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Exploring Trip Chain Pattern Choices at Urban Relaxation Facilities: A Case Study of Lego-Lego in Central Point of Indonesia

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***Abstract*—Lego-Lego at Central Point of Indonesia (CPI) is one of the famous relaxation facility areas currently hosting numerous visitors, specifically on weekends. People tend to spend their time at the first multi-purpose facilities in the morning and afternoon, causing traffic congestion and long queues at the entrance and exit. Therefore, this study explored the trip chain activity pattern and behavior of visitors using the facilities provided in Lego-Lego. This study was considered necessary because the government and stakeholders need to understand the trip chain pattern choices preferred by the people to give infrastructure, manage traffic problems, and formulate relevant regulations. The data were collected through interview-based questionnaires randomly distributed to visitors and analyzed using a multinomial logistic regression model to determine individual and trip characteristics. The results showed the variables with significant impacts on the trip chain and the trip chain models for the morning and afternoon were similar. It was also discovered that the probability of selecting trip chain pattern 1 reduced as the time activity increased while the probability of selecting patterns 2, 3, and 4 increased. This indicated that time activity influenced the trip chain activity pattern, but the cost was not. Another important observation was that the greater the diversity of facilities influencing the activity-travel patterns, the more time was required to engage in the activities.**

***Keywords*—Trip chain; trip pattern; trip attributes; choices.**

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I. INTRODUCTION

Non-working or non-commuter trips, characterized by flexibility and unpredictable timing, contribute significantly to travel demand management challenges and urban transportation issues in developing countries [1]. These trips include shopping, visiting cafes, engaging in tourism, and more [2]. Unlike non-working trips, working trips have specific constraints and schedules that differentiate them from their leisure counterparts.

Makassar is one of the metropolitan cities with several tourist locations where family, friends, and relatives can relax. An example is Lego-Lego, located in Central Point of Indonesia (CPI) Makassar. This is the city's most famous tourist area, leading to consistent traffic congestion. Lego-Lego, one of the tourism trips, is preferred by several visitors due to the facilities [3]. This usually causes more congestion during weekends in both the morning and afternoon with subsequent traffic congestion and long queues. Moreover, the parking space on the street can reduce the access road width to the location [4].

The attraction to this site can cause critical problems unless the government implements some preventive actions. This was observed to have led to the implementation of traffic demand management (TDM) according to the trip activities [5]. TDM was based on several factors significantly influencing travel attractiveness, trip frequency, travel behavior, activity duration, and transportation mode prediction [6]. These were required to be considered in formulating policies to create sustainable transport.

The activity-travel behaviors of residents generally play an important role in transportation and urban planning toward reducing traffic congestion. This is necessary because the activities of residents are usually distributed in different places [7]. The record of movements between different destinations for various purposes within a day is known as a trip [8]. A previous study on travel demand showed that all the activities performed within a day are interconnected and form a series of daily activity chains. This led to developing

an activity-based travel model emphasizing the arrangement and sequencing of activities within a specific schedule [9].

This study examined the activity trip chain within the Lego-Lego facility, focusing on morning and afternoon visits. The main objective was to explore the variables significantly influencing the choice of trip chain patterns and estimate the probability of selecting different patterns based on trip attributes. The trip chain was initially identified using the activity schedules of visitors within the facility, starting from parking as the point of origin and concluding at the destination facility. Each facility was later categorized to determine the predominant trip chain patterns. Moreover, individual and trip characteristics were considered explanatory variables to analyze the factors influencing trip chain patterns using a multinomial logistic regression model [10], [11].

The analysis showed four categories of trip chain patterns for both morning and afternoon, and these were further assessed with due consideration for the trip attributes influencing the choice of visitors. Therefore, this study mainly contributed to two specific aspects: 1) variables significantly influencing the trip chain of individuals while using the facilities and 2) the probability of selecting trip chains based on certain influencing factors. This indicated the information was provided to enrich existing studies on activity trip chains [12], explicitly concerning specific activities in urban relaxation multi-purpose facilities [13]. The findings were also used to describe travel demand management comprehensively.

