Determining a Zoning Regulation based on Parking Vehicle Characteristics. A Circumstances in Kupang City, East Nusa Tenggara Province, Indonesia

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Abstract: Road network performance is usually influenced by trip attractiveness and parking characteristics. Their negative impact arrangements are stipulated in various laws and regulations but it only apply to large-scale types of activities, resulting in inadequacy of vehicle parking management. A change in building designation make it worst. This study investigates the effect of parking characteristics to road network performance and its possible consequences for determining zoning regulation. It was found that on-street parking decrease travel speed and road capacity. Moreover, although the planned parking index were suited to the minimum standardized parking space coefficient, but the existing parking index in some observed buildings were > 1.0. This indicates that standardized coefficient for buildings with improper planned and existing parking indexes needs to be modified, depending on their trip rate. Consequently, these should be added as new criterion and used as the basis for stipulating the zoning regulations.

Keywords: Building designation, existing parking index, land use plan, planned parking index, zoning regulation criteria

1. INTRODUCTION

Theoretically, a reduction in the effective width of the roadway due to on-street parking vehicles may affect road performance (Direktorat Jendral Bina Marga, 2023a). It was reported to be caused by the growth rate of the type, number and scale as well as the density of socio-economic activities (da Costa et al., 2019). The government has attempted to regulate strategies for controlling the negative impacts through various laws and regulations such as Law Number 29 of 2009, Government Regulation Number 30 of 2019, Minister of Transportation Regulation Number 17 of 2021 and the latest is Regulation Government of East Nusa Tenggara Number 8 of 2018 which basically regulates the traffic engineering strategy and management needed to minimize their impact. This arrangement is implemented through the obligation of the owner of the large-scale socio-economic business plan and/or activity to complete the Building Permit files with a Traffic Impact Analysis (TIA) document.

However, since these regulations only apply to a large-scale types of activities category the cumulative impact of a number of small to medium scale socio-economic activities concentrated on a particular road segment tends to be unmonitored. On the other hand, to avoid the obligation to prepare the TIA document, the developer usually slightly reduces the area and/or capacity of the planned business and/or activity so that it does not meet the mandatory TIA criteria. It was triggered by the relatively high cost of permits (accumulated costs for

preparing not only TIA, but also Environmental Impact Analysis / EIA documents).

This phenomenon was initially observed by investigating the impact of on-street parking on a number of fast-growing corridors in Kupang City. These corridors are predominantly filled with trading activities, supporting tourism (hotels and restaurants) as well as residential and educational or office facilities. It is assumed that these various activities grow and develop rapidly in line with population growth (consumers), growth in economic structure (public purchasing power) and lifestyle (consumptive culture). In addition, the pattern of land use along these corridors is indeed stipulated in the Spatial Plan product as a mixed area. The accumulation of various socio-economic activities may increase the trip attraction and/or generation. Unfortunately, the occurrence of on-street parking is triggered by inadequacy or even by the unavailability of off-street parking space. As a result, the travel speed and road capacity were decrease (Stella Belinda Kartika & Prahara, 2021; Tsakalidis & Tsoleridis, 2015). Therefore, in order to prevent the occurrence of similar mistakes, i.e. on-street parking due to the inadequacy in available off-street parking space and/or the absence of off-street parking space.

In addition, the results of field observations also indicate that a changes in building designation, for example: from a shop-houses into a restaurants or banking offices, also have an impact on the number of vehicle parking accumulation. Consequently, a reduction in the width of roadway not only may decrease road performance, including environment quality, but also increase traffic accident risk. These unintended impacts (scale of impacts or even the number of problems) may increase if the presence of a micro-zoning regulation is neglected.

These situations underlie the aim of this research, i.e., to identify the impact of the existing and planned parking indexes to the road network performance, and to analyze the strategic point obtained which may be use to consider an appropriate zoning regulation. The urgency of this research is relied on the need to provide a strong recommendation for improving the building permit mechanism, to ensure the increasing of road performance and environmental quality.

