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VISUAL CONNECTIVITY AND STREET NODES LIVEABILITY: A CASE STUDY OF JOHOR BAHRU HERITAGE DISTRICT, MALAYSIA

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Abstract:

In Malaysia, streets could be identified as public spaces for various activities especially at the heritage district. This study aims to promote street node as a potential liveable and sociable public space between buildings focussing on Johor Bahru city. The paper objectively proposes a method on identifying street nodes liveability pattern and introduce a relationship between occupied socio-physical and visual connectivity. It is argued that people sitting and standing at the sidewalks can also be affected by the visual connection amongst the pedestrians in addition to the condition to the street itself. The distribution of static activities of people are measured according to socio-physical elements and visual graph analysis (VGA) in Depthmap software. The results show simple relationship between the socio-physical element and the presence of static activities of people in the walkway. It is suggested that street designers, business operator and the authority could be able to create liveable spaces according to the environmental conditions and types of existing static activity.

Keywords:

Street Activities, Static Activities, Visual Connectivity, Space Syntax

Introduction

Beginning 1970s, most of the local authorities that faced development pressures often failed to achieve the standards due to limited urban spaces and land scarcity. Due to high economic pressure and increased densification, some cities like Kuala Lumpur, Penang or Johor Bahru

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failed to provide public spaces (Maryanti, M., 2017). The public spaces on street should promote quality activities for the city (Gehl 1987, Mahdzar 2008, Shamsuddin 2011). Street is a lively river of the city (Whyte, 1980) and if a city street looks interesting, the city looks interesting; if they look dull, the city looks dull (Jacobs, 1961). Secondly, it was highlighted by several previous researchers that it is important to quantify the numbers of static activities on street and it seems lacking during the understanding process of a public spaces especially on street (Mahdzar 2008, Jamil 2019, Ismail 2016, Hadi 2019, Guerreiro 2015, Campos 2005).

In Malaysian context, informal vendors can be seen along street for operating their activities based on the accessibility while bringing space qualities to urban life (Shamsuddin, S. 2011). Historically, street vendors were among the common activities occurring on the streets of the oldtown centres in Malaysia. Several streets incorporate wide sidewalks and canopied by extended overhang roof structure to provide optimum thermal comfort on the street. By announcing street node as new public spaces concept and adapting visual graph analysis in space syntax method, it is hope that street designers, business operator and the authority could be able to create better alternative liveable spaces on street according to the environmental conditions and the quantification of static activities.

Literature Review

Outdoor activities in public spaces can be divided into three categories, each of which places have quite different demands on the physical environment: necessary activities, optional activities, and social activities (Gehl, 1987). When the quality of outdoor areas is good, optional activities occur with increasing frequency, furthermore, as level of optional activity rise, the number of social activities usually increases substantially (Gehl, 1987). It has already been mentioned that the outdoor activities that are particularly dependent on the quality of the outdoor spaces are the optional, recreational activities, and by implication, a considerable part of the social activities (Litt, 1995). According Mahdzar (2008) static activities such as standing and sitting are the predominant behaviour in the interaction between people in streets and these activities are to be treated as important urban variables in making streets lively for people. The Table 1 summarize the type of static activities (NOR) with accordance to the quality of physical environments and the rate of occurrence of activities.

Table 1: Type of Static Activities (NOR), Quality of Physical Environments and The Rate of Occurrence of Activities

Static Activities (NOR)	Human Behaviours	Physical Environment Quality	
		Poor	Good
Necessary Activity (N)	Browsing, Waiting, Phone Calling, Wayfinding, Smoking	★★	★★
Optional Activity (O)	Eating, Drinking, Photograph, Reading	★	★★★★★
Resultant Activity (R)	Selling, Talking, Watching	★★	★★★

Source: Mahdzar, 2008

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Static activities manifest informal relationships to the land uses, where they interact indirectly with the environment. In this situation, people are observed reading newspaper at narrow backlane, using their mobile phones at window displays, cafes or restaurants, etc. Sometimes, people behave in a way which is divorced from the design intention of these landuse and people perform static activities at these locations wherever they find them suitable. In some extreme cases, people oddly resort to standing or sitting against lamppost, planter box, or simply at the edge of footpaths on the streets. However, people 'see' these settings as an 'opportunity' and use them according to their needs (Whyte 1980, Pressman 1987, Kostof 1992, Batty 1994). Some physical settings are not intended for any aspects of use by people (Rapoport 1976). These situations explain the manifestation of an indirect and "unfocussed" interaction between static activities and the environment.

Sociologists have come up with several theories for describing human behaviour according to the visual surrounding. Appleton (1996) explained about the idea "to see without being seen" or prospect-refuge theory as basic primitive human behaviour. It stated that the ability to see that is prospect but not to be seen that is refuge as foundation to many biological needs. Next is ecologically based theory. This theory explained that enclosed space could promotes such feelings of relaxation, comfort, and happiness whereas a prospect is said to be stimulating and exciting (Ramanujam, 2006). The other concept is "panopticism". Panopticism is a permanent state of control and power through visibility. A person who is subjected to a field of visibility will feels constrained by the power of being seen therefore such "visibility is a trap" (Foucault, 1977). According to Gehl (2010), spaces along facades or transitional zones between one space and the next are the most popular zones for public crowds. Staying along façade is less exposed and provide the best opportunities for observing other human activities rather than staying at the middle of space. This theory is called "The Edge Effect" by Jan Ghel. Like the theory formulated by Alexander (1977), people do enjoy looking at the pedestrian flow as the life of public spaces forms naturally around their borders and edges where people gravitate (Alexander, 1977). Nodes offer the person in them multiple perspectives of the other core elements. At the junction, people heighten their attention at such places and perceive nearby elements with more than normal clarity. Nodes maybe be both junctions and concentrations. Where the space has some form, the impact is much stronger hence making node becomes memorable. (Lynch K, 1960). According to him, nodes with sharp boundaries could be identifiable within a few feet. Successful street node should be intensifying to the surrounding characteristic hence street node could be proposed as new public spaces.