The remaining aspect of this study includes a description of the materials and methods in section two, followed by the presentation of results and discussion in section three and the provision of a conclusion in the last section.

II. Materials and Method

A. Study Area

This study was conducted in Makassar, the biggest city in South Sulawesi Province, Indonesia. It is one of the metropolitan cities with several tourist areas that attract visitors [14]. The city's most famous tourist area with multi-purpose facilities is CPI, designated as the Midpoint of Indonesia and is observed to be located in the delta and coastal area. CPI has several facilities, business centers, tourism, education, and settlements. The infrastructure and total area were planned by the Makassar City Master Plan to position the city strategically both nationally and internationally that projection from land use in the surrounding urban area [15]. The part of CPI that visitors often visit is Lego-Lego. Moreover, the name “Lego-Lego” was derived from the part of a traditional house of the Bugis ethnic, the principal tribe inhabiting the South Sulawesi area. The name was used explicitly for the vast terraces before the entrance of most traditional houses and was usually used by people to interact with their family and friends. This means Lego-Lego represents an extensive place designed for relaxation in the urban society of Makassar. The total land area for CPI was 157,23 hectares, while the aspect used for Lego-Lego is presented in Fig. 1.

In the master plan, the CPI area was described as the Garuda bird, which was the State Symbol of Indonesia. Lego-Lego was in the eastern wing of the bird and was first entirely constructed instead of the other parts of the tourism area [16]. The area provided facilities for relaxation as well as other multi-purpose functions such as the food court (1), courtyard (2), playground (3), rest area (4), and sports center (5), as indicated in Fig. 2.

Fig. 1 Master Plan for the Center Point of Indonesia (Lego-Lego)

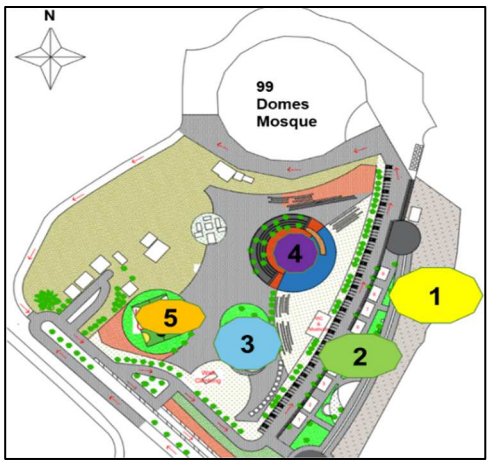

Fig. 2 The relaxation facilities zone in Lego-Lego

The activities conducted mainly by the visitors in these facilities include culinary in the food court, enjoying the sunset and hanging out with relatives in the courtyard, kids’ activities in the playground, sports activities such as wall climbing, playing basketball, jogging using the track, walking, cycling, and others, and resting in the rest area with several benches provided. These facilities are close to each other and accessible by walking. It was discovered that most visitors engaged in different activities using all the facilities in Lego-Lego.

Lego-Lego is the closest area to the main gate of CPI, thereby influencing the traffic of vehicles within the premises. This means there is a need to understand the demand for travel and activities in the area to reduce the traffic congestion often experienced, specifically during weekends.

This study focused on the total inter-zone-shaped trip chain conducted within the facilities using a travel diary survey. The key factors related to individual and trip characteristics were analyzed and used to develop a model to select the optimal travel chain when utilizing facilities in Lego-Lego area. Meanwhile, the trip was not included in the travel mode due to the consideration of the distance between the facility as the destination and the parking space as the starting place [17], [18].

