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INFLUENCE OF INTERSECTION ON WALKABILITY INDEX IN CAMPUS AND SURROUNDINGS (CASE STUDY INDONESIA AND JAPAN)

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ABSTRACT

As one of the nations with biggest number of populations, Indonesia should concern the best practice and way to design their cities, including the urban form. City complexity to provide high amounts of activities could be determined by how the road, streets, and path were designed in terms of the form and directions. Some assessments have been developed to examine the effectiveness of the streets and paths for the pedestrian. University campus, which sometimes recognized as miniature of the city were chosen as the case of this study, and will try to find the correlation between walkability index and number of intersections in Indonesian campus and compared with Japanese Campus as a benchmark. This study will try to revealed if the number of intersections have impact to the walkability value in Indonesia's and Japan's universities and its surrounding areas by using several methods such as measuring the walkability value from author's previous research and combine it with connectivity formula. Walkability and connectivity maps are produced with some graphics to showing the relationship of those main topic.

Keywords : *Walkability, urban form, intersections, pedestrian, campus.*

A. INTRODUCTION

More than 70% of world population expected to live in urban areas by 2050 according to United Nations. It is crucial to provide a better facility for citizens mobility throughout the city. In 2015, 53 percent of Indonesian population were living in urban areas, and projected to be around 65 percent by 2035 (Indonesian Statistic Bureau/BPS, 2015). However, the increasing number of citizens for Indonesian case were not followed by proper physical development on urban areas such as well facilities and infrastructure, especially that related to sustainable and low emission produced by methods that were using to transporting people inside the urban area. Moreover, Indonesia as one of the biggest countries by its population still facing several transportation problems including automobile dependence. From the perspective of sustainable living and energy consumption, combination between poor transportation management and huge number of populations could be harmful.

On the other hand, Indonesia is facing another problem caused by high number of vehicles used by Indonesian as their choice to moving from one place to anther instead of active transport such as walking or cycling, which are obese and overweight. Overweight and obese rate in Indonesia is shifting from 13% to 25% in the last 2 decades (Asian Development Bank, 2016). This condition could get worse since it is still difficult to access reliable public transportation in many

Indonesian cities. Moreover, several factors such as lower price of gasoline compared to another country and affordable cost to owning motorized vehicle making people are choosing not to use public transportation in daily case. Indonesians only taking steps around 3.500 steps, almost twice less compared to people in Hong Kong which have averaging walking around 6.800 steps a day (Althoff, 2017).

On the other hand, number of people that come to the urban areas were increased and one of the factors is higher education such as university that attract people to moving and live in the city. Some universities in Indonesia even have students that originated not in the city where the university belong, such as Malang more than 69% students, Padang more than 72% students, and Yogyakarta which has more than 75% students that were not coming from that area. This could be produced multiple poor impacts to urban environment which more people come to the city but they are not supported by great and sustainable way to support their mobility such as less active transportation and high amount of motorized vehicle users.

Hierarchy of Walking Needs (Alfonso, 2005) has explained several basic principles of walking needs, which are pleasurability, comfort, safety, accessibility, and feasibility. Pleasurability and feasibility strongly related with personal reason from pedestrian point of view, so that to find out the level of walkability index that based on the walking platform or physical environment, then comfort, safety and accebility being a based to developing the walkability evaluation tool (Ikram, 2018).

Based on this condition, his study aims to find whether there is a relationship between connectivity and walkability index by using several methods such as measuring the walkability value from author's previous research and combine it with connectivity formula. Case study are Indonesian campus that has a large size from several islands, and will compared with several Japanese campuses as one of the leading countries in terms of urban design quality.

B. METHODS

1. Sampling

To keep the topic of this research not getting wider, the smpling for case study of this research will be set as follows:

a. Samples are Indonesian public universities and Japanese imperial universities.
b. Then each university required a Google Street View because of strrets assessment that used as an early method of this study. Google Street View were used as a method such as study that has done by Li (2016).
c. Selected universities are the university that has area that almost 100 hectares or more which are good enough compared with the city scale. Those are: Sumatera Utara, Gadjah Mada, Mulawarman, Udayana, Kyushu, Hokkaido, and Hiroshima University.
d. Establishing pedestrian catchment area which are measured from every university access gate.