2. METHOD

According to the Technical Guidelines for Implementation of Parking Facilities in Indonesia (Winayati et al., 2019), parking space capacity could be assessed based on the following parameters:

2.1 Volume and Accumulation of Parking Vehicles

Parking volume is the number of vehicles parked in a parking lot for a certain time. To obtain it, a week survey (recording) of the number of each type of vehicle was carried out during peak hours period (9 hours/day). In addition, the dimension of each parking zones (for each type of vehicle) was also measured. Moreover, the type of parking must be differentiated (whether off-street or on-street parking). This parking volume data is used to describe the magnitude of the attractiveness of trips to the observed building units and/or locations of socio-economic activity. The higher the volume of parked vehicles, the higher the attractiveness of traffic generated.

Accumulation of parking vehicles is calculated by taking into account not only the number of parked vehicles (that were already in the parking lot before the recording process began), but also the number of vehicles entering as well as leaving the parking zone in each recording period displayed in units of vehicles per 15 minutes or vehicles/hour (Eq.1).

$$Parking\ Accumulation = Q_{exist} + Q_{in} - Q_{out} \quad (1)$$

where is:

Q_{exist} $= the\ number\ of\ vehicles\ in\ the\ parking\ lot, veh/hr$

Q_{in} $= the\ number\ of\ vehicles\ entering\ parking\ lot, veh/hr$s

Q_{out} $= the\ number\ of\ vehicles\ exiting\ the\ parking\ lot, veh/hr$

From Equation 2.1 it can be seen that the accumulated value of parked vehicles can be used to determine the ability of a parking lot to accommodate a total of vehicles in a certain time unit. Therefore, the types of parking vehicles must be distinguished in such a way that the total minimum parking space requirement for each type of vehicle can be determined proportionally.

2.1.1 Duration of parking

Parking duration describes the length of time of parked vehicle calculated using Equation 2. It influence the capacity of each parking zone and may trigger or has an impact on the on-street parking occurrence, resulting in disturbance to road capacity and vehicle speed (Direktorat Jendral Bina Marga, 2023b), air pollution (Djen & da Costa, 2014), and accident risk level (da Costa et al., 2017).

$$Parking\ duration = Ex_{time} - Ent_{time} \quad (2)$$

where is,

Ex_{time} $=$ the time the vehicle leaves the parking lot

Ent_{time} $=$ the time the vehicle entering the parking lot

2.1.2 Parking index

In this study, parking index values was classified into 2 (two) terms, i.e. the existing parking index and the planning parking index as follows:

1) Existing parking index

The existing parking index PI existing is the ratio of the total number of vehicles in each parking zone in a certain time unit (accumulation of parking vehicles) to the available parking area or the number in each parking zone calculated using Equation 3.

$$PI_{existing} = \frac{Accumulation\ of\ Used\ Parking\ Space}{Available\ Parking\ Space} \quad (3)$$

The accumulation of used parking space (m2) is multiplication result of the vehicle parking accumulation and Parking Space Unit (PSU), depending on type of vehicle, whilst the available parking space is multiplication result of parking length and width (m2). Thus, the accumulated number of parked vehicles must be converted to a unit square meter (m2), distinguished by their type because the PSU for each type of vehicle varies, depending on the dimensions of the vehicle in question as can be seen in Table 2.1 below.

