel at both street and site level. Such well-structured designs, based on the elements, make it easy for pedestrians to opt for walking based on their build environment perception (Frank, Engelke, & Schmid, 2003). The primary stage in defining walkability is to resolve what physical properties to test and calculate. Design elements that ensure safety from traffic, at the level of the street, are paramount to a walkable environment (Brown et al., 2007; A. B. Jacobs, 1993). In the list are marked pedestrian crossings, curb extensions (chokers), curb cuts or curb ramps, pedestrian refuge islands, medians, and raised crosswalks, traffic signals, speed bumps all of which provide a protective measure for the pedestrians to calm traffic and improve visibility to drivers (Daisa, 2010; Giles-Corti et al., 2009). Bicycle lanes and on-street parking can also serve as a demarcation between automobile traffic and pedestrians (Daisa, 2010; A. B. Jacobs, 1993). Way finding signs, pedestrian signals, flashing warning lights, overpasses/underpasses, and pedestrian crossing warning lights are intended to ease pedestrian movement, some actually end up benefiting vehicles (Whyte, 2012). Sufficient lighting should be made available for the safety of both pedestrian facilities and vehicle traffic. Continuous pedestrian network (crosswalk) are located at the intersections for greater safety for pedestrians (Daisa, 2010). The pavement of the road should slope up with a gradual inclination to meet the sidewalk's elevation so as to prompt vehicular traffic to slow down. A wider sidewalk creates a comfortable and inviting walking environment and can accommodate more pedestrians of varying speeds without their colliding with each other, and café seating or other suitable building-related functions give more life to the pedestrian environment (McNally, 2010). Landscaping and street trees can serve as barriers between fast moving traffic and pedestrians, and can also stimulate visual enjoyment and protective measures, thereby making walking a pleasing experience (Giles-Corti et al., 2009; A. B. Jacobs, 1993). Elements like kiosks, benches, public garbage and signs, which are pedestrian scale, can give the pedestrians some orientation and provide an attractive, leisurely, enjoyable walking experience (A. B. Jacobs, 1993). The pedestrian facility material must not accommodate any form of obstruction and physical interruption. Smaller building width and transparent facade helps to create more variety of uses as well as activities. The monotony of a long block can be broken up by a variety of building types and materials, and helps give visual interest for the pedestrian (Daisa, 2010). Public transportation and bus stops and shelter have great impact on the pedestrian environment (Nakazawa, 2011) . Finally, a pedestrian space that provides a variety of above-mentioned amenities located appropriately in an effort to encourage long stay of people is considered successful (Moughtin, 2003).

2.5 Mawlawi Street

The rapid economic growth of Iraq after the war in 2003 made the citizens more dependent on private cars resulting in difficulties and an unsafe environment for walking. Mawlawi Street is one of the busiest and famous commercial streets located in the city center of Sulaymaniyah in Iraq. It can be considered as the main link that connects the city center and historical area to the public park and Salm Street (Figure 1a). The width of this historic street is 15m and it is almost 1 km long. It is the entrance to the city center and historical district in Sulaymaniyah (Taha, 2007). There are different types of activities on both sides of the street, including hotels, green groceries, retail shops, restaurants, book shops as well as informal activities such as vendors and hawkers. However, lack of efficient public transportation has made people more dependent on private cars. In addition, after 2003 most of the residential houses around Mawlawi Street were bought by traders

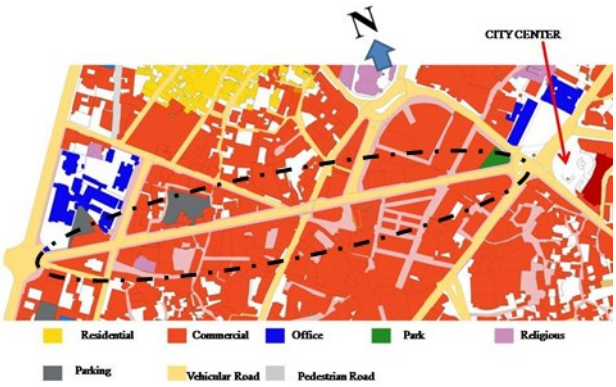

Figure 1 (a) Location of Mawlawi Street

Figure 1 (b) Mawlawi street as the busiest commercial area

who have now demolished the houses and converted them to commercial buildings. Thus, lack of residential function around the street reduced security, especially at night time. More importantly, the unpleasant quality of the built environment in such historical street has made the street inactive at all times of day excluding the evening (Figure 1b). Despite being the main and busiest commercial path, the street is now uncomfortable for walking affecting pedestrians and visitors no longer use the street for walking, fun and pleasure during their free time. Therefore, it is essential to improve the walkability level of such commercial street by focusing mainly on the design and provision of streetscape elements.