B. Data Collection

Data was collected from interviews through a questionnaire. The process involved the on-site distribution of the questionnaires to randomly selected respondents based on the zone of the facilities. The respondents were asked to fill out the questionnaire individually by providing basic information related to their trip to the inter-zone facilities of Lego-Lego in the morning and afternoon. The survey was conducted on Monday, July 12, 2020, based on the total peak visits recorded in previous weekends from July 3 to 4. The morning period started from 06.00 – 10.00 CIT (Central Indonesian Time) zone and the afternoon period from 16.00 – 20.00 CIT. The total number of visitors counted on Saturday is presented in Fig. 3.

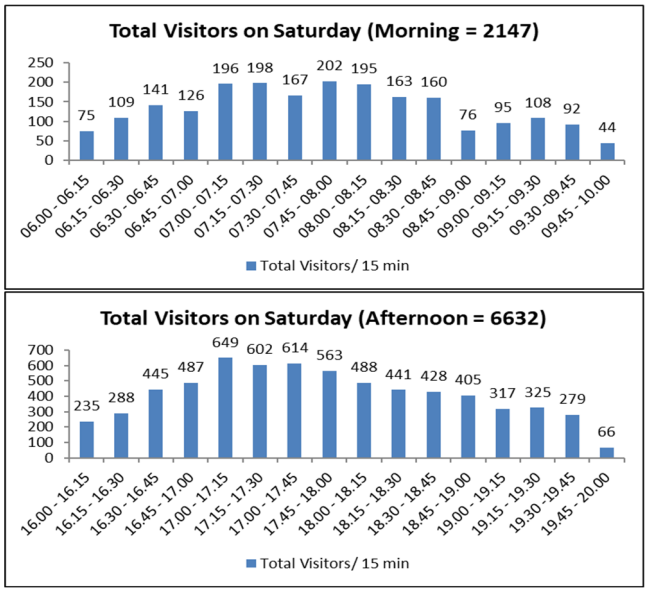

Fig. 3 The total number of visitors during the Morning and Afternoon on Saturday

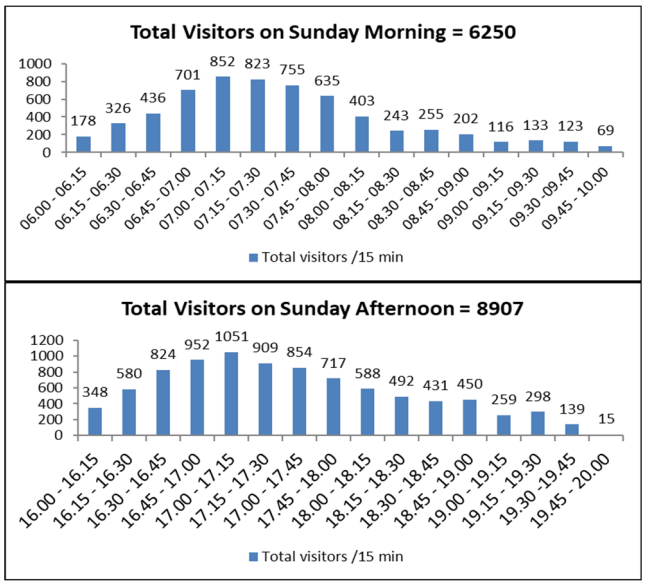

Fig. 4 The total number of visitors during the Morning and Afternoon on Sunday

The visitors were counted every 15 minutes to determine the total number in the morning time. The findings showed that the 6632 visitors counted on Saturday afternoon were more than 2147 recorded in the morning. Moreover, the peak number on Saturday was found to be 649 at 17.00 – 17.15 CIT.

