Evolution and Expansion of Urban Space in Harbor City

- Case Study of Makassar, Indonesia -

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1. Introduction

1.1. Background

The phenomenon of changing the function of harbor city from centers of production (industrial) to be centers of consumption causes several abandoned old ports to eventually become empty land that does not function on edge of urban waterfront if it is not designed with proper planning. This will increase the urban problems around the abondened port area and have an impact on the lives of the people.

Makassar is a metropolitan city with a waterfront city concept that has become a model for other regions. This research is expected to be the new innovation for Indonesia to introduce spatial syntactic theory with a case study of post-industrial waterfront in Makassar by looking at the spatial quality of Makassar city.

1.2. Objectives

The research aimed to clarify the process of evolution and expansion of urban space in harbor city by looking at the past and present spatial developments in waterfront city of Makassar and made a proposal as a solution. This research considers needs of city and urban problems that is solved by rethinking, reorganizing and transforming a specific area of Makassar city.

1.3. Method

Space Syntax Theory was chosen as a method to analyze the spatial quality of harbor city in Makassar with topological variables such as connectivity, integration and intelligibility by using DepthMap software to produce digital data. The resulting data analysis will reflect the comparison of urban network quality in the past and present.

1.3.1. Connectivity

Connectivity measured a certain element that is directly connected to a space. Meanwhile, the distance from one element to another is measured through the depth value.

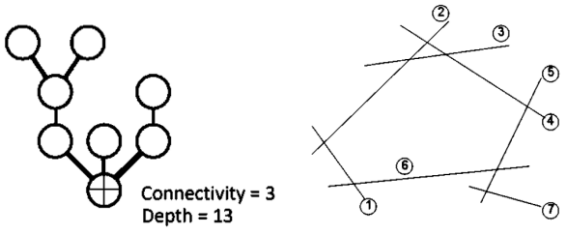
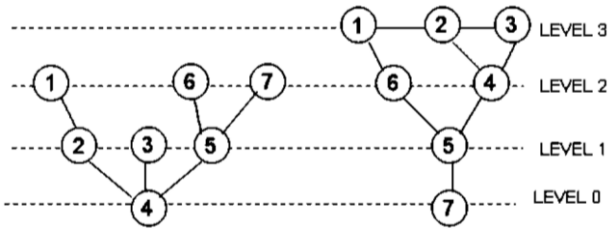


Figure 1. Connectivity (left) and simple axial (right)
Source: Hillier et al., (1983)

1.3.2. Integration

Global integration analysis was carried out by looking at the overall value of the system using Rad-N. Whereas for local integration, the value of each road is calculated up to level 3 (Rad-3) to see the spatial quality of the city from a smaller scale for pedestrian distance.



Mean depth line 4	= ((3x1) + (3x2)) / 6 = 1.5
Mean depth line 7	= ((1x1) + (2x2) + (3x3)) / 6 = 2.3
Integration value α	= 1 / mean depth

Figure 2. Measuring of integration
Source: Hillier et al., (1983)

1.3.3. Intelligibility

The relationship between local features and the system as a whole part is intelligibility. The spatial intelligence value is obtained by calculating the relationship between spatial connectivity (local size) and its integration value (global size).

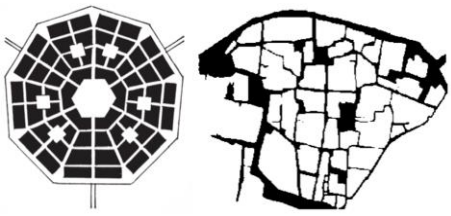


Figure 3. Intelligible (left) and unintelligible patterns (right)
Source: Hillier et al., (1983)

1.4. Case Study

The boundary area of case study is decided by using the Makassar city landuse. Industrial and post-industrial zones along the Makassar coastal area will be used as case study. The surrounding area of harbor city as far as 3 km from the water's edge to city center is taken as an environmental situation to evaluate the spatial quality of Makassar City which is affected by the harbor city.

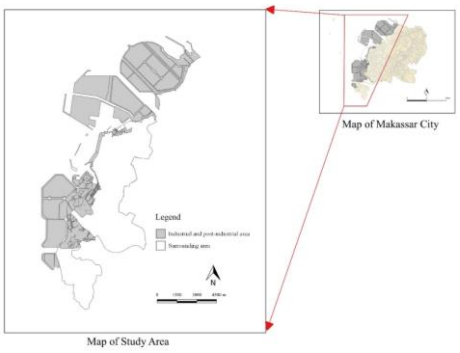


Figure 4. Case study of research

Source: Author (2020)

2. Theoretical Background

Hoyle's analytical theory was developed into the evolution of the port area by investigating each conversion cycle in an actual, local to national context. Restructuring has taken place on a global scale in Brisbane over the last few decades. There have been many changes that have occurred in the water boundary area (Schubert, 2001).