Table 2 shows the relationship between previous research method and characteristic of research with short finding descriptions. Early combined method of public snapshot observation and visual graph analysis has been clearly shown by Campos and Bada in year 2005 and 2009. According to them, people create liveable spaces based on visual spatial properties. Previous Johor Bahru street observation has been conducted by Ismail and Mahdzar in year 2015 and it shows that people chose resting spaces according to specific physical characteristic. The other group of researchers have been producing the result of relationship among syntactical analysis, static activities, and visual graph analysis in the city of Lisbon and Biaskra (Guerreiro & Guarda, 2015) (Bendjedidi, Bada, Meziani, 2019). The same group of researchers have been describing the relationship between static activities and visual graph analysis in Johor Bahru city centre (Hadi, Jamil & Mahdzar, 2019). The latest social interaction studies have been produced by Zerouti and Askarizad in year 2020 with snapshot and Visual Graph Analysis

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(VGA) method. Based on Table 2, 8 out of 10 listed research chose Visual Graph Analysis method in Depthmap software.

Table 2: Relationship And Differences By Previous Related Research.

Authors	Common Variables	Methodology	Short Findings and Study Area
Campos and Golka (2005)	Urban Spaces, Static Activities, Spatial Configuration	Snapshot Observation, Isovist, VGA	People's preferred location follows a distinct pattern, with people selecting more secluded areas compared to the exposed ones for informal static activities. London, UK
Bada and Farhi (2009)	Social Pattern, Spatial Configuration, Syntactical Analysis, Urban Spaces	Space Syntax, Snapshot Observation, VGA, Agent Based Analysis	The relationship of the visual "affordance" of Spaces, people's perception, and the spatial properties are needed to produce more liveable spaces. Biaskra, Algeria
Ismail and Turiman (2015)	Urban Spaces, Behavioural Pattern, Static Activities	Direct Observation, Interview, Descriptive Analytics	The majority of the homeless were local people who tried to find jobs and were choosy in the choice of resting places in public spaces. Johor Bahru, Malaysia
Guerreiro and Guarda (2015)	Social Pattern, Spatial Configuration, Syntactical Analysis, Static Activities	Snapshot Observation, VGA	There is a good correlation between the syntactic measures and the user evaluation of the benches and other standing places within the plaza. Lisbon, Portugal
Mahdzar and Baghi (2015)	Urban Spaces, Pedestrian, Static Activities, Street	Direct Observation, Pedestrian Counts	Commercial street with high population should have various spaces with impressive physical characteristics. Johor Bahru, Malaysia
Hadi and Mahdzar (2019)	Urban Spaces, Static Activities, Syntactical Analysis	Direct Observation, Snapshot Observation, VGA	The location of digital urban screens affected by the density of static activities along Wong Ah Fook road. Johor Bahru, Malaysia.
Bendjedidi, Bada and Meziani (2019)	Urban Spaces, Syntactical Analysis Static Activities, Behavioural Pattern	Space Syntax, Interview, Snapshot Observation, VGA	There is a high correlation between the human behaviour and the visibility syntactic properties in selecting places of plaza for definite activities. Biaskra, Algeria
Jamil and Mahdzar (2019)	Urban Spaces, Static Activities, Spatial Configuration	Direct Observation, Snapshot Observation, Photography, VGA	The results show an interesting diagrammatic pattern between the sidewalk condition and the presence of static activities of people in the walkway. Johor Bahru, Malaysia
Zerouati and Bellal (2020)	Social Interactions, Spatial Configuration, Syntactical Analysis	Space Syntax, Snapshot Observation, VGA	Social activities are dependent on the degree of permeability, which when low, boosts social interaction and activities. Setif, Algeria
Askarizad and Safari (2020)	Urban Spaces, Behavioural Pattern, Social Interaction, Static Activities	Space Syntax, Snapshot, Gate Counts, Directional Split, Photography, VGA,	Social interactions have a profound impact on the way that people behave in urban spaces which is derived from the quality of the built environment. Rasht, Iran

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Methodology

Framework Method- This section proposes an assessment of street nodes liveability pattern using combination of different methods. The proposed framework method is shown in Figure 1 followed by a detailed description of its implementation process. The overall procedure comprises of four steps: mapping static activities snapshots of street activity, categorizing static activities pattern according to socio-physical and visual connectivity, Analysing the distribution of static activities according to socio-physical and visual connectivity and finally describing the potential relationship between the occupied socio-physical and visual connectivity. Hence, the framework method elaborates on the process of developing the socio-physical of street and the understanding of visual connectivity.

