Model of Coastal Transit Oriented Development (TOD) Based on the Potential of Local Port and marine Tourism Port, Case Study: Fort Rotterdam Makassar and the Surrounding Areas

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Abstract. The lack of social and public facilities of seven small islands around Makassar, causing the commuters to experience inefficiency in fulfilling their basic needs in the mainland of Makassar city. The purpose of this study is finding the location of coastal TOD in accordance with the principles of development model of coastal TOD. The result showed that inefficiency of time, cost and distance could be eliminated by applying vertical, united and integrated development model of coastal TOD. Using survey, interview and literature study through expert system analysis based on GIS deliniates coastal TOD.

1. Introduction

Research about the principles of transit oriented development (TOD) spatial plan for coasts based on the potency of local and marine tourism port, case study: Fort Rotterdam and the surrounding areas in Makassar. Makassar is the capital city of South Sulawesi. Makassar is situated at coordinate 119° 18’ 27.79” east longitude and 5° 3’ 30.81” south latitude with boundaries; in the north is Maros city in the east is Maros regency, in the south is with Gowa regency, in the west is with Makassar straits. Makassar city has several ports, some of them are ports around Fort Rotterdam (Kayu Bangkoa local port, Kayangan and Association of Boat Sport water ski marine tourism port), Paotere commerce port, Untia fishery port, and Soekarno-Hatta national port, as shown in this following figure 1 (b).

Figure 1. (a) position of smal islands toward Makassar city; (b) Position of ports around Fort Rotterdam
The trip of goods and people in urban area in transit location around Fort Rotterdam will be more increased along with the increase of needs and activities of commuters. Commuters from mainland of Makassar to small islands are dominated by the purpose to have water sport and tourism or picnic such as boat sport, swimming, diving, dan snorkeling. Generally, the vehicle used from their residence to transit location are motorcycle, public transportation \textit{(pete-pete)} and private cars. Besides, commuters from small islands (Lae-lae, Samalona, Barrang Caddi, Barrang Lompo and Kodingareng) to ports around Fort Rotterdam use speed boat or motor boat. The trip will be continued to the main land of Makassar city by using pedicab, motor boat, pete-pete, taxi, bus or private cars.

The purpose of commuters are quite varied such as visiting relatives, traditional market, mall and shops to shop for their daily needs whether they are physical or non physical [1] [2]. Physical and non physical needs are about shopping for food and drinks needs, clothes, building materials, joining the education to improve their intelligence ability, receiving the health treatment, enjoying the beauty of nature, doing sport, picnic or marine tourism, and also doing the worship according to their belief [3], [4], and [5].

Generally, in travelling commuters use motorcycle and that is not massive, only a few of them use bus, non motor vehicle (pedicab) or walking, hence the number of vehicles tend to be more increased as well as the use of fuel, there was redundancy in cost congestion and traffic accident [6] [7]. In overcoming several problems of development urban and traffic on the main land then it is applied some urban policies, they are development city which oriented to TOD. It is a kind of policy strategy using integrated concept among land use and transportation, compact, diverse use, walking in 5-10 minutes from transit location or bus stops [8]. The lack of the willingness to walk within \( \frac{1}{2} \) mile radius is also affected by the development pattern of shopping facilities and residential, building density, and mixed used land planning [9].

The development of urban is strongly related with accessibility of citizen and job so the development of massive public transportation is concentrated around residential, working places, transit area or stop stations of massive public transportation[15]. Success key of development of coastal TOD is the integrated land use from various activities, massive public transportation, pedestrians for doing sport, recreation and many other services safely and friendly around port or transit location [11]. TOD principles and compact city are a reference to bring closer various services of goods and service around port where the commuters transit. The service of goods and service are supposed to be able to be accessed through walking comfortably, cycling safely and better quality of the using of massive public transportation[12]. It will be beneficial for commuters both from small islands to Makassar mainland and vice versa in order to increase the efficiency of distance and travel time, energy, trip cost and also prevent traffic congestion and traffic accident [13][14]. Besides, the application of TOD principles and compact city development are hoped to reduce goods and passangers mobility and number of private motor vehicles and to make massive public transportation effective, provide safe pedestrian route and also spatial urban palnning with transit oriented [16][17] and [11].

Vehicle oriented development around transit location is conducted by putting pedestrian, high density of residential building and the variety of buildings as priority [18]. It happens also for environment development around massive public transportation, it will be friendly to pedestrian, disability people, wheelchair users, and bicycle users by providing pedestrian route, crossroads which built in with garden and trees, they are comfortable and safe to be able to access shopping places which are closer than using motor vehicle[8]. The use of land in mixed and various ways with high density whether they are residential, jobs, shopping places and easy access to walk to transit location or transportation stops, reduction of parking area will boost citizen and commuters to travel by using public transportation facility instead motor vehicle. Therefore, it can decrease dependency for land [8][19]. This transportation problem happen due to the lack of transportation management and low quality of massive public transportation [20], another problem is massive public transportation facility is not available every time it is needed, it is not regularly available and it can not arrive and depart on time[21].

This Model of city development is a kind of compact and sustainable city [22]. Compact city with integrated land planning and transportation supported by policy and politic related with territory
development to have high quality and sustainable city, the increase of diverse function and high density of building and located in transportation center by prioritizing the mobility of non motor vehicle to reduce dependency on land use and cars [17]. Hence, it is important to improve the transportation management of land and sea transportation management to be better in integrated way and coordinated especially in the port area and its surroundings as transit location without traffic congestion and traffic accident. The improvement here means certainty of departure and arrival schedule for motor boat, comfortable and safe pedestrian route, open public space and enough green open space, efficiency of transportation cost. Open public space and enough green open space from those two ports are utilized together to make it efficient[20].