3. Method

In order to promote walkability, it is significant to determine those basic physical factors that influence the walkability in the streets. This study employed the mixed-method approach including quantitative and qualitative data. Qualitative survey consisted of direct observation and interview, whereas quantitative data were collected via questionnaire. First, direct observation was applied in collecting the streetscapes information, namely the PEDS audit tool and taking photographs in order to observe the streetscape features that were available on the street segment for appraising the pedestrian environment quality. Four criteria were considered in PEDS audit tools: environment, pedestrian facility, road attributes, walking environment, and subjective assessment as a separate part. These criteria gave the researcher a broad direction in terms of the observation to be made by being specific about the

streetscape features and facilities to consider. Meanwhile, photographs were taken throughout the observation to provide a visual depiction and to contextualize the observed streetscape features. For triangulation of data, a 5 point Likert scale questionnaire survey was conducted on pedestrians who come to Mawlawi Street for their needs. In order to know their subjective ideas about the quality of physical elements four basic features were found: safety, comfort, accessibility, and connectivity. Later, the interview was conducted with local people who work in Mawlawi Street to validate the previous findings. They were asked questions about the strength, weakness, opportunity, and threat of the street in terms of walking. Finally the potential proposal was drawn in order to reinforce the physical elements of the street to enhance walkability. Figure 2 depicts the methodological framework of this study.

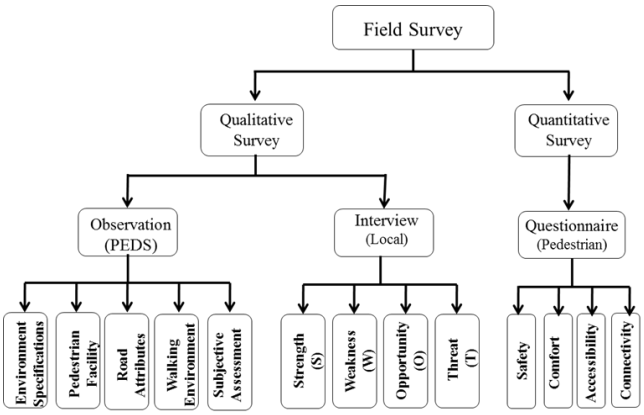

Figure 2: *Methodological Framework*

4. Result and Discussion

4.1 Observation

With the rising interest in active living and a bigger concern for the quality of public space, many audit instruments have been introduced by researchers which focus on the streetscape environment and measure the physical components or features related to walkability (Clifton, Livi Smith, & Rodriguez, 2007). Audit tools are a systematic observational method which demands that personal data be collected by an observer within a targeted environment. There is also considerable variation in the level of details measured by each audit tool; some focus only on a couple of features while others are more in depth and include dozens of features that address many different environmental characteristics (Brownson, Hoehner, Day, Forsyth, & Sallis, 2009). This study makes use of PEDS audit tool. The PEDS audit tool is made to be a systematic assessment of the physical environment that appraises streetscape features, presence, and qualities. It is hypothesized to influence walkability consisting of both sides of one street block (Clifton et al., 2007). With the use of on-site assessments, auditors observe the environment against definite criteria. This audit tool included 36 criteria that focused on different components of a pedestrian environment which are grouped into four major sections as "Environment, Pedestrian Facility, Road Attributes, Walking Environment" and subjective assessment. Within each section, there are predominantly close-ended questions (Likert scales and check boxes) with a few open-ended questions to incorporate researcher's comments. Each criterion is based upon extensive research and literature to reflect environmental features that are considered to be a key attribute of pedestrian environments that affect walkability (Clifton et al., 2007). Section A as "Environment" dealt with streetscape features that were less tangible but still important to consider when evaluating the quality of the pedestrian environment. Section B was focused on "Pedestrian Facility", the type of pedestrian facility depending on the surrounding environment and the activities that would occur along it. Section C included "Road Attributes" as the condition, features, and size of a roadway which could have a remarkable efficacy on the quality of the pedestrian environment. Section D consisted of "Walking Environment" and showed that the elements of a street along with the overall image of the streetscape contribute to the quality of the walking environment. Finally, the subjective ideas of the researcher were wanted in the last segment (Figure 4). As shown in the results of this audit tool and photographs which were taken from the site, Mawlawi Street was not attractive and safe for walking (Figure 3).