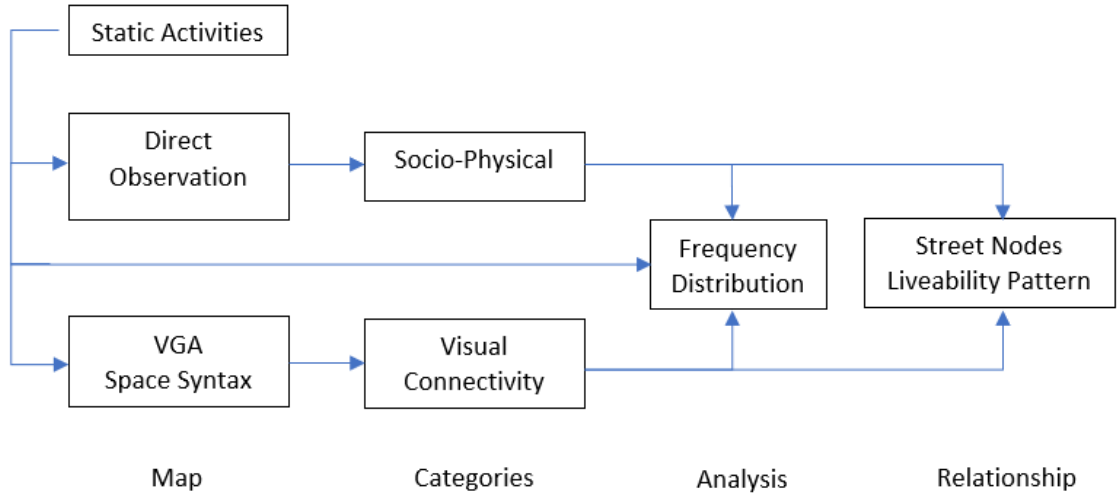

Figure 1: Proposed Framework Method

Static snapshot method records the use of public's stationery pattern of spaces within buildings and public squares at one snapshot moment (Mahdzar 2008, Gehl & Svarre 2013). In this method the precise location and if of interest activity is recorded on the plan. The observer walks from space to space and takes a mental snapshot of the activity precise now at which the space was observed (T Grajewski, L Vaughan 2001). The snapshot is then recorded on the plan, with coding according to activity. Using the rules of convex break-up to segment space into smaller parts in applying the data on during spatial analysis. Regarding the snapshot's perimeter, Ghel mentioned that we usually recognize a person at somewhere between 50 and 70 meters. Body language can also be read from this distance. And at the distance of about 22 – 25 meters, which is the distance between the longer sides of the plaza, we can accurately read facial expression and dominant emotions (2010:34).

According to Mahdzar (2008), physical designs are the activity settings where the actual physical locations in which static activities occur. The physical designs form the topography of the streets, and they are referred to as the socio-physical variables. Such a term is used to reflect the social and physical manifestation of static activities in streets. Three main categories of socio-physical variables are categorised in Table 3 during direct observation on street.

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Table 3: Proposed Socio-Physical Variables

Socio-Physical Category	Detailed Category
Street Element	Pavement - Sidewalk Road Access, Public Facilities (staircase, furniture, bins, lighting)
Building Element	Building Façade, Window Display Public Private - Covered Walkway (five-foot or extended awning
Landuse Element	Street Vendors Open Temporary Lot Eatery – Dining area

Compare to street and building elements, landuse element is the most unique socio-physical aspect of street especially in the urban tropical context (Jamil AH & Mahdzar, 2019). The three physical designs in landuse element include the street vendors, open temporary lot, and eatery spaces such as street cafes, sandwich bars or sidewalks dining. These are related to retail or temporary land uses on the street allowed by the authority in the municipality of Johor Bahru. Retail uses are also the retail attractors to pedestrian movements as well as to pedestrian static (Pushkarev and Zupan 1975). In the context of Malaysian old town centres, the shop keepers utilising the space beyond their building's boundary to entice the passers-by to come (Shamsuddin, 2011). Furthermore, the most noticeable activity in the townscape is that related to street peddlers and hawking. The sense of movement, aroma, sound, and colours fill the air with a sense of festivity that dominates the townscape and able to make the place memorable. Street vendors are among the common activities in landuse element occurring on the street of the old town centres in Malaysia. Informal vendors chose sites along the street to operate their activities based on the accessibility of passing motorist and pedestrian's movement (Shamsuddin, 2011).

Benedikt (1979) has introduced isovist theory in the famous paper "To take hold of space: isovist and isovist fields" which explore the question of visibility in the built environment and its relationship with people's behaviour. In 2001, Alasdair Turner created Depthmap software that combine isovist fields with Space Syntax theory (Hillier and Hanson, 1989). He integrated isovist within a plan of an environment and then formalized as Visibility Graph Analysis (VGA). VGA has proved to give a good indication of how people interact with space, we will explore this technique to analyse space configuration of public spaces to understand static activities. Arruda Campos (2005) has summarized that visibility graph analysis are functional methodologies for studying patterns of space use in public spaces. In this study, visual binning (1-10) is adopted to create clear measurement scale of VGA connectivity value. Binning the VGA metrics seems to work best as a tool for exploring and predicting the activities of people in spaces (Koutsolampros, P., Sailer, K., Varoudis, T., & Haslem, R. 2019).

Case Study

Johor Bahru is one of the fast-growing cities of Malaysia and could be regarded as the dual city of Singapore like Shenzhen of Hong Kong. Johor Bahru is currently undergone a socio-spatial

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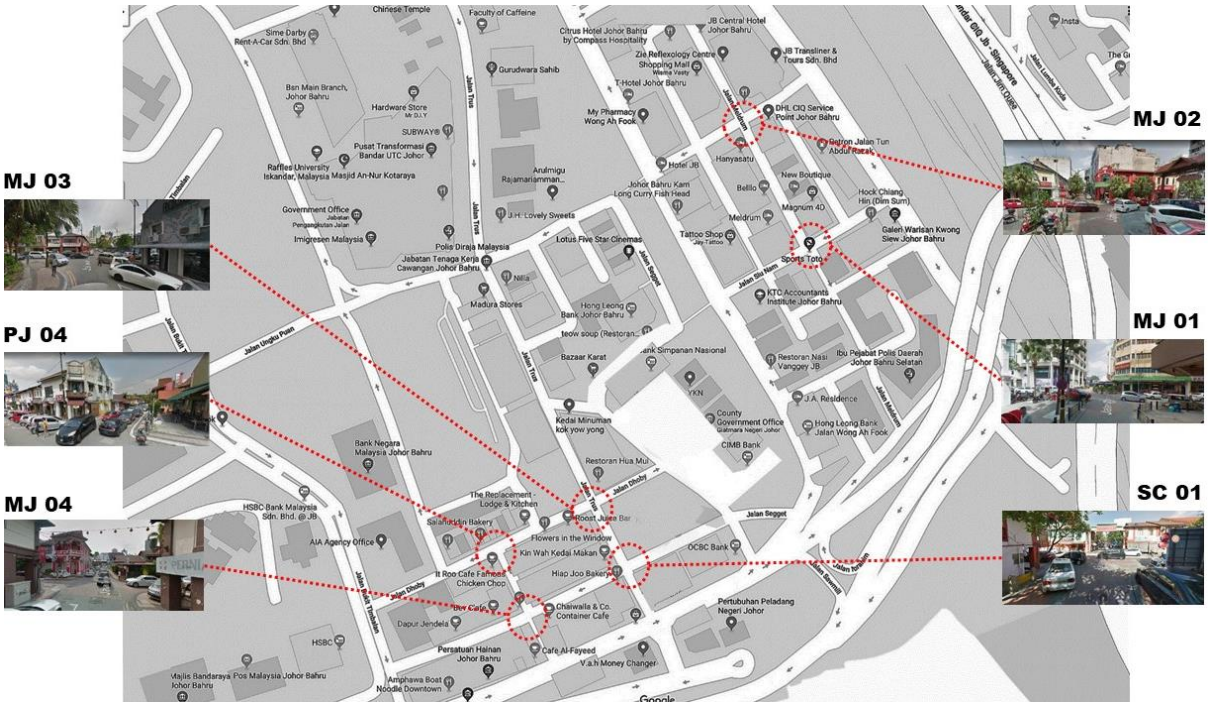
transformation and resulted in the decline of the old centre and suburban sprawl, while reinforcing the cultural hegemony of spaces by the dominant socioeconomic class and ethnic groups (Nasongkhla & Sintusingha, 2013). Preliminary, Johor Bahru is a city caught between national influences and conflicting transnational (Williams, J. M. R. 2016) making it as second home especially for Singaporean, Indonesian and others. As similar to other river and sea straits based organic city, Johor Bahru is now facing post spatial decentralisation due to urban developments (Chau, 2005). In this study, 6 street nodes were selected in Johor Bahru city focussing on the heritage district gazetted by the city council named Majlis Bandaraya Johor Bahru or MBJB till year 2025. Figure 2 shows the exact location of all nodes in Johor Bahru city with the vicinity relation among each other nodes together. Street is called "Jalan" in Malay language in Johor Bahru city. 2 nodes which named MJ01 and MJ02 are located at sub-district of old Meldrum area while 4 nodes which named MJ03, MJ04, PJ04 and SC01 are located at the Tan Hiok Nee heritage area.