2. Walkability Value

To get the walkability value from each university, there are several steps that have to be done. First by developing the evaluation tools based on walking needs criteria, which then combined with Indonesian point of view related to the criteria to set the scoring formula. Next step is translating the result of the evaluation tool into the map which are showing the walkability value of campus and surrounding areas in Indonesia and Japan. This including database development and convertion to the mapping process using ArcGIS software.

3. Connectivity

One of key aspect of the resilience in transport is the connectivity of street network in urban area. City with high number of intersections could create many possible routes that making movement inside the urban area easier. After the walkability measured has done, connectivity will also measure by using formula as follows:

$$Connectivity = number\ of\ intersection\ /\ selection\ area\ (km^2) \quad (1)$$

Connectivity result will then compare with the walkability result to find out the relationship between walkability and connectivity.

C. RESULT AND DISCUSSIONS

1. Walkability Value

As mentioned in methods, walkability value produced from the result of evaluation tool that are transferred to the mapping tool to showing the place that has value in every street segment. It could be seen in figure 1 how the steps were done to get the walkability value.

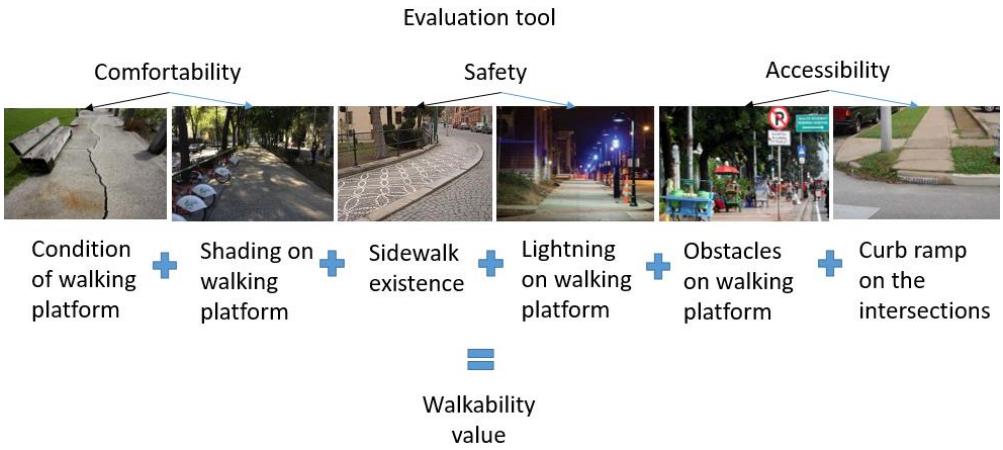

Figure 1. Evaluation Tool Development Concept
Source: Author's Analysis

To give the scoring from each criterias are based on questionnaire that filled by Indonesian to find out which are the most important thing to consider which could pursue them to implement active transport and choose walking as their

option if they want to go somewhere within walking radius. The scoring details as follows:

Table 1. Tool Scoring

Walking Needs	Main Factors	Source	Developed Criteria	Score
		SPACES, Q-PLOS, PEDS, WABSA	Sidewalk separated vehicle's street	A (19 points)
	Sidewalk Existence (19 points)		Sidewalk shared with vehicle street	B (10 points)
			No barrier or line to define sidewalk	C (1 points)
Comfortability Factor 37 maximum points			Street width is smaller than average building height on segments/sidewalk covered by trees	A(18 points)
	Shading (18 points)	SPACES, PEDS, Q-PLOS	Street width is almost same as average building height on segments / several trees exist	B (9 points)
			Street width larger than building height / less shading by trees	C (1 points)
			No or few cracks.	A (18 points)
	Condition of the Surface	SPACES, PEDS, WABSA	Some cracks or holes.	B (5 points)
Safety Factor 36 maximum points	(18 points)		Heavily damaged, soil or mud exist.	C (1 points)
			Lighting was available in every 25 meters or less.	A (18 points)
	Lighting (18 points)	SPACES, WABSA, PEDS, Q-PLOS	Lighting was available in every 30 until 50 meters.	B (10 points)
			Lighting was available only every 50 meters or more.	C (1 points)
		SPACES, PEDS, Q-PLOS	No obstacles exist	A (14 points)
	Obstacles (14 points)		Blocking by street furniture	B (7 points)
			Blockings by non-street furniture	C (1 points)
Accessibility Factor			Sidewalk exists, proper slope.	A (13 points)