4.2 Triangulation by pedestrians via questionnaire

Previous works have indicated several main criteria determining the walkability of urban public spaces. For the purpose of this paper, only those criteria relating to safety, comfort, accessibility, and connectivity were discussed in the questionnaire. The questions in this survey were divided into five parts. Figure 5 shows the dependent and independent variables in the survey. According to this conceptual framework, five independent variables of demographics, comfort, safety, accessibility,

Figure 3: *(a) Pedestrian-vehicle conflict*

Figure 3: *(b) Unsuitable place of informal activities*

Figure 3: *(c) Lack of street furniture*

and connectivity features (by Likert scale) were developed with each consisting of several item variables. Table 1 shows the descriptive analysis of the collected data. The questionnaire survey was distributed among pedestrians who come to the street for their own purposes. According to Ferguson and Cox (1993), 100 respondents are considered as a minimum number of respondents for taking part in a questionnaire. Thus, one hundred participants were considered for this study. Moreover, SPSS software has been used to analyze the data in this study.

4.2.1 Analysis of questionnaire

For investigating the determinants of street walkability, a series of statistical methods can be applied. First of all, reliability analysis via

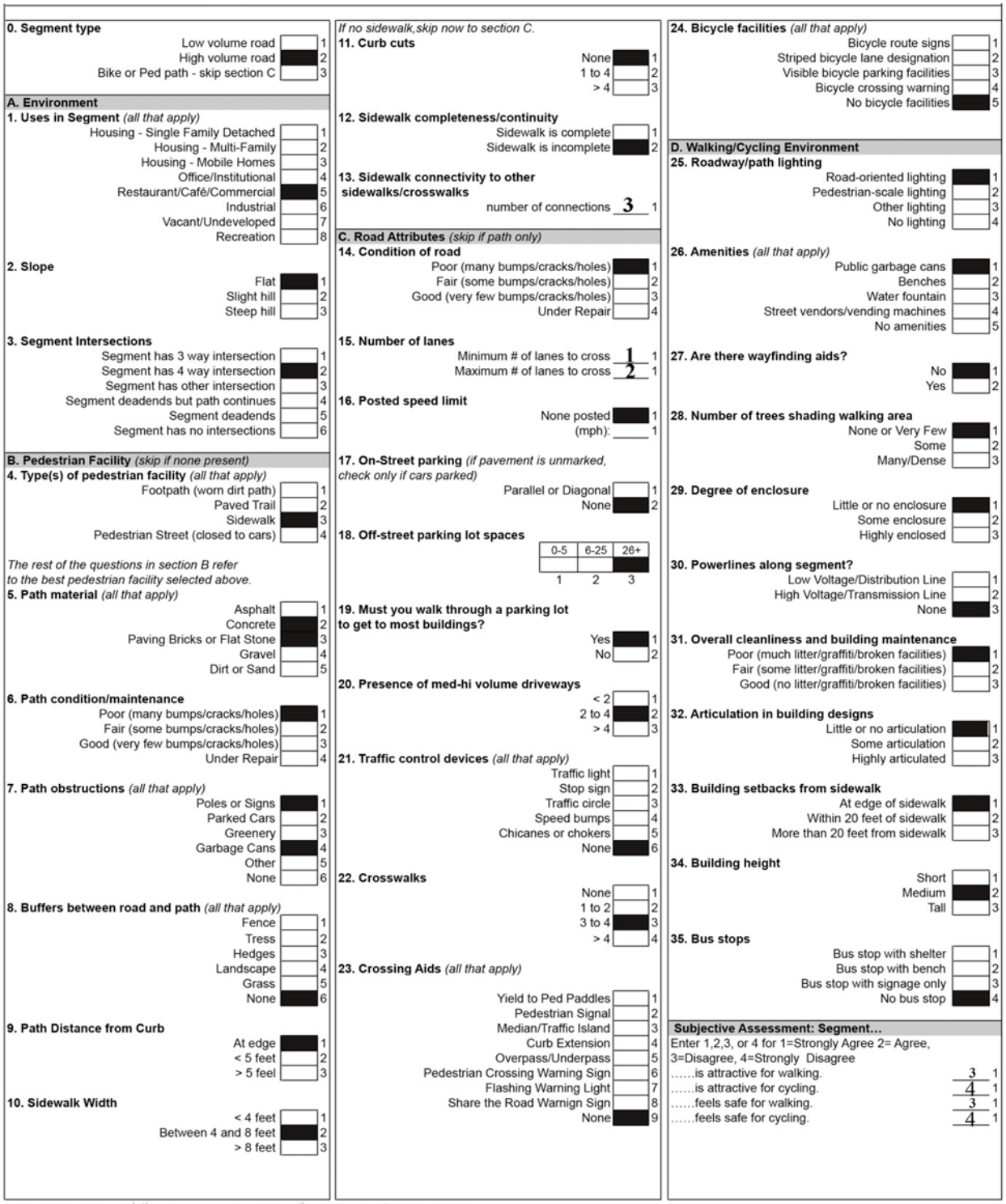

Figure 4: PEDS audit tool for Mawlawi Street

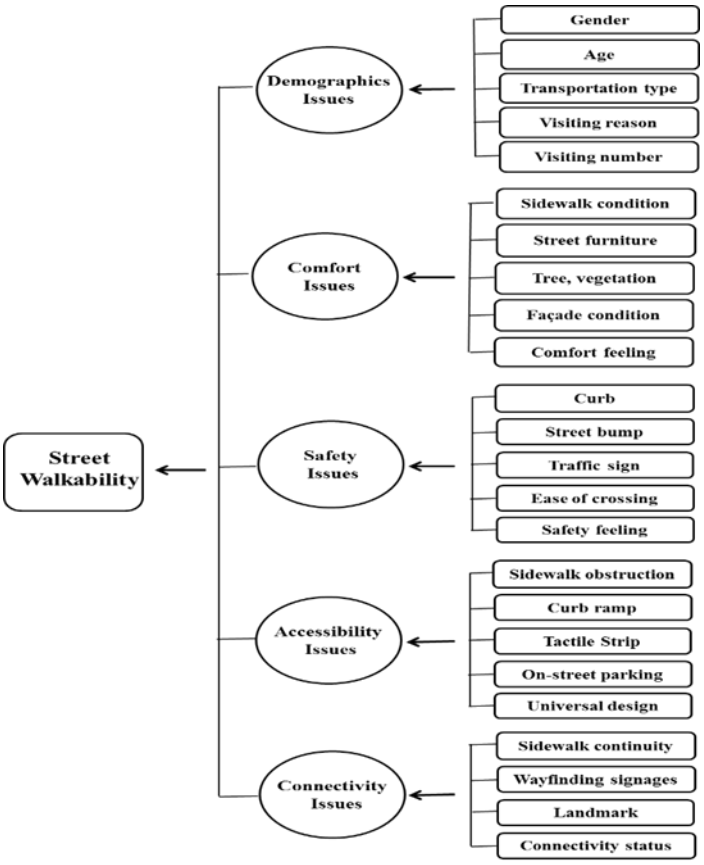

Figure 5: *Conceptual Framework*

Cronbach's alpha, which is the most common reliability measurement technique, may be conducted in the research. The Cronbach's alpha of this variable was 0.941, and as it was more than 0.9, the acceptability of the result was considered excellent. Afterwards, the KMO (Kaiser-Meyer-Olkin) measure and Bartlett's test was performed to specify the sample adequacy. Since the KMO value was 0.935 which is more than 0.5, it has an acceptable value to go forward to the factor analysis (Seyed Mohammad Mousavi, Khan, & Javidi, 2013). Lastly, exploratory factor analysis and correlation analysis were served to detect different relationships.