Figure 2: 6 Selected Street Nodes in Johor Bahru



(Source: Google Street Map 2019)

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Table 4: Pictures of Surrounding Socio-Physical of Each Node

		
PJ04 – Jalan Dhoby & Jalan Pahang (Tan Hiok Nee Heritage Area)		
		
MJ01 – Jalan Siu Nam & Jalan Meldrum (Meldrum Area)		
		
MJ02 – Jalan Siu Chin & Jalan Meldrum (Meldrum Area)		
		
MJ03 – Jalan Trus & Jalan Dhoby (Tan Hiok Nee Heritage Area)		
		
MJ04 – Jalan Tan Hiok Nee & Jalan Pahang (Tan Hiok Nee Heritage Area)		
		
SC01 – Jalan Trus & Jalan Tan Hiok Nee (Tan Hiok Nee Heritage Area)		

(Source: Google Street Map 2019)

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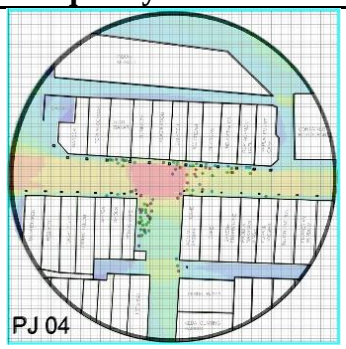
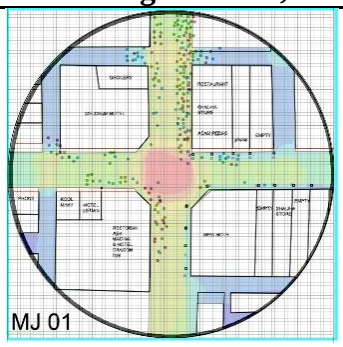
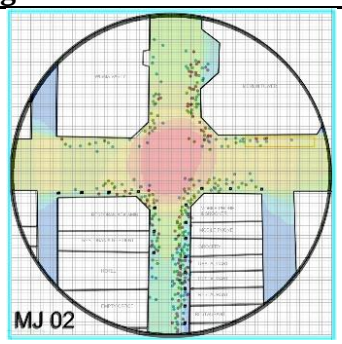
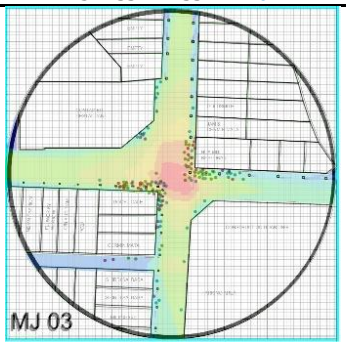
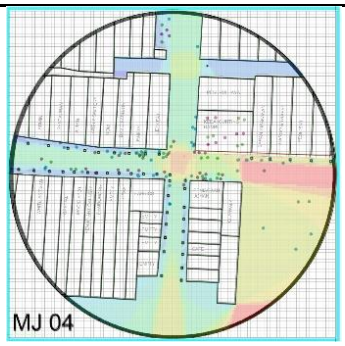
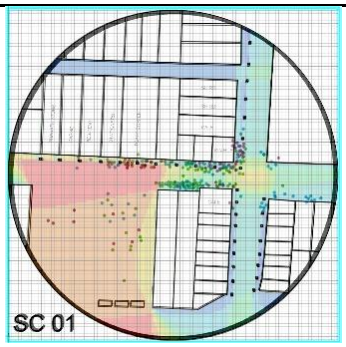
Results

Table 5 shows 6 different nodes of static activities snapshot pattern collected from total of 6 different times throughout a month of data collection in year 2019. The data counts comprise weekday and weekend for diversity. Each snapshot is limited up to 5 minutes for maximum duration and consistency. MJ02 and SC01 were among the highest count of static activities with total of 358 and 305 counts while PJ04 was the lowest value with total of 92 counts.