A similar trend was also found on Sunday and the peak number of visitors was recorded as 1051 in the afternoon, as indicated in Fig. 4. Therefore, the total number of visitors in the morning and afternoon was used as the population for the study while the total sample size was determined for an infinite population using the following equation [19].

$$S = Z^2 x\ p\ x\ \frac{(1-p)}{m^2} \quad (1)$$

where S is the sample size for an infinite population, Z is the value of confidence level determined as 95% = 1,960, and m is the margin error of 5% = 0,05. Moreover, the formula for adjusted sample size is generally presented as follows [20].

$$S = \frac{S}{1+[\frac{(S-1)}{population}]} \quad (2)$$

The population used was 15.175 based on the total visitors counted on the peak day, Sunday. This was further used to determine the minimum sample, which was 374,6 or 375 visitors. Meanwhile, 1218 respondents participated in the survey conducted on July 4, 2020, including 843 in the morning and 375 in the afternoon. The information retrieved through the questionnaires was used to develop the model.

C. Questionnaire Design

The questionnaire was divided into sections focusing on the respondents' individual and trip attributes. The individual attributes include gender, age, occupation, education, income in Indonesian Rupiah (IDR), and vehicle ownership. These were further categorized into man and woman for gender, 9-22, 23 – 36, 37 – 50, and above 51 years for age, student, private employer, military or police, public official, entrepreneur, politician, retired, and others for occupation, primary school, middle, high, bachelor, masters or doctorate for educational qualification, below 1,600,000 to above 5,900,000 for income, and 1 to 4 units of motorcycles and cars for vehicle ownership.

The trip attributes were focused on the origin, participants, mode of transport, number of accompany, cost (alone and group), and time. In this case, the time was the total time required for the activity in each facility and recorded in the time diary sheet. This was further used to determine the trip chain and patterns formed using the facilities. The process was based on the chain of using each facility by counting from the parking to the moment the visitors walk to each facility. This led to categorizing the pattern choices available to the visitors into four major clusters. The first was from the parking to Facility 1, the second was from the parking to Facility 1 to Facility 2 and back to the parking space, the third involved three facilities, and the last cluster focused on four facilities. These trip chain patterns were included in the choice available to the visitors and also used as the main variables [21], [22], [23], [24], [25].

D. Study Instruments and Variables

The questionnaire was a popular study instrument in Bali for coastal areas [26]. It was applied in this study to collect data on independent and dependent variables associated with individual characteristics, trip characteristics, and trip chain patterns. The variables and categories used are presented in

the following Tables 1 and 2. The variables have nodes with X for each category specific to independent variables and trip chain as independent variables notation with Y.

TABLE I
INDEPENDENT VARIABLES

I. Individual Characteristics			
No	**Variables**		
X1.	Gender	X2. Age	X3. Occupation Field
X4.	Education	X5. Income (IDR)	X6. Car Ownership
X.7	Motorcycle Ownership		
I. Trip Characteristics			
X8.	Origin	X9. Participation	X10. Transport Mode
X11.	Number of accompany	X12. Cost (Alone)	X13. Cost (Group)
X14.	Time Duration		

TABLE II
DEPENDENT VARIABLES

No	Variables		
Y1.	Trip Chain Pattern	1. Pattern 1 3. Pattern 3	2. Pattern 2 4. Pattern 4

E. Methodology

This study aimed to determine the significant variables of the individual and trip characteristics and to create the trip chain pattern choice for urban relaxation facilities. The activities of a visitor were conceptualized as a series of connected trips, forming a trip chain. Making decisions regarding the sequence of activities within the chain was typically a multi-choice problem. Moreover, during the implementation of the trip chain, each decision made by the visitor regarding the facility to visit first and the time to allocate to each activity contributed to the formation of a unique chain pattern. This means the objective of this study can be effectively addressed by employing a multinomial logistic model, which is well-suited for examining the complexities above and the challenges associated with trip chains [27], [28].

Multinomial Logistic Regression (MNL) is a common discrete choice model widely used to study multiple-choice problems based on random utility theory. It was developed on the assumption that an individual will prefer an alternative travel plan with maximum utility. In the context of travel behavior and mode choice, the utility of each alternative was determined through the following equation [29]:

$$U_{nj} = V_{nj} + \mathcal{E}_{nj} \quad (3)$$

where, V_{nj} is the observed aspect known as the deterministic portion and $\mathcal{E}_{nj}$ is the unobserved aspect referred to as the stochastic portion.