27 maximum points				
	Curb Ramp on Intersection or T-Junction (13 points)	SPACES, WABSA, PEDS, Q-PLOS	Separated sidewalk exists, not proper slope.	B (5 points)
			Sidewalk not exists, not proper slope.	C (1 points)

Source: Author's Analysis (2018)

It could be seen from the table that comfortability got the highest intention by 37 points, followed by safety by 36 points, and accessibility 27 points. From this table, the street assessment then assessed by this table. The process could be seen from figure 2 below:

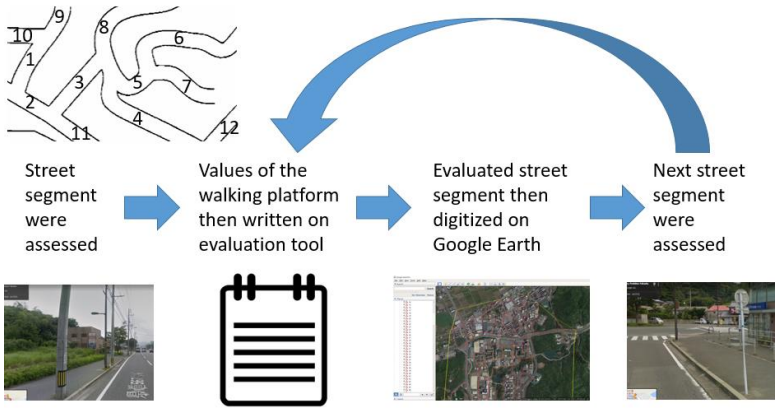

Figure 2. Assessment and digitized process
Source: Author's

Files from digitized map in Google Earth then converted to the ArcGIS to find the walkability value by combining the streets segment and street points from the evaluation tool. The process as follows:

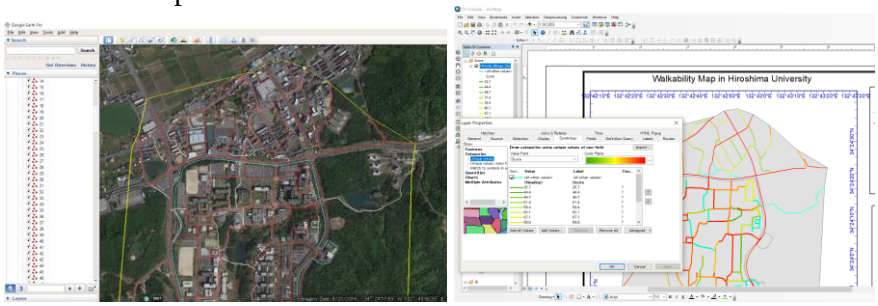

Figure 3. Street value convertion to the ArcGIS
Source: Author's

2. Connectivity

After mapping process of walkability value was done, the method continued by measuring the connectivity on case study area. The process shown on figure 4

and by using formula (1), the connectivity result shown on table 2 below (order by highest score to lowest):

Table 2. Connectivity score from Study Area

Campus and Surroundings	Connectivity
Hokkaido	160
Hiroshima	95
Gadjah Mada	83
Sumatera Utara	66
Kyushu	65
Mulawarman	52
Udayana	25

Source: Author's Analysis (2021)