Table 5: Visual Connectivity and Static Activities by Space Syntax Software with frequency of Static Activities according to Street, Building and Landuse Element

 Total: 92 SE=33 BE=33 LE=26	 Total: 231 SE=23 BE=52 LE=156	 Total: 358 SE=140 BE=49 LE=169
 Total: 154 SE=81 BE=6 LE=67	 Total: 105 SE=60 BE=13 LE=32	 Total: 305 SE=79 BE=103 LE=123

Based on Table 5, 2 nodes with high static activities in landuse element were recorded at node MJ01 and SC01 with total of 156 and 123 counts. 2 nodes with high Static Activities in Street Element were recorded at node MJ03 and MJ04. However, MJ01 and SC01 shows low static activities in street element. MJ02 and MJ03 also shows low static activities in building element. Finally, PJ04 recorded low static activities in landuse element. Bonferroni method with SPSS adjusted P-value of 0.05 level significance ratio were applied in Table 5 and Table 6 for data comparison. Table 6 is a detailed frequency of static activities according to each socio physical element. Based on Table 6, street element has a node of high ratio of necessary activity at SC01. Building element has 3 nodes of high ratio of necessary activity at MJ01, MJ02 and PJ04. Landuse element has 3 nodes of high ratio of optional activity at MJ02, MJ03 and SC01. Landuse element has 3 nodes of low ratio of necessary activity at MJ03, PJ04 and SC01. Street element has 3 nodes of low ratio of optional activity at MJ02, MJ03 and SC01. Building element has a node of low ratio of optional activity at MJ 01. No Significance value of differentness was detected at MJ04.

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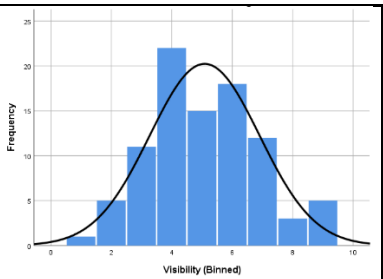
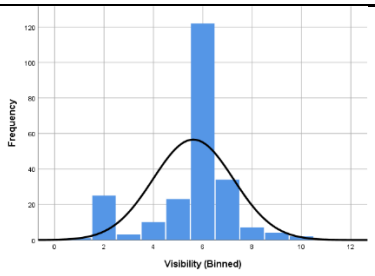
Table 6: Frequency of Static Activities in relationship to Socio-Physical and NOR.

		PJ 04	MJ 01	MJ 02	MJ 03	MJ 04	SC 01
Street Element	Necessary	11_a 12.0%	13_a 5.6%	63_a 17.6%	38_a 24.7%	23_a 21.9%	**49_a 16.1%**
	Optional	12_a 13.0%	4_a 1.7%	**25_b 7.0%**	**13_b 8.4%**	21_a 20.0%	**12_b 3.9%**
	Resultant	10_a 10.9%	6_a 2.6%	52_a 14.5%	30_a 19.5%	16_a 15.2%	18_b 5.9%
Building Element	Necessary	**17_a 18.5%**	**26_a 11.3%**	23_a 6.4%	**5_a 3.2%**	10_a 9.5%	47_a 15.4%
	Optional	**7_b 7.6%**	**3_b 1.3%**	8_a 2.2%	$1_{a,b}$ 0.6%	2_a 1.9%	21_a 6.9%
	Resultant	9_b 9.8%	23_a 10.0%	18_a 5.0%	0_b 0.0%	1_a 1.0%	35_a 11.5%
Landuse Element	Necessary	**1_a 1.1%**	49_a 21.2%	44_a 12.3%	**8_a 5.2%**	8_a 7.6%	**31_a 10.2%**
	Optional	11_b 12.0%	**46_b 19.9%**	**69_b 19.3%**	**33_b 21.4%**	13_a 12.4%	**48_b 15.7%**
	Resultant	14_b 15.2%	61_a 26.4%	56_a 15.6%	**26_c 16.9%**	11_a 10.5%	44_b 14.4%
Total		92	231	358	154	105	305

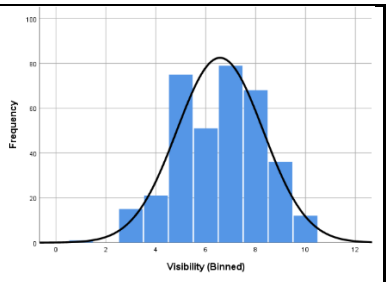
Table 7: Frequency of Static Activities with Connectivity Level of VGA Value.



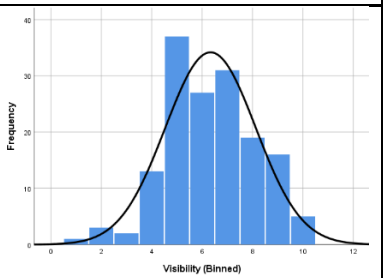
PJ04 Mean=5.09
Std Dev=1.814 N=92
Skew= 0.241 Kurt= -0.352



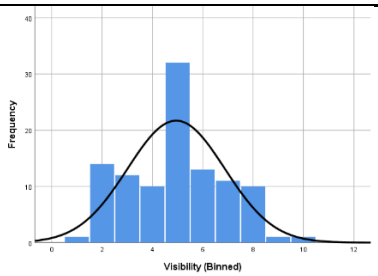
MJ01 Mean=5.61
Std Dev=1.29 N=231
Skew= -0.876 Kurt= 1.108



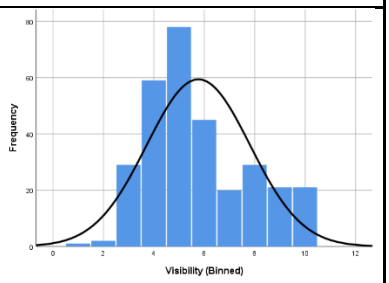
MJ02 Mean=6.57
Std Dev=1.731 N=358
Skew= -0.166 Kurt= -0.494