Table 1 Vehicle parking space unit

No	Type of Vehicle	Dimension of parking space (Length x width)	Parking Space Unit / PSU (m^2)
1	Motorcycle	0,75 x 2	1,5
2	Light vehicle, group I	2,3 x 5	11,5
3	Light vehicle, group II	2,5 x 5	12,5
4	Light vehicle, group III	3 x 5	15

Source: Technical Guidelines for Implementation of Parking Facilities (Winayati et al., 2019)

2) Planning parking index

This study develops a new indicator to evaluate the parking capacity namely the planning parking index (PI planning) intended to describe the commitment of building managers/owners in providing a minimum parking space according to the standard parking space requirements (Eq. 4) for each type and scale of socio-economic activity as stipulated in the parking planning guidelines. This should be addressed because the results of field observations strongly indicate the impact of a limited parking space capacity, represented in on-street parking vehicles. This confirms that the minimum parking space criteria in the parking zone has not been met.

$$PI_{planning} = \frac{existing\ parking\ space\ dimension}{minimum\ standradized\ parking\ space\ area\ required} \quad (4)$$

The existing parking space dimension is the available parking space for each type of vehicle (m2), whilst the standardized parking space area is the multiplication result of a minimum PSU coefficient (Table 2) and number of PSU for light vehicle, depending on their effective floor area or number of students, beds or seats as regulated in the Parking Planning Technical Guidelines issued by the Directorate General of Land Transportation. It explains that the minimum PSU coefficient is determined by the scale of activities for each type of business plan and/or activity. Thus, the need for a minimum parking space in each building, especially one that experience a change in designation function can be compared and its impact can be precisely evaluated.

Table 2. Standardized parking space requirement

Building Utilization	Parking Space Unit/PSU Indicator	Parking Space Unit Coefficient
Trading Centre 1. Shops 2. Supermarket 3. Traditional market	PSU/100 m^2 effective floor area	3.5 – 7.5
Office Centre 1. Non-public services 2. Public services	PSU/100 m^2 effective floor area	1.5 – 3.5 1.5 – 3.5
School	PSU / number of students	0.7 – 1.0
Hotel	PSU / bed room	0.2 – 1.0
Hospital	PSU / bed	0.2 – 1.3
Cinema	PSU / seat	0.1 – 0.4

Source: Technical Guidelines for Implementation of Parking Facilities (Winayati et al., 2019)

It can be seen that the PSU efficiency is within a certain range or threshold. The lower threshold indicates the minimum standard of PSU requirement for a light vehicle type, whilst

the upper threshold represents the optimum condition. Thus, if the planned parking area is also allocated parking lots for other types of vehicles (2-wheeled or 6-wheeled) then the amount of the PSU needs to be converted to the PSU area of the intended conversion vehicle. The assessment of the performance and/or capacity of the existing parking lot must be adjusted to the composition of the types of parked vehicles. Consequently, the accumulation of parked vehicles should be differentiated based on vehicle type.

3. RESULT AND DISCUSSION

3.1 Parking Capacity in Each Type and Scale of Activity

The existing (available) vehicle parking space provided in the observed building's yard (Table 3). When the trip attractiveness is high, the over capacity of it triggers on-street parking surrounding. It shows that the existing parking space is influenced by the scale of activity. According to Indonesian Traffic Impact Analysis Guidance (Transportation Ministry, 2015), if it greater than 500 m2 (trade buildings), or greater than 100 seat (restaurant, school), or greater 50 bed (hotels) then it was categorized into large scale of activity, whilst if it between 200 to 500 then it is in a medium scale category level.

However, some Ruko have been change their function into a restaurant, or a bank office (noticed as to *) so that although their scale of activity within small category level but their trip attractiveness was greater than before. Ruko is an abbreviation of "rumah-toko" where is "rumah" is house placed on the 2nd floor whilst "toko" is shop placed on the first floor. This type of building increase very rapidly in Kupang City and could be easily found anywhere. This strongly indicates that every building utilization change should be confirmed to local authority so that they could advice suitable parking management policy to anticipate the unintentional negative impacts produced based on suitable minimum parking space coefficient for the new proposed activity.