In addition to MNL, a Modeling Conditional Logistic (MCL) was also applied to generate the model through some additional attributes by applying the following equation (4) [30]:

$$P_i = \frac{e^{-\beta_1 X_{1i} - \beta_2 X_{2i} - \beta_3 X_{3i} + \beta_0}}{e^{-\beta_1 X_{1i} - \beta_2 X_{2i} - \beta_3 X_{3i} + \beta_0} + e^{-\beta_1 X_{1j} - \beta_2 X_{2j} - \beta_3 X_{3j} + \beta_0}} \quad (4)$$

Where x_{nj} is the vector of observed variables representing the attributes, β_l is the parameter of x_{nj} to be estimated, and β_0 is a specific constant of the model.

Four trip chain pattern choices were developed in this study and tagged Pattern 1, Pattern 2, Pattern 3, and Pattern 4. The factors influencing these patterns were investigated and this was followed by the application of the MNL model to create the probability for the selection of a trip pattern and determine the significant variables [31], [32]. Moreover, the process to select a trip pattern was modeled using the MCL model with due consideration for the trip attributes [33]. It was pertinent to note that the MNL and MCL modeling's were conducted using the statistics program *STATA 16.0*. This is an econometric tool used to calculate parameters for discrete choice model.

III. RESULTS AND DISCUSSION

The descriptive information of the respondents presented in the following Table 3 showed that the gender was almost balanced as indicated by 52,46% male and 47,54% female. Meanwhile, the age variable was dominated by those between 9 – 22 years with approximately 44,58%, the education variable was mostly High School certificates with 55,99%, and income was mostly under IDR 1,600,000. On the car ownership variable, the findings showed that the majority, represented by 58.13%, had 0 cars while 59,28% had a minimum of 1 motorcycle.

TABLE III
INDIVIDUAL CHARACTERISTICS

No	Individual Variables	Categories
1	Gender	Male (52.46%), Female (47.54%)
2	Age	9-22 (44.58%), 23-36 (38.75%), 37-50 (12.81%), and Above 51 (3.86%)
3	Occupation Field	Student (46.14%), Private employer (18.56%), Military/ Police (2.71%), Public Official (12.48), Entrepreneur (10.59), Politician (0.33%), Retired (1.07%), Other (8.13%)
4	Education	Primary School and below (0.74%), Middle School (5.67%), High School (55.99%), Bachelor degree (23.89%), Master/Doctor (13.71%)
5	Income (IDR)	Under 1,600,000 (50.08%), 1,600,000 – 2,300,000 (5.91%), 2,400,000 – 3,00,000 (7.55%), 3,100,000 - 3,700,000 (9.85%), 3,800,000 – 4,400,000 (7.64%), 4,500,000 – 5,100,000 (7.88%), 5,200,000 – 5,900,000 (4.60%), Above 5,900,000 (6.49%)
6	Car Ownership	0 (58.13%), 1 (28.98%), 2 (10.02%), 3 (2.55%), 4 (0.33%)
7	Motorcycle Ownership	0 (16.83%), 1 (59.28%), 2 (17.16%), 3 (5.91%), 4 (0.82%)

The trip attributes used to determine the significant variables influencing the chain pattern are presented in Table 4. It was discovered that most of the respondents, 88,51%, came from their homes to Lego-Lego. Furthermore, a significant majority, 76,03%, reported either participating in a group or having relatives present during their visit. Regarding transportation mode, motorcycles were the most commonly used means with approximately 50%, followed by car usage at 29,64%. When considering the number of

accompanying participants during the visits, the data indicated that the total number of individuals, including the respondents, was considered. The analysis showed that most visitors arrived in groups of at least two people, as indicated by 30,95% of the sample.The cost incurred by single visitors during the visit was estimated to be mostly IDR 1.700, or 14.37%, while a group had IDR 5.400, or 25,78%. As the activities varied between morning and afternoon, the duration was also significantly different. During the morning, the visitors predominantly engaged in sports activities such as jogging, walking, basketball, cycling, and more. However, during the afternoon and evening, the focus shifted towards enjoying the sunset and leisurely hangouts.