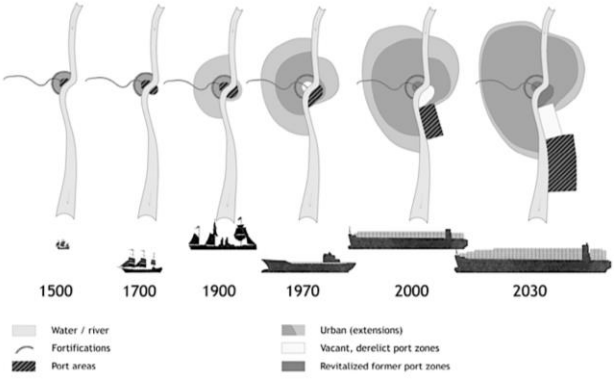


Figure 5. Phenomena of waterfront evolution

Source: Schubert, Dirk (2008)

3. Urban Morphology of Harbor City in Makassar

Based on the history of port development in Indonesia, almost all ports in Indonesia started as small ports because the movement of people in the past was carried out using sea transportation. These ports experienced evolution in the Dutch colonial era which later became the history of the great ports of the present.

Table 1. Urban revolution of harbor city in Makassar

Period	Year	Basic Concept	Phase
I (~1900) Construction	1548	Construction of Paotere Harbour	Industrial
	1600s	Paotere Harbour become a trading port	
	1775	The first old pier by VOC of Rotterdam Port in Makassar	
	1840	Moving the function of Rotterdam Port	
	1846	Soekarno Hatta Port Development	
	1900s	Paotere Harbour was closed	
II (~1945) Reconstruction	1930	The Soekarno-Hatta port has become an important port of trade in Eastern Indonesia	Transition
	1945	Construction of concrete walls along the Losari	
III (~1990) Revitalization	1962	Losari has changed in function from residential area to central business	
	1976	Revitalization of Losari	
	1980s	Utilization along Losari by street vendors	
	1990s	Relocation of street vendors to another place.	
IV (~2020) Regeneration	1991	Re-functioning of Paotere Harbour	Post-Industrial
	1997	Construction project of Tanjung Bunga Metro Road	
	2004	Losari beach platform development project	
	2009	Development of Center Point of Indonesia	
	2015	Construction of Makassar New Port	
	2025	Plans for completion of the construction of Center Point of Indonesia (CPI)	
	2032	Plans for completion of the construction of the Makassar new port	

Source: Author (2021)

4. Spatial Analysis: Space Syntax Data

4.1. Global Integration (Rad-N)

The road structure network in the city of Makassar morphologically continues to develop irregularly with many oblique intersections (figure 6). Overall, the analysis of global integration revealed that the integration core is centered in the historical area of Fort Rotterdam which develops north and south of the city of Makassar. From time to time, the integration of the road network is increasingly developing towards the Makassar city peninsula as to form a waterfront city.

Scatterplots (figure 7) describe the relationship and correlation between connectivity and its interpreted integration and distribution form. The analysis results from the DepthMap software will produce the number of points that will form a straight line up with an angle of 45 degrees from bottom left to top right. The greater angle of slope, urban system network is easier to understand.

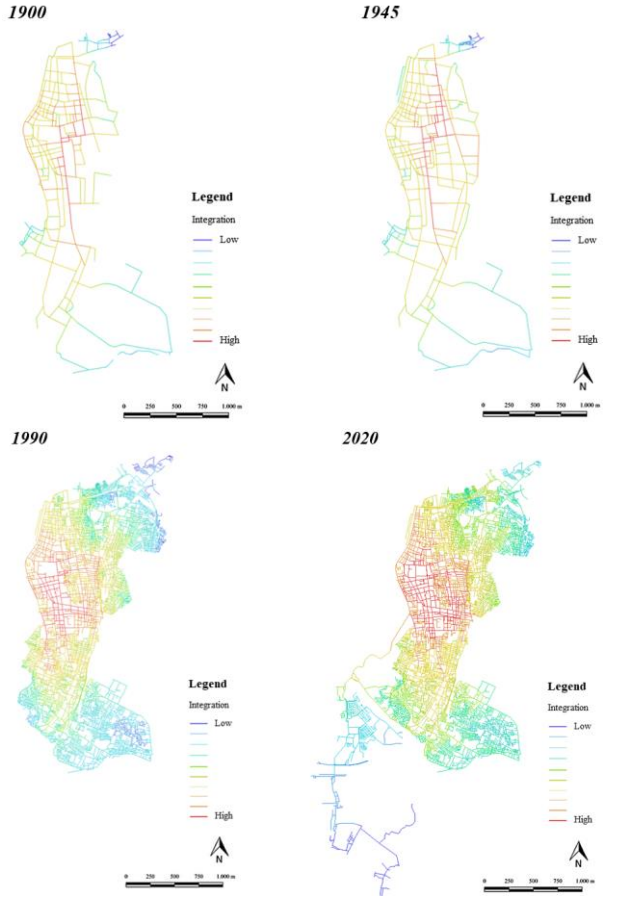


Figure 6. Global integration (Rad-N) analysis of Makassar city from 1900-2020 (based on axial models)
Source: Author (2021)