Table 3. Parking zone characteristics based on scale of activity

No	Name of Building and/or Activity	Existing Parking Lot (m^2)	Effectiveness Floor Area (m^2)	Scale of Activity
A	Corridor of Oepura-Kuanino			
1	Glory Restaurant*	700	1632	Large
2	Matahari Store	60	180	Small
3	Murah Store	35	225	Medium
4	Group of Ruko in front of POLDA Office	36	108	Small
5	Central Hp	300	225	Medium
6	Gramedia Book Store and Borneo Bakery	80	225	
7	Sinar Bangunan Store	18	189	Small
B	Corridor of Tuak Daun Merah			
1	Hotel Amaris	740	324	Medium
2	Hyperstore + DIY minimarket	285	800	
3	Surya Bangunan store	105	600	Large
4	Sinar Bangunan store	1250	600	

No	Name of Building and/or Activity	Existing Parking Lot (m²)	Effectiveness Floor Area (m²)	Scale of Activity
5	Stella Gracia School	280	252	Medium
6	Bank BRI unit TDM*	252	252	Small
7	Bank Mandiri unit TDM*	105	180	
C	Corridor of Frans Seda			
1	Padang 2 Restaurant*	140	120	
2	Kentucky Fried Chicken*	210	120	
3	Pak Sadly Restaurant*	280	64	Small
4	Group of Ruko – BPN	140	108	Small
5	Group of Ruko – Princes	200	120	
6	Group of Ruko – Ohayo	200	120	
7	Group of Ruko – KFC	280	240	Medium
D	Corridor of Pit A Tallo			
1	Suka Ramai Restaurant	160	480	Medium
2	Bank Nasional Indonesia'46 Branch Office*	40	96	
3	Alfa Mart	80	80	
4	Group of Ruko – X_2	280	160	Small
5	Group of Ruko – Suka Roti	126	160	
6	Ruko – JJ	140	120	
7	Group of Ruko – Mitra	210	80	

3.2 Vehicle parking accumulation and road environment characteristic

Table 4 confirms that the accumulation of vehicle parking in each observed building is much influenced by their type and scale of activity, in accord with similar previous study (Cahyono et al., 2020). However, for the same type of activity, such as restaurant, it seems like the vehicle parking accumulation is might be more influenced by specific type of product offered such as the price, the taste, or even parking accessibility, or their road environment. This explain that trip attractiveness not only being influenced by the type and scale of activity but also by zone attractiveness. Therefore, it should be considered when approving a building license. Building within a great scale of activity or great attractiveness category level should be prohibited based on road environment condition, especially surrounding intersections, and current roadway capacity.

Table 4. The characteristic of vehicle's parking accumulation

No	Name of Building and/or Activity	Maximum Parking Accumulation (Vehicle/hour)	Location characteristics
A	Corridor of Oepura-Kuanino (secondary arterial roadway)		
1	Glory Restaurant*	100	Near unsignalized intersection and street vendors zone
2	Matahari Store	108	
3	Murah Store	116	
4	Group of Ruko in front of POLDA office	125	Near signalized intersection