Table 2: *Exploratory factor analysis*

Items	Component	
	1	2
Sidewalk Condition	0.823	
Street Furniture	0.796	
Tree, Vegetation	0.791	
Facade Condition	0.806	
Comfort Feeling	0.804	
Curb	0.853	
Street Bump	0.889	
Traffic Sign	0.784	
Ease of Crossing	0.817	
Safety Feeling	0.818	
Sidewalk Obstruction		0.662
Curb Ramp		0.749
Tactile Strip		0.783
On-Street Parking		0.679
Universal Design		0.782
Sidewalk Continuity		0.780
Wayfinding Signs		0.877
Landmark		0.857
Connectivity Status		0.871

Table 1: *Summary of the demographics, comfort, safety, accessibility and connectivity variables*

Variables	Descriptive Values/Measures/Scales	Mean
Gender	**1** male; **2** female	1.40
Age	10< '**1**' <19 ; 20<'**2**'<29; 30<'**3**'<39; 40<'**4**'<49; 50<'**5**'<59; '**6**' ≥ 60	2.79
Transportation Type	**1** bus; **2** private car; **3** taxi; **4** on foot; **5** bicycle; **6** others	2.17
Visiting Reason	**1** working; **2** shopping; **3** meeting; **4** walking; **5** eating; **6** others	2.50
Visiting Number	**1** every day; **2** once in a week; **3** twice in a week; **4** more than twice; **5** only weekends	3.42
Sidewalk Condition	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.68
Street Furniture	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.12
Tree, Vegetation	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	1.98
Facade Condition	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.80
Comfort Feeling	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.09
Curb	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.40
Street Bump	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.20
Traffic Sign	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.45
Ease of Crossing	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.33
Safety Feeling	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.42
Sidewalk Obstruction	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.57
Curb Ramp	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.13
Tactile Strip	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.14
On-Street Parking	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.28
Universal Design	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.34
Sidewalk Continuity	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.52
Wayfinding Signs	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.63
Landmark	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.34
Connectivity Status	**1** very poor; **2** poor; **3** average; **4** good; **5** very good	2.89

4.2.2 Exploratory factor analysis

First, basic item analysis with Varimax rotation was conducted to test whether variables regarding street walkability could be categorized into a smaller number of factors. In this case, item variables with factor loading less than 0.40 were removed from the groups (S.M Mousavi & Khan, 2013). 19 questionnaire items were categorized into 2 components. Component 1 had ten items regarding comfort and safety issues, while component 2 had nine items regarding accessibility and connectivity issues. All reliability loadings were more than 0.6 representing adequate reliability (Table 2).

4.2.3. Correlation analysis of affordability price & knowledge

Correlation analysis was carried out to test the intensity of relation among four main features of walkability (comfort, safety, accessibility, and connectivity). Table 3 illustrates the correlation matrix of those items. It revealed that all walkability-related items were positively and significantly correlated to each other at the significance level of 0.01. However, comfort and safety were more correlated to each other in comparison to the rest, meanwhile accessibility and connectivity items were mostly correlated to each other compared with the others.

4.2.3. Demographic and walkability features

The number of males was more than females; most respondents were between 20 and 40 years old. The study showed that age was not a basic variable of street walkability. Most of the respondents came to the site with their private cars or taxi (60%) while the minority of them came on foot. This may be a strong reason that street cannot persuade people to come there on foot. In addition, the street was not inviting for walking. Most people (70%) visited the site for shopping, with a small percentage showing a tendency for walking in such a main street of Sulaymaniyah. According to descriptive statistics, although all the figures of items related to street walkability were between 'Poor' and 'average', participants were mostly partial to choose poor status rather than neutral choice. Among them, comfort issue had the lowest mean score (2.09) than the other three features of walkability, while the mean scores for safety and accessibility were 2.42 and 2.34, respectively. Although connectivity obtained the highest mean score (2.89) compared to others, "average" was the most common choice of participants. Finally, it can be concluded that participants declared the poor status of physical elements of street in terms of walkability.

4.3 Validations by local people

An interview including open-ended questions was conducted with seven local people who work and live on Mawlawi Street. They were asked questions about the strength, opportunity, weakness and threat of this street on the basis of those four items based on audit tools. Table 4, 5, 6 present the summary of these interviews. Table 4 shows those four items related to the environment. Moreover, most of interviewees only declared some weaknesses regarding 'pedestrian facilities' including unpleasant sidewalk materials, poor condition of the sidewalk in some places, narrow sidewalk, existence of path obstruction such as bollards in sidewalk, lack of buffer between pedestrians and vehicles, and lack of ramps and curb cuts on the corner of sidewalks especially for disabled pedestrians.