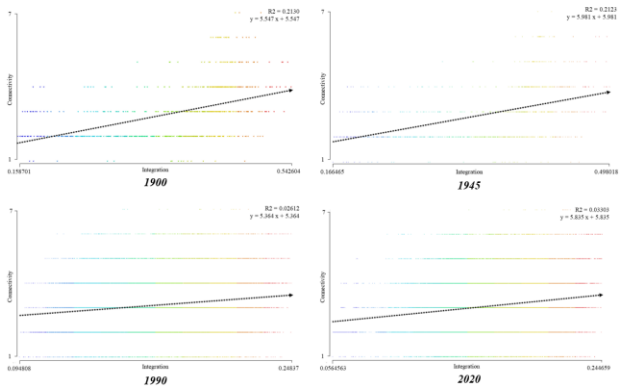


Figure 7. Scatter plots of global integration showing intelligibility of street layout in Makassar city
Source: Author (2021)

Period 1 and 3 give results with a scattergram to form a more linear and dense distribution. This indicates a good degree of correlation with the clarity of the larger urban network structure. On the other hand, periods 3 and 4 show a scattergram with a more widespread distribution. This means a poor level of correlation where urban spatial networks are difficult to understand.

4.2. Local Integration (Rad-3)

Radius (level) is decided by middle coordinates which displayed on the software. For Makassar city as case study, the middle coordinate of map is level 3 (Rad-3). When axial maps are analyzed using local integration up to level 3 (figure 6), which is likened to access to each area using transportation (typical vehicular movement), then each period shows increased in the quality of integration.

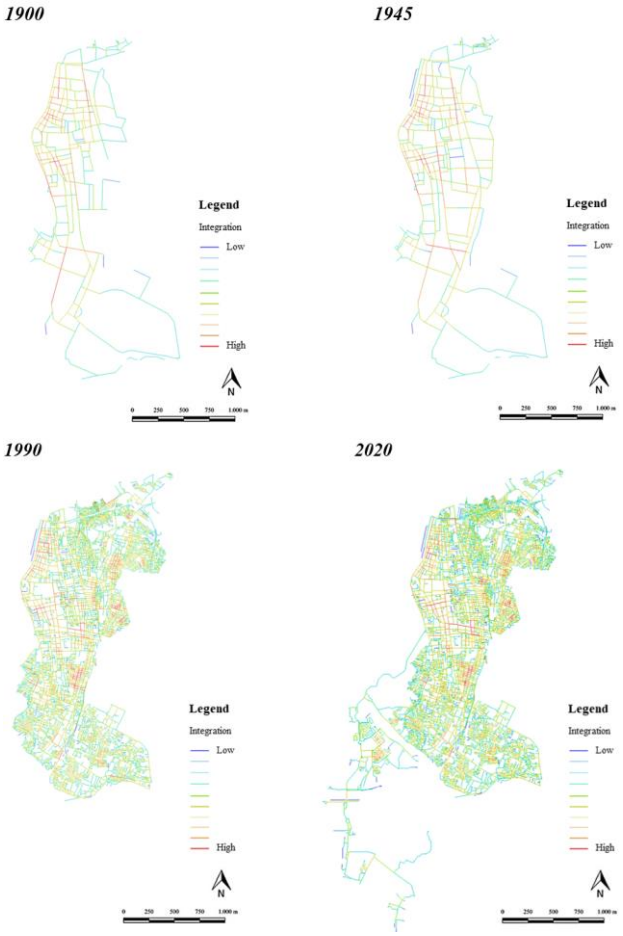


Figure 8. Local integration (Rad-3) analysis of Makassar city from 1900-2020
Source: Author (2021)

The results of analysis of local integration (Rad-3) revealed that the quality of integration is increasing periodically due to the construction of neighborhood roads <3 meters wide that were built in period 3. The local integration value shows a much higher value when compared to the integration value at the global level. This indicates that the growth of Makassar city has a huge impact on increasing the quality of connectivity and integration from the local level. However, in global level, the decreased quality of integration is in a decrease in the value of accessibility due to the development of irregular road construction due to tourism and residential needs.