No	Name of Building and/or Activity	Maximum Parking Accumulation (Vehicle/hour)	Location characteristics
5	Central Hp	84	
6	Gramedia Book Store + Borneo Bakery	87	Near signalized intersection, and trade centre
7	Sinar Bangunan Store	97	Near unsignalized intersection and trade centre, minor road is collector road
B	Corridor of Tuak Daun Merah (secondary arterial roadway)		
1	Hotel Amaris	57	Near unsignalized intersection (minor road is local road) and roundabout
2	Hyperstore + DIY minimarket	182	Two different types of stores with high volume of on-street parking, near trade centre
3	Surya Bangunan Store	130	On-street parking due to public transport and indiscipline private vehicles' drivers
4	Sinar Bangunan Store	141	
5	Stella Gracia School	255	Elementary, junior and senior high school located at the same zone
6	Bank BRI unit TDM*	99	Near unsignalized intersection, minor road is collector road
7	Bank Mandiri unit TDM*	89	
C	Corridor of Frans Seda (secondary arterial roadway)		
1	Padang 2 Restaurant*	119	
2	Kentucky Fried Chicken *	175	Near unsignalized intersection, minor road is local road
3	Pak Sadly Restaurant*	55	
4	Group of Ruko – BPN	25	
5	Group of Ruko – Princes	17	Near unsignalized intersection, school and office zone, minor road is local road
6	Group of Ruko – Ohayo	40	
7	Group of Ruko near KFC	74	
D	Corridor of Pit A Tallo (secondary arterial roadway)		
1	Suka Ramai Restaurant*	47	
2	Bank Nasional Indonesia'46 Branch Office*	67	Near hotel, bank office, trade and residence zones, minor road is local road
3	Alfa Mart	40	
4	Group of Ruko – X_2	68	Near unsignalized intersection and residence zones, minor road is local road
5	Group of Ruko – Suka Roti	14	
6	Ruko – JJ	13	Near unsignalized intersection, street vendors and residence zones, minor road is local road
7	Group of Ruko – Mitra	34	

3.3 Parking Index Characteristics

Parking index describes the level of parking space usage. Inadequate parking space explain the reason of on-street parking occurrence surround it in which decrease the effective width of roadway and may increase accident risk level. This study describes the characteristic of parking index for two conditions: 1) existing parking index and 2) planned parking index.

As previously described, the PI existing is a function of vehicle parking accumulation and parking space availability. If it was less than 1.0, then the available parking space is inadequate to accommodate the trip attraction and generation due to the type, scale and location's attractiveness. Therefore, existing parking index is used to describe the current level of parking index usage, whist the PL planning is a function of a minimum standardized parking space and

the availability of parking space. Accordingly, the PI planning is used to evaluate the suitable of available parking space with a minimum standard of parking space zone that should be provided by building owner, depending on the type and scale of activities offered. The following Table 5 below shows some interesting facts:

1. There are several inadequate parking space capacities due to a change in building utilization, i.e., from Ruko to restaurant, or bank office (*). Restaurant and bank office usually produce higher trip rate so that each changing of building utilization should be coordinated to local authority. In addition, 42.86% (12/28) of a total of 28 observed buildings require immediately handling because their existing and/or planned parking index are inadequate and unstandardized respectively. Meanwhile, around 21.43% (6/28) of parking zones should be monitored periodically due to their existing parking index greater than 0.75.
   These strongly indicate that negative impact due to on-street parking triggered by inadequacy in parking space capacity should be addressed and/or considered when determining a micro zoning regulation.
2. A change in building designation i.e., from Ruko to become Restaurant, or Bank Office significantly affect parking space capacity. Their trip attraction and/or generation is greater than before.
3. During the TIA assessment process, the use of maximum standardized parking space unit coefficient is strongly recommended for restaurant and bank office.
4. Parking space capacity is not only influenced by trip attractiveness due to type, number and scale of activities offered by each building but also by the duration of parking vehicles as indicated as follows:
   a) Although the duration of parking is relatively short but since the trip attractiveness is high, then the existing parking capacity is inadequate as can be seen in the Matahari department store.
   b) Vehicles' parking duration is much influenced by type of activity, predominantly by restaurant and trade centre.

Table 5. Recapitulation of the existing and planned parking index, and average duration of parking

No	Observed Buildings	Max. Park. Accum. (Veh/h)	Used Parking Area (m²)	Exist. Park. Lot (m²)	$PI_{Existing}$	Criterion: $PI_{existing} < 1.0$	Eff. Floor (m²)	Std. Parking Lot (m²)	$PI_{Planned}$	Criterion: $PI_{planned} > 1.0$	Average Duration of Parking (min)	Remark
A	Corridor of Oepura-Kuanino (Old corridor)											
1	Glory Restaurant *	99	673.5	700	0.96	ok	1632	714	0.98	un Std	57	required monitoring
2	Matahari Store	123	316.5	238	1.33	not ok	180	78.75	3.02	Std	18	immediate handling
3	Murah	136	369	175	2.11	not	225	98.43	1.78	Std	28	immediate