Table 3: *Correlations*

	Comfort	Safety	Accessibility	Connectivity
Comfort	1	0.820**	0.721**	0.584**
Safety	0.820**	1	0.734**	0.638**
Accessibility	0.721**	0.734**	1	0.785**
Connectivity	0.584**	0.638**	0.785**	1

** .*Correlation is significant at the 0.01 level (2-tailed).*

Table 4: *Issues related to 'Environment'*

Strength	• Existence of various activities • The main road is flat.
Weakness	• Street vendors make barriers resulting in traffic for both pedestrians and vehicles • Different levels between front side and back side of the road • Poor condition of building.
Opportunity	• The street located in the city center.
Threats	• Some activities like chicken sellers made the area dirty.

Table 5: *Issues related to 'Road attributes'*

Strength	• The maximum allowed speeds is 30 km/hour.
Weakness	• Poor condition of roads in some spots • Lack of on-street parking • Invisible crosswalks • Lack of traffic control at the intersection and cross-walks • High traffic volume • Conflict between pedestrian and vehicles • Lack of maintenance
Opportunity	• Named as the main road of city center.
Threats	• NA

Table 6: *Issues related to 'Walking environment'*

Strength	Combination of historical buildings and modern buildings.
Weakness	• Lack of proper lighting • Lack of maintenance of lighting • Lack of sufficient urban amenities such as public toilets, beaches, and litter bins • Lack of sufficient and mature trees • Lack of landscape maintenance • Lack of Wayfinding signs and Directional Maps • Lack of shelters and benches in the bus stop • Lack of cover linkages • Lack of Building Setbacks from Sidewalk • Unattractive appearance like electricity wire, chicken shops
Opportunity	• Historical location
Threats	• Wet market

5. Potential proposal for redevelopment

At this stage the proposals to enhance walkability can be directly based on those four factors. As the walkability level in Mawlawi Street was low, the following recommendations can improve walkability through proper design of physical elements.

Enhancement of the pedestrian environment by widening sidewalks for multiple site furnishing configurations and narrowing the road width. Benches should be located under the trees to take benefit of shading and also to be out of the way of the pedestrian passageway. Benches, bollards and planting more trees along the sidewalks can also create buffer between the sidewalks and road.

Providing landscape elements and public toilets in the park and providing awning in front of shops can protect pedestrians from the intense sunshine and rain. In order to increase pedestrian safety and enhance the quality of the pedestrian environment, it was recommended that cross lines should be raised and visible in the crosswalk area with material different from the road.

Applying curb cuts and ramps in the corners and intersections and providing street lighting can make the street safer at nights. Traffic lights, signs and traffic control devices can be installed at the intersections. Bus stops and shelters can be designed and installed. In order to create a more accessible street for disabled, elderly, and women with strollers, it was recommended that fixed bollards on the sidewalks should be removed to create a consistent, unobstructed pedestrian path.

The vegetation and water feature along the street should be provided. Some activities on the street like chicken shops should be removed. The street vendors should be arranged on the sidewalks to enhance vibrancy of the site. Figure 6 shows the master plan of the street with above-mentioned recommendations.

6. Conclusions and recommendations

Based on triangulation method which included a questionnaire with pedestrians, interview with local people and direct observation by PEDs audit tool, the following results were acquired that can influence the level of walkability in Mawlawi Street: inadequate and poor qualities of sidewalk's infrastructures; lack of street amenities; inadequate or poor qualities of the street's infrastructure. Finally, it can be concluded that the street was not comfortable and safe for walking. In addition, the street was not accessible for disabled people and crossing of the street was not easy. This study showed that there was a strong relationship between the physical elements of street and walkability concept. The results showed that the level of walkability in Mawlawi Street was in low level due to the poor qualities of the sidewalk infrastructure, poor quality of the street furniture's amenities and poor quality of the street infrastructure. Thus, the provision and design of the physical elements have a significant role to improve walkability in the street. Finally, Mawlawi Street can be more walkable through designing physical elements, if done properly. This study focused on the relation of the physical elements of the street and walkability, while land use as the other aspect can play a major role to promote walkability.

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Figure 6: *Master plan*

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