MJ03 Mean=6.33
Std Dev=1.797 N=154
Skew= -0.084 Kurt= -0.139



MJ04 Mean=4.94
Std Dev=1.931 N=105
Skew= 0.107 Kurt= -0.535



SC01 Mean=5.77
Std Dev=2.049 N=305
Skew= 0.567 Kurt= -0.551

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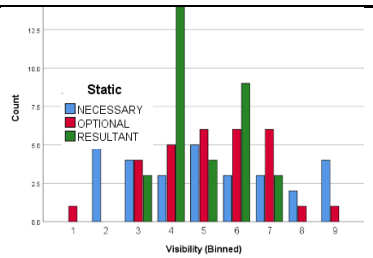
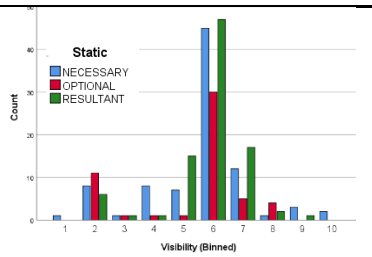
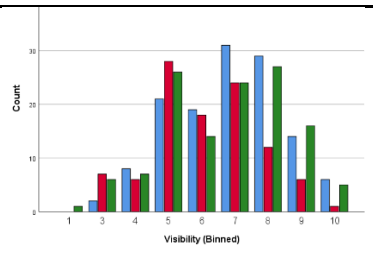
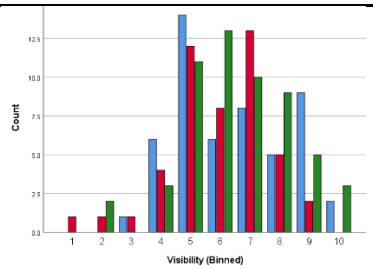
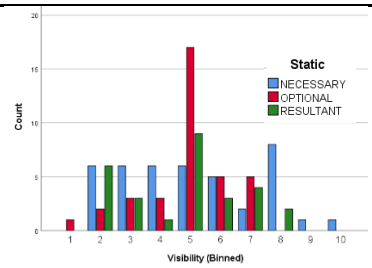
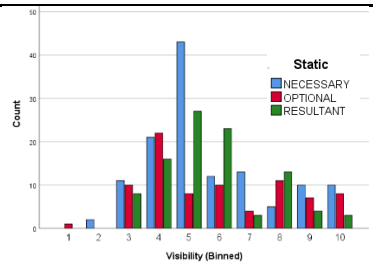
Table 7 shows the distribution of static activities according to 10 scales of visual binned connectivity value where the maximum of visual connectivity indicated with value of 10. High visual connectivity value of static mean could be observed at node MJ02, MJ03 with value above than 6. High measure of static spread is recorded at MJ04, PJ04, and SC01 with value above 1.8. This value shows that people perform static activities by scattering almost everywhere. Low measure of static spread is recorded at MJ01 with value less than 1.3. Negative measure of symmetry (right tendency) is recorded at MJ01, MJ02, MJ03 and PJ01. Negative means the distribution has the tendency towards high value of connectivity. Positive measure of Symmetry (left tendency) is recorded at MJ04, PJ04, and SC01. High value of peakedness is recorded at MJ01 with value above 1 in term of kurtosis. Finally, low value of peakedness or kurtosis is recorded at MJ04, SC01 with value less than -0.5.

Table 8: VGA Value Distribution to Necessary, Optional and Resultant Activity

 **PJ04** N – Mean: 5.17 Std D: 2.391 O – Mean: 5.27 Std D: 1.760 R – Mean: 4.85 Std D: 1.202	 **MJ01** N – Mean: 5.64 Std D: 1.743 O – Mean: 5.30 Std D: 1.887 R – Mean: 5.78 Std D: 1.314	 **MJ02** N – Mean: 6.86 Std D: 1.632 O – Mean: 6.09 Std D: 1.593 R – Mean: 6.66 Std D: 1.864
 **MJ03** N – Mean: 6.47 Std D:1.880 O – Mean: 5.94 Std D: 1.673 R – Mean: 6.54 Std D: 1.799	 **MJ04** N – Mean:5.515 Std D: 2.286 O – Mean: 4.89 Std D: 1.450 R – Mean: 4.71 Std D: 1.941	 **SC01** N – Mean: 5.74 Std D: 2.056 O – Mean: 5.9 Std D: 2.370 R – Mean: 5.69 Std D: 1.746

Based on Table 8, MJ02 has high NOR activity (necessary, optional, and resultant) mean with value above 6. MJ03 have high NR activity (necessary and resultant) mean with value above 6. MJ03, MJ04, PJ04 and SC01 have high measure of spread in necessary activity with value above 1.8. MJ01 & SC03 nodes following the measure of spread in necessary activity at the value slightly above 1.7. Next, MJ01 and SC01 have high measure of spread in Necessary and Optional Activity with value above 1.8. MJ04 have high measure of spread in resultant activity with value above 1.9. PJ04 has the lowest measure of spread in Resultant Activity. MJ02 and MJ03 have the similarity in high value of mean for static activities at almost above 6.

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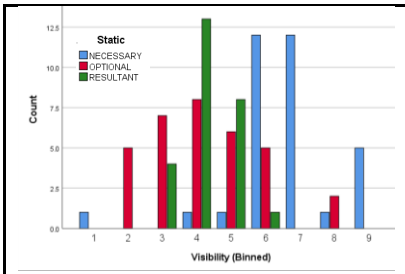
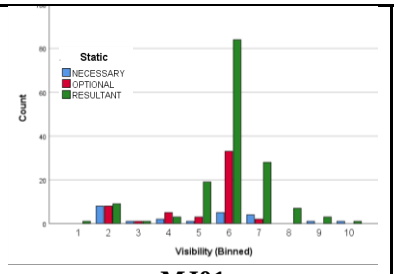
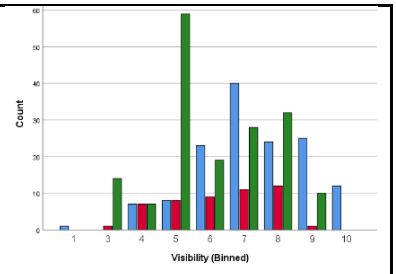
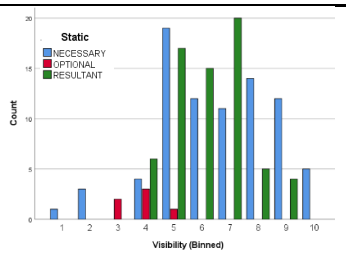
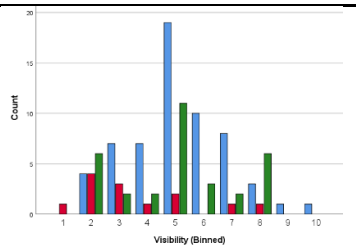
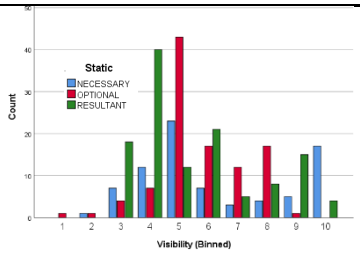
Table 9: VGA Value Distribution to Static Activities on Street, Building and Landuse