No	Observed Buildings	Max. Park. Accum. (Veh/h)	Used Parking Area (m²)	Exist. Park. Lot (m²)	PI Existing	Criterion PI existing < 1.0	Eff. Floor (m²)	Std. Parking Lot (m²)	PI Planned	Criterion PI planned > 1.0	Average Duration of Parking (min)	Remark
	Store					ok		75				handling
4	Group of Ruko in front of POLDA office	156	476	255	1.87	not ok	108	47.25	5.40	Std	44	immediate handling
5	Central Hp	55	203.5	400	0.51	ok	225	98.4375	4.06	Std	67	fair
6	Gramedia Book Store + Borneo Bakery	44	297	242	1.23	not ok	180	78.75	3.07	Std	34	immediate handling
7	Sinar Bangunan Store	23	171.5	60	2.86	not ok	144	63	0.95	un Std	28	immediate handling
B	Corridor of Frans Lebu Raya (TDM), New Corridor											
1	Hotel Amaris	33	288.5	455	0.63	ok	1234	231.375	1.97	Std.	55	fair
2	Hyperstore + DIY mini market	147	514.5	210	2.45	not ok	1267	237.563	0.88	un Std	64	immediate handling
3	Surya Bangunan Store	32	188	280	0.67	ok	1010	189.375	1.48	Std	44	fair
4	Sinar Bangunan Store	34	213	545	0.39	ok	1525	667.188	0.82	un Std	33	good
5	Stella Gracia School	26	333	600	0.56	ok	120	52.5	11.43	Std	39	good
6	Bank BRI unit TDM*	54	312	260	1.20	not ok	120	52.5	4.95	Std	48	immediate handling
7	Bank Mandiri unit TDM*	132	374	280	1.34	not ok	240	105	2.67	Std	43	immediate handling
C	Corridor of Frans Seda (New Corridor)											
1	Padang 2 Restaurant *	54	210	140	1.50	not ok	120	22.5	6.22	Std	55	immediate handling
2	Kentucky Fried Chicken *	78	601	210	2.86	not ok	120	22.5	9.33	Std	64	immediate handling
3	Pak Sadly Restaurant *	15	55.5	280	0.20	ok	64	12	23.33	Std	44	good
4	Group of Ruko – BPN	25	58	140	0.41	ok	108	47.25	2.96	Std	33	fair
5	Group of Ruko – Princes	81	154.5	200	0.77	ok	120	52.5	3.81	Std	39	required monitoring
6	Group of	41	179.5	200	0.90	ok	120	52.5	3.81	Std	48	required

No	Observed Buildings	Max. Park. Accum. (Veh/h)	Used Parking Area (m²)	Exist. Park. Lot (m²)	PI Existing	Criterion PI existing < 1.0	Eff. Floor (m²)	Std. Parking Lot (m²)	PI Planned	Criterion PI planned > 1.0	Average Duration of Parking (min)	Remark
	Ruko – Ohayo											monitoring
7	Group of Ruko near KFC	109	273.5	280	0.98	ok	240	105	2.67	Std	43	required monitoring
D	Corridor of Pit A Tallo (New Corridor)											
1	Suka Ramai Restaurant *	42	316	160	1.98	not ok	480	210	0.76	un Std	65	immediate handling
2	BNI'46 Branch Office *	28	108	40	2.70	not ok	96	42	0.95	un Std	77	immediate handling
3	Alfa Mart *	8	116	120	0.97	ok	80	35	3.43	Std	61	required monitoring
4	Group of Ruko – X_2	17	124.5	280	0.44	ok	160	70	4.00	Std	78	fair
5	Group of Ruko – Suka Roti	24	198	112	1.77	not ok	160	70	1.60	Std	44	required monitoring
6	Group of Ruko – JJ	12	51	140	0.36	ok	120	52.5	2.67	Std	54	good
7	Group of Ruko Mitra	17	80.5	140	0.58	ok	80	35	4.00	Std	44	fair