The mix of diverse land use planning happen and it complete each other among residential or housing with non-housing in the same block or closed block, society residential for low income can access the location of fresh food seller, less than ½ mile and it is completed with parking area [8]. Based on theory and existing condition of Kayu Bangkoa local port and coastal tourism port Fort Rotterdam, the writer assumed; spatial planning of coastal TOD based on port is very urgent to be developed to fasten the improvement of prosperity of citizen and commuter from small islands by applying principles; efficiency, accessibility, density, distance, and diversity.

Those negative effects can be reduced by encouraging growth of areas smartly, applying integrated spatial planning development model among land function, diverse land uses, high density of building, connectivity of pedestrian and people with disability and massive public transportation in friendly way around transit location such as port [23][25][24][11]. To improve spatial planning of coastal TOD to be better, to be able to eliminate redundance of cost, time and distance, it requires integrated overcoming and management of public infrastructure development as well as corporate patnership among few parties; goverment, private sectors and bussiness world, it is hoped it may impact on commuters to be able to create efficiency toward redundance of cost, time and distance, hence the price of goods and services will be under controlled [23] and [26]. This problem happen due to the lack of transportation management and low quality of masssive public transportation[20]. The other is inavailibility of massive public transportation when it is needed by the commuters, fixed schedule and also it doesnt depart and arrrive on time. The objective of this research is to identify land function, the potency of physical problem, the pattern and purpose of commuters trip from and to small islands around Fort Rotterdam for coastal TOD development.

2. Data and Methods

2.1 Modelling methodology

The research location is at western of Makassar city at Losari beach, its exact location is around Fort Rotterdam, Makassar as shown in this following figure 3 within radius about ½ mile from transit location includes several local ports: Kayu Bagkoa, Kayangan and the Association of boat sport dan water ski - Persatuan Olah Raga Perahu dan Ski Air (POPSA) marine tourism port. Kayu Bangkoa local port is dominated by commuters of households from small islands to shop for their basic needs in the mainland of Makassar. Kayangan or Benteng Pannyua marine tourism port is dominated by commuters ranging from teenagers and juvenille who will head to islands like Lae-lae. Kayangan and another small islands to visit their relatives or recreational activities. POPSA marine tourism port is used by the commuters from low end to middle end to have water sport such as swimming, water ski, diving, and snorkeling.
The data obtained in this research is pattern of commuter trip from and to small islands; Lae-lae, Samalona, Barang Caddi, Barrang Lompo and Kodingareng. Big redundancy experienced by commuters can be decreased if all the facilities of public services of shopping, sports and recreational put closer to ports around fort Rotterdam. Existing condition, building diversity, and building density around Fort Rotterdam - Figure 3 (a), (b), and (c).

Figure 3. (a) Existing Building Function Map around Fort Rotterdam, (b) Building Diversity Map, (c) Building Density Map. Source: Makassar City Spatial Planning, observation, processed, 2016

2.2 Methods
The data is collected through survey method and direct and random interview about commuters trip pattern from small islands to mainland of Makassar and vice versa. Data of function building is conducted through literature study and field survey within walking radius around ½ mile from ports or quay as transit location for sea transportation. Analysis technique used is expert system in figure 5 and set up the certainty factor (CF) in figure 6 for judgement based on geographic information system (GIS) to delineate areas in accordance to development principles of coastal transit oriented development (TOD) vertically and integrated related with efficiency, density, diversity and distance.
Figure 4. Export System
3. Result and Discussions
The following table is the result of fortran to determine the location to develop coastal TOD. This following map shows the location of existing TOD around Fort Rotterdam Makassar, in sequence; from north to the south in Figure 7, they are POPSA marine tourism port, Kayu Bangkoa local port, and Losari beach.
4. Conclusions

Land function around Fort Rotterdam is for shopping places, offices, residential, education, health, sports and recreational. Potency around Fort Rotterdam can support development of coastal TOD covers ports area, massive public transportation route of bus rapid transit (BRT) supported by transit stops and parking areas, and other area marine tourism, culture tourism, culinary tourism, Somba Opu shopping, hotels, restaurants, health facilities such as hospitals and drugstores. Physical problem found; generally, land and buildings around Fort Rotterdam are owned privately and individually. Trip pattern of commuters from small island to mainland of Makassar is generally done in the morning and the afternoon.

Development model of coastal TOD is recommended to build vertically, diverse, dense, integrated and bring closer the facilities of goods and services around TOD. Development principles of coastal TOD is to make the availability of land and buildings as the center of goods and services shopping which guarantee the price is same and under controlled, the availability of residential building, working places- education and health facility includes the availability of massive public transportation, fuel and clean water in the ports area around Fort Rotterdam effective. Based on distance and time, shows that TOD at three locations are needed to be developed. Commuters spend a lot of time and long distance to buy something. In order to increase the quality of TOD, some facilities have to be located near by TOD. POPSA local port around Fort Rotterdam used commuters from mainland of Makassar including tourist from hotels for having water sport activity and recreation at small islands around Makassar. Kayu Bangkoa local port is generally used by commuters from small islands to mainland of Makassar to fulfil their basic needs, yet the distance is quite far from TOD, hence it leads redundancy of time, energy and cost to happen. Losari beach is situated at collector road, around hotels, is used for beach recreation, culinary, and to small islands around mainland of Makassar (Lae-lae, Samalona, Kodingareng, Barrang Caddi, and Barrang Lompo).

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