 **PJ04** SE mean: 6.64 sd: 1.558 BE mean: 4.21 sd: 1.616 LE mean: 4.23 sd: 0.765	 **MJ01** SE mean: 4.74 sd: 2.508 BE mean: 5.12 sd: 1.542 LE mean: 5.91 sd: 1.407	 **MJ02** SE mean: 7.31 sd: 1.636 BE mean: 6.27 sd: 1.511 LE mean: 6.04 sd: 1.652
 **MJ03** SE mean: 6.63 sd: 2.034 BE mean: 3.83 sd: 0.753 LE mean: 6.19 sd: 1.317	 **MJ04** SE mean: 5.18 sd: 1.742 BE mean: 3.62 sd: 2.103 LE mean: 5.03 sd: 2.040	 **SC01** SE mean: 6.28 sd: 2.480 BE mean: 5.72 sd: 1.498 LE mean: 5.48 sd: 2.097

MJ03 & SC01 have the resultant activity with high measure of spread above at 1.7 value. PJ04 has low measure of spread in Resultant Activity with value below 1.3. Finally, MJ01 follow with the low measure of spread for resultant activity slightly at the value below 1.4. Based on Table 9, MJ02 has high value of SE BE LE (Street, Building and Landuse Element) visual mean. Meanwhile, MJ03 has high value SE LE visual mean. MJ02, MJ03 & SC01 has high measure of spread for SE in visual connectivity. MJ03 has low measure spread of BE in visual connectivity.

Data Synthesis. Based on Table 6, Low significance of optional activities at street element of MJ02 and MJ03 may resulted by lack of street physical quality. From Table 4, it could be understood that vehicular traffic jams may affected the street physical quality. High significance of necessary activity at street element of SC01 shows lack of interaction among people and environment. The same result shows at building element of MJ03 and PJ04. SC01 in Table 4 shows high number of motor vehicles occupying the area of street element. Table 4 also shows that MJ03 and PJ04 have low quality element of window display or building façade to promote human and environmental interaction. MJ01 may show low significance of optional activity in building and landuse element due to low level of attraction specifically in environmental quality. Buildings in MJ01 also were built with no specific of architectural values and merely just focussing on high density. In addition, no variety of landuse element could be seen due to the type of business operated. Table 6 and Table 4 shows high optional activity at MJ02 and MJ03 due to landuse element such as eatery spaces. In addition, MJ03, PJ04 and SC01 have low necessary activity for landuse element, making these nodes recognise food nodes for its liveable and sociable.

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Table 8 shows the congestion of parked vehicular motor and high volume of traffic as seen in Table 4 may have resulted on the comfortability of static activity to perform at the remarkably high value of connectivity. Even MJ01 has central tendency mean of 5.61, this node may be having high tendency for connectivity value due to the provided wide area of sidewalks in street element. Also, static crowd at MJ01 has tendency to stick together at specific connectivity value especially at the border when businesses extending their building spaces merging with landuse element for outdoor dining area. MJ04 and SC01 have tendency for low connectivity value due to huge open area exhibited in Table 4 and Table 5. Therefore, Appleton (1996) and Foucault (1977) have described these visibility-based phenomena in the formation of crowd pattern.

Based on Table 9, necessary activity is not primarily affected by the visual connectivity. This pattern could be seen in high measure of spread because this activity does not require any social or environmental interaction. Based on Table 9 and Table 7, high NOR (Necessary, Optional and Resultant) mean in MJ02 may be affected by high incremental volume of crowd. It could be understood that when performing necessary Activity, people would hide from high visual connectivity unless if there is a vehicular motor or visual blockage on street. In Table 4, more visual connectivity and activities could be introduced if the stretch of long metal hoarding demolished from MJ03 and SC01. Other than necessary activity, resultant activity is less dependent on specific region of connectivity value because social interaction may only rely on crowd. MJ01 and SC01 have high visual robustness when it comes to eating spot in landuse element. For PJ04, only one business operator named “chicken chop” encourage social interaction by providing street furniture for dining area. Factors may affect by the synergy of the designer or authority intention along with the static activity’s preferences regarding on Table 9. Street Nodes in Johor Bahru City Centre still depending on landuse element when it comes to the liveability. Landuse element overrule the connectivity variable hence people were scattered at random spaces. Street element has high measure of spread in visual connectivity. Building element has strong tendency for low spread measure of static activities.

Table 10: Visual And Numerical Comparison Pattern For VGA Occupied Socio-Physical Distribution With The Percentage Frequency Of Static Activities.