Note:

5. Although some Ruko that have been change into restaurant or bank office were categorised within a small scale of activity, but their trip attractiveness was high resulting in the inadequacy of existing parking space. Therefore, the technical standard of Traffic Impact Analysis should be rearranged by taking into account this unpredicted situation. Thus far, this was neglected, resulting in the absence of an appropriate off-street parking space. This strongly indicates that the future micro zoning regulation should consider not only the scale of each type of activity but also their number or density in a certain corridor, especially at vulnerable traffic congestion zone such as road intersection.

3.4 Interesting and Important Findings

3.4.1 The impact of limited parking space on road section capacity

A reducing in the effective width of roadway due to on-street parking not only reduce its capacity but also travel speed and the driver's visibility, thus triggering the possibility of an accident. On the other hand, a previous related research (da Costa et al., 2019) reported that the capacity of a road section is strongly influenced by the scale, the type, the number and the density of activities. This study found that even though the scale of the activity is relatively small, but if the number or density is large, then resulting in high trip attractiveness. Ironically, even though the accumulation of parking vehicles is large they don't have to provide off-parking space. Even, the results of field observations show that the activity space coincides with

pedestrian lanes (sidewalks). This increase pedestrian accident risk.

These facts should be established as the basis for setting more contextual zoning regulations. The contextuality must be seen through the arrangement of the type, number, scale and density activities that may exist and develop in a corridor. In turn, restrictions on the type, amount, scale and density of these activities can have a positive impact on improving the quality of the natural environment and the built environment in a sustainable manner.

3.4.2 Use of an appropriate PSU coefficient

Uniquely, even though the parking index has been planned to meet the required minimum parking space standard but the existing parking index value exceeds 1. This strongly indicates that the use of the appropriate parking space coefficient should be adjusted to the actual trip rate. This should be adopted by urban planners in determining the optimum parking area, and also needs to be used as a basis for granting principle permits for space utilization, especially in road corridors that are classified as fast-growing area.

3.5 The Implication of Study Result

3.5.1 Improvement of building construction and utilization control mechanism

The following efforts are proposed to minimized the possible occurrence of similar situation due to a change in building designation in the future:

1. The building owner should inform and/or confirm local authority because it may produce greater traffic attractiveness (trip attraction and generation). Accordingly, the impact of building designated to appropriate parking space dimension suited to actual parking space coefficient should be calculated precisely. As a result, it may confirm the requirement of additional parking zone and/or appropriate type of parking management.
2. The effective width of roadway at a certain corridor should be monitored regularly to ensure that: 1) there is no on-street parking due to inadequacy of available parking zone, 2) all parking space provided in building's yard has been fully utilized. However, if the on-street parking still occurs, then they should evaluate the cause and/or triggering factors behind it. Is it occurring due to in-discipline driving behaviour and/or due to the unpredictable trip attractiveness.
3. A change in building utilization during the operational stage should be controlled. The building owner should report the intention of it, pro-actively.

3.5.2 Controlling the building construction criteria based on the type of proposed building utilization

In general, three types of regulations are provided in a zoning ordinance with reference to "use", "height," and "area". The zoning ordinance should designate the official upon whom the duty or administration and enforcement shall devolve. They should be given power to grant building and occupancy permits, to make inspections, and/or to make all decisions necessary to a proper carrying out of its provisions.

Since most of arterial and collector secondary road network in Kupang City has been designed to be a mixed land used corridor, then un-controlled socio-economic buildings such as Ruko, hotel, restaurant, private and government offices or schools and street vendors have been spread out along the corridors, varying in not only the type but also the number, the scale of activity and its density; resulting in the increasing of not only the number as well as the

location distribution traffic congestion but also its frequency or duration of congestion.