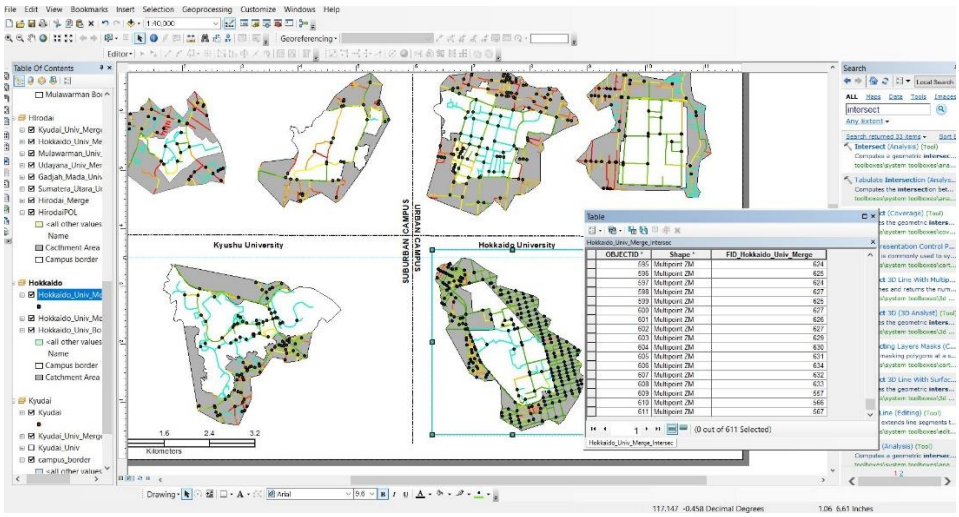

Figure 4. Intersection Count process
Source: Author's

It could be seen that Japanese Universities area got a better connectivity score compared to Indonesian Universities area. Still there are several factors that need further study why this situation happened, especially the case of Kyushu Unversity that still has lower score of connectivity compared to the others. Author hypothesize that the established year of university and the area playing an important role since Kyushu University were still on development stage when this study done as well as Gadjah Mada and Sumatera Utara University that has aged more than 2 other Indonesian universities that shown on table.

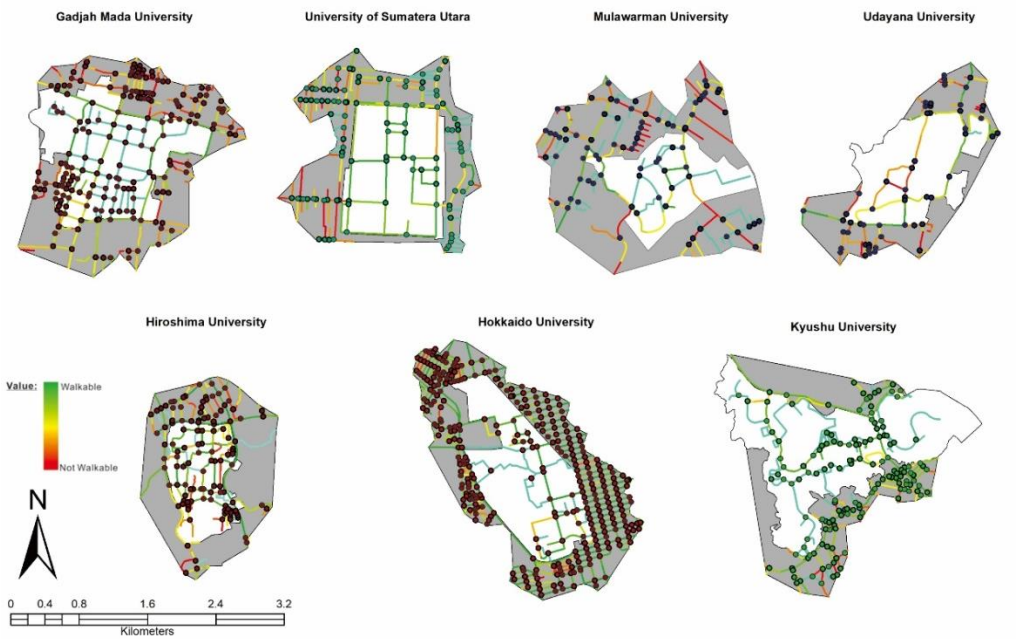

Figure 5. Intersections and Walkability Map on Study Area
Source: Author's

Figure 6. Intersection Counted and Walkability Score
Source: Author's

D. CONCLUSIONS

The study reveals that number of intersections did not have any intervention at all with the walkability score. As shown on figure 6, there are no combination that could explain and showing a strong related influence between the number of intersection and walkability score. Author hypothesized that this happened because the terms of walkability in this study are based on the evaluation tool that

focused on the walking surface or pedestrian condition, which not have any connection with human's personal option.

On the other hand, the terms of connectivity in this study strongly related to human personal choices to choose their route for walking. The bigger the number of the intersection, the more options that people get for the route choice. There should be further study to be done to found out if is it still possible to get the strong relationship between intersection and walkability.

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