Node	VGA occupied distribution 1-10			Percentage Frequency of Static Activities (%)									VGA occupied distribution 1-10		
	SE	**BE**	**LE**	**SE**			**BE**			**LE**			**SE**	**BE**	**LE**
	mean			N	O	R	N	O	R	N	O	R	sd		
PJ04	6.64	4.21	4.23	12.0	13.0	10.9	18.5	7.6	9.8	1.1	12.0	15.2	1.558	1.616	0.765
MJ01	4.74	5.12	5.91	5.6	1.7	2.6	11.3	1.3	10.0	21.2	19.9	26.4	2.508	1.542	1.407
MJ02	7.31	6.27	6.04	17.6	7.0	14.5	6.4	2.2	5.0	12.3	19.3	15.6	1.636	1.511	1.652
MJ03	6.63	3.83	6.19	24.7	8.4	19.5	3.2	0.6	0.0	5.2	21.4	16.9	2.034	0.753	1.317
MJ04	5.18	3.62	5.03	21.9	20.0	15.2	9.5	1.9	1.0	7.6	12.4	10.5	1.742	2.103	2.04
SC01	6.28	5.72	5.48	16.1	3.9	5.9	15.4	6.9	11.5	10.2	15.7	14.4	2.48	1.498	2.097

Note: (1) Landuse element has the highest number of static activities. (2) Building Element is isolated with a smaller number of static activities. (3) Street element has the highest value of well distributed pattern of static activities.

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Street Nodes Livability Pattern. Based on Table 10, Building Element should be enhanced more and integrated to the center of node. For example, a huge canopy above street with structurally connected between buildings could be constructed to enhance the quality of environment. Based on Table 11, MJ02 at Meldrum area and MJ03 at Tan Hiok Nee area shows similarity in visual crowds by static activities pattern. From Table 4, MJ02 and MJ03 shared the similarity of high traffic flows and visual node area. Resultant Activity tend to focus on specific area and isolated regardless of any average value in visual connectivity. Table 12 shows that the Optional Activity is still relatively low and this was resulted due to low physical environmental quality. Next, Optional Activity and Resultant Activity are still solely depending on Landuse element such as policy of eatery spaces or street vendors. Building element has the lowest number of Optional and Resultant Activities.

Table 11: Comparison For Overall VGA Distribution Pattern Of Static Activities.

Node	VGA distribution 1-10 mean			Total Distribution (1-10)	VGA distribution 1-10 sd			Total Distribution (1-10)		
	N	**O**	**R**	**mean**	**N**	**O**	**R**	**sd**	**skew**	**kurt**
PJ04	5.17	5.27	4.85	5.09	2.391	1.76	1.202	1.814	0.241	-0.35
MJ01	5.64	5.3	5.78	5.61	1.743	1.89	1.314	1.29	-0.88	1.11
MJ02	6.86	6.09	6.66	6.57	1.632	1.59	1.864	1.731	-0.17	-0.49
MJ03	6.47	5.94	6.54	6.33	1.88	1.67	1.799	1.797	-0.08	-0.14
MJ04	5.515	4.89	4.71	4.94	2.286	1.45	1.941	1.931	0.107	-0.54
SC01	5.74	5.9	5.69	5.77	2.056	2.37	1.746	2.049	0.567	-0.55

Note: (1) MJ02 and MJ03 have the highest mean in VGA distribution. (2) Resultant Activity tend to focus at specific area and isolated.

Table 12: Comparison For Overall VGA Distribution Pattern Of Static Activities According To Socio-Physical Elements.

Node	VGA distribution 1-10 mean			Percentage Frequency of Static Activities (%)									VGA distribution 1-10 sd		
				N			**O**			**R**			**N**	**O**	**R**
	N	**O**	**R**	**SE**	**BE**	**LE**	**SE**	**BE**	**LE**	**SE**	**BE**	**LE**			
PJ04	5.17	5.27	4.85	12.0	18.5	1.1	13.0	7.6	12.0	10.9	9.8	15.2	2.391	1.76	1.202
MJ01	5.64	5.3	5.78	5.6	11.3	21.2	1.7	1.3	19.9	2.6	10.0	26.4	1.743	1.887	1.314
MJ02	6.86	6.09	6.66	17.6	6.4	12.3	7.0	2.2	19.3	14.5	5.0	15.6	1.632	1.593	1.864
MJ03	6.47	5.94	6.54	24.7	3.2	5.2	8.4	0.6	21.4	19.5	0.0	16.9	1.88	1.673	1.799
MJ04	5.515	4.89	4.71	21.9	9.5	7.6	20.0	1.9	12.4	15.2	1.0	10.5	2.286	1.45	1.941
SC01	5.74	5.9	5.69	16.1	15.4	10.2	3.9	6.9	15.7	5.9	11.5	14.4	2.056	2.37	1.746

Note: (1) Optional Activity is still relatively low indicating low environment quality. (2) Optional Activity and Resultant Activity are still solely depending on Landuse element. (3) Building element has lowest number of static activity.

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Conclusion

It is suggested that street designer, business operator and authority could be able to create better alternative liveable spaces on street according to the environmental conditions and the quantification of static activities. Authority should rethink in designing the physical of street element for landuse element based on the repercussion towards outdoor activities on street. Enhancement of street and building is still needed in Johor Bahru city centre particularly in reviving the walkable heritage street. Street Element could be improved by enhancement of street physical structures. Optional activity is significantly high in Johor Bahru only and if the landuse allow for eatery activity. However, street nodes have the potential of high optional activity even with low landuse element.

Building Element should be enhanced more in physical and focussed to the center of node for visual integration such as large canopy or roof overhang. Apart from that, building element could blend with street element by introducing street art or street furniture. Landuse element could be improved by thoughtful policymaking driven by real social data based. It is also concluded that low visual connectivity and narrow lane in heritage street nodes promote intimate relationship among people, street, and building.

For future research method, visual connectivity should alternatively consider on the vehicular motor placement to describe on street visual obstruction. Furthermore, breakdown of each specific distribution of snapshots could be made instead of totalling up the whole day to visualise its consistency for sustaining static activities. Finally, the city needs less parking spot for vehicular motors on street to encourage liveable and sociable human activities on street.
Bringing street night vendor like Bazar Karat just a literal solution and too dependent on landuse element. Also, it created more other problems like blocking the visual of building and street element. To describe it briefly, too much dependent to landuse element like street vendor and open eatery spaces may seems like making a Johor Bahru heritage district like temporary artificial theme park. Early 2020, the streets have been rejuvenated by the city council allowing more pedestrian spaces rather than car parking spaces. Therefore, new data analysis for static activities can be done in future.

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