On the other hand, building designer should determine the optimum parking space capacity based on appropriate standardized parking space unit coefficient and the zone attractiveness level. If it offers great scale of activity and is located nearby the high dense of existing socio-economic zone, then it should be calculated based on appropriate trip rate. This required further study, i.e., to analysis the correlation between scale of activity located on high dense zone and suitable parking space unit coefficient.

Subsequently, the government should limit the type, number, scale of activities on dense corridor such that socio-economic activities may distribute or spread out proportionally to other urban zones. It might distribute traffic volume and/or trip purposes significantly which in turn maintain the road network level of service as well as the environmental quality due to controlled vehicle's emission produced.

3.5.3 Improvement of zoning regulation criteria and/or concept

Zoning is a part of city or community planning, designed to promote and protect the health, safety, morals, convenience, prosperity, and general welfare of the inhabitants of the community. Usually, it should be uniform for each class or kind of buildings throughout each district, but the regulations in one district may differ from those in other districts (Advisory Committe on City Planning and Zoning of the U.S Department of Commerce, 1931). These statements strongly indicate that the presence of zoning regulation is a mandatory requirement. However, in Indonesia, the determination of zoning regulation was undertaken merely based on the aspect of land use suitability indicated by land use's bearing capacity regulated in land use planning products (Korlena et al., 2011). Consequently, until now, a zoning regulation in Kupang City cannot be implemented because the unavailability of the product of Technical Urban Land Use Planning. Even, the General Land Use Planning Product has not been upgraded since 2019.

This lack of urban planning management aspect could increase the intense of current problems and trigger the arising of derivative problems so that it should be anticipated and/or intervened by providing a discretion policy. For example, a mayor regulation as a basis of authority which strictly regulate the type of building that could be built, and/or determining the number as well as the scale of activity and/or the buildings' density in a certain corridor. This type of intervention could be classified as an interim zoning ordinance, in accord with the Advisory Committe on City Planning and Zoning of the U.S Department of Commerce (1931).

As the results of this study strongly indicate that trip attractiveness is much influenced by building's type, number and scale of activities, in accord with previous related reports (Advisory Committe on City Planning and Zoning of the U.S Department of Commerce, 1931; Karunagappally Town, 2018) as well as a change in building utilization, then the decreasing of natural and artificial environment qualities should be strictly controlled and evaluated periodically by a zoning commission formed based on mayor regulation, in accord with (Korlena et al., 2010, 2011). However, since zoning is not simply an engineering proposition and it includes many other professions, then it is hoped that by permitting, or limiting, or prohibiting the type, or number, or scale of activity, the road network performance could be integrated with the business oriented of buildings, or property and/or land owners. The possible benefit obtained from the improvement of zoning regulation criteria might produce better environment quality and socio-economic structure as mentioned above. Therefore, uses limitation should be given when the technical or environmental criterion are in warning categories whilst uses prohibition should be produced when the impacts are intolerable.

4. CONCLUSION

The conclusions that can be made from the results of this study are:

1. The use of appropriate parking space unit coefficient when determining the parking space capacity should be based on local trip rate, including when estimating the effect of a change in building designation.
2. The inadequacy of existing parking space capacity due to unstandardized planned parking index as well as the increasing of trip attractiveness due to the building designation strongly indicate that local authority should: 1) control the construction stage to ensure the presence of suitable parking space dimension based on the building's scale of activity, 2) monitor the effect of on-street parking due to inadequacy of the available parking capacity to the environment quality scale.
3. Since the influence of the number and density of activity locations from various types of socio-economic activities belonging to the small-medium scale also have a major impact on the cumulative travel attractiveness, this must be used as a basis for determining zoning regulations (limiting or even prohibiting building's type or number or scale of activity), especially in the strategic corridors of urban areas..

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