Table 2. Values of topological variables

Space Syntax Data			Period			
			I	II	III	IV
Axes Count			793	941	15,373	17,200
Connectivity		Mean	2.94	2.87	3.06	3.03
		Min.	1	1	1	1
		Max.	7	7	7	7
		Standard Deviation	1.12	1.12	1.15	1.15
Integration	Global (Rad-N)	Mean	0.38	0.34	0.25	0.16
		Min.	0.16	0.17	0.11	0.06
		Max.	0.54	0.49	0.39	0.24
		Standard Deviation	0.09	0.09	0.06	0.06
	Local (Rad-3)	Mean	1.29	1.27	1.35	1.32
		Min.	0.33	0.33	0.33	0.33
		Max.	2.27	2.28	2.35	2.39
		Standard Deviation	0.38	0.39	0.36	0.37
Intelligibility (R2)			0.21	0.21	0.02	0.03

Source: Author (2021)

5. Relation between Urban Morphology and Space Syntax Data

Comparison of results of data analysis using syntax space with urban morphology in study area was implemented to determine relationship between the analyzed data and the real conditions at location. Several aspects that are compared and analyzed with integration data are land-use, population density, route faced traffic congestion, gathering place, old and new settlement.

Table 3. Relation between urban morphology and space syntax data

No.	Aspects	Tendency
1.	Land-use	a. Trade/service area ➔ High integration b. Settlement area ➔ Low integration
2.	Population density	a. High population ➔ Low integration b. Low population ➔ High integration
3.	Traffic congestion	a. High traffic congestion➔ High integration b. Low traffic congestion➔ Low integration
4.	Gathering place	a. Nearby gathering place➔ High integration b. Far from gathering place➔Low integration
5.	Settlement	a. Old settlement ➔ High integration b. New settlement ➔ Low integration

Source: Author (2021)

6. Conclusion and Proposal

Overall, the problem of the city of Makassar is at a high level of vehicle density with a spatial arrangement system that still needs to be addressed. Transit Oriented Development (TOD) was chosen as an urban solution for Makassar to change the urban orientation from using private vehicle to compact city with using public transportation.

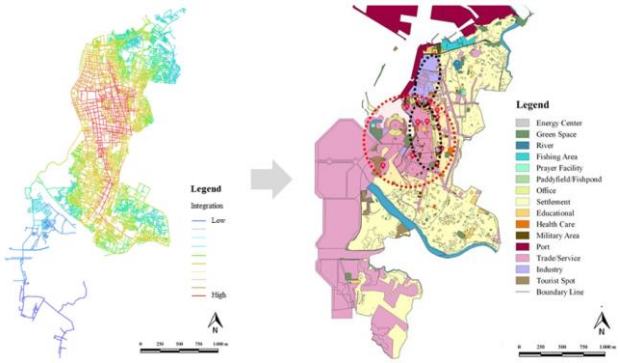


Figure 9. Overlapping integration and morphology map
Source: Author (2021)

Based on the image above (figure 9), the determination of the transit corridor route is done by selecting the roads with a high level of global integration which are marked in red line. Station points (nodes) are in areas close to historical, tourist or commercial sites that can make it easier for people to reach important sites in the city.

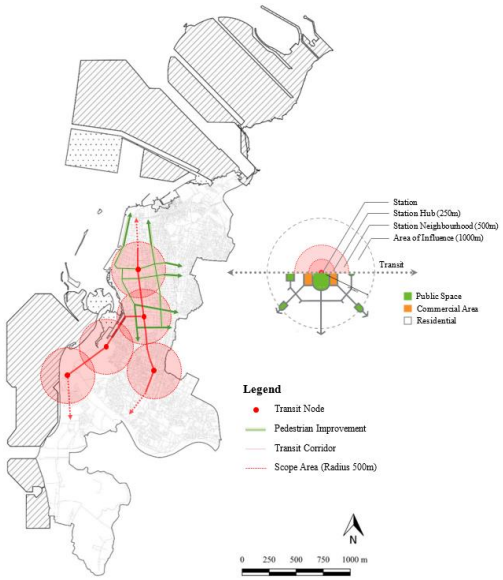


Figure 10. TOD system as a solution for Makassar city
Source: Author (2021)

The pedestrian improvement area shown in figure 10 was chosen based on roads in tourist areas that are close to historical sites and trade. A coverage area of 500 meters is determined because this is the distance a person can reach by walking.

REFERENCES

1) Hillier B, Hanson J, Peponis J, Hudson J, Burdett R. 1983. *Space syntax: a new urban perspective*. Architects Journal, 178 (48) 48-63.
2) Schubert, Dirk. (2008). *Transformation processes on waterfronts in seaport cities: Causes and trends between divergence and convergence*. Bielefeld: Transcript-Verlag.