TABLE IV
TRIP CHARACTERISTICS

No	Trip Characteristics	Categories	
1	Origin	Home (88.51%), Office (0.57%), School (0.25%), Campus (2.22%), Mall (1.64%), Relatives Home (2.87%), Other (3.94%)	
2	Participation	Alone (23.97%), Group (76.03%)	
3	Transportation Mode	Bike (8.54%), Motorcycle (50.00%), Car (29.64%), Motorcycle (Online) (2.46%), Car (Online) (2.22%), Public Transport (0.57%), Walking (4.93%), Other (1.64%)	
4	Number of Acc.	1 (23.97%), 2 (30.95%), 3 (15.52%), 4 (12.89%), 5 or above (16.67%)	
5	Cost/ IDR (Alone)	0 (28.41%), 900 (7.47%), 1700 (14.37%), 2500 (16.42%), 3300 (9.93%), 4100 (8.78%), 4900 (4.02%), 5400 (10.59%)	
6	Cost/ IDR (Group)	0 (37.60%), 900 (3.04%), 1700 (4.60%), 2500 (7.39%), 3300 (7.39%), 4100 (7.31%), 4900 (5.25%), 5400 (25.78%)	
7	Time Activities (minutes)	Morning	Afternoon
	Below 120	69.40%	18.40%
	Below 240	29.89%	44.53%
	Below 360	0.71%	28.27%
	Above 360	0.00%	8.80%

In addition to individual and trip attributes, another constraint for the dependent variables was the trip chain. Therefore, the trip chain patterns describing the movements of the visitors are presented in the following Table 5.

TABLE V
TRIP CHAIN CHARACTERISTICS

No	Chains Attributes	Proportion (%)	
1	Trip Chain Pattern	Morning	Afternoon
	1	25.94	7.06
	2	24.88	10.59
	3	14.04	7.31
	4	4.35	5.83

The trip chain pattern captured the movement and utilization of facilities by visitors. Each visitor's trip was recorded, and the total number of trips was documented. The trip started from the designated "parking" area and then included every facility visited. The patterns used in this study are indicated as follows:

- Parking – Facility 1 – Parking as Pattern 1
- Parking – Facility 1 - Facility 2 – Parking as Pattern 2
- Parking – Facility 1 - Facility 2 – Facility 3 – Parking as Pattern 3
- Parking – Facility 1 – Facility 2 – Facility 3 – Facility 4 and more as Pattern 4

These patterns were used to analyze the variables influencing individual and trip attributes, and their level of significance.

A. Variable Significance Analysis

In the significance analysis step, all variables were measured, and the results are presented in Table 6. The analysis was conducted using Multinomial Logistic Regression (MNL) with fourteen independent variables (X1-X14) for the trip chain pattern. It was discovered that the morning and afternoon activities exhibited different schemes but followed the same pattern of rules. The significance of variables for the morning pattern can be observed in the following Table 6.

TABLE VI
THE RESULTS OF VARIABLE SIGNIFICANCE ANALYSIS FOR THE MORNING TRIP CHAIN

Variables	Coef.	p > |Z|	Coef.	p > |Z|	Coef.	p > |Z|
Base Category				**Pattern 1**		
Category		**Patten 2**		**Pattern 3**		**Pattern 4**
Gender (X1)	0.009	0.056**	-0.127	0.540	-0.141	0.658
Age (X2)	0.004	0.022*	0.006	0.086**	0.003	0.890
Occupation (X3)	-0.058	0.793	-0.110	0.686	0.364	0.376
Education (X4)	0.171	0.068**	0.221	0.048*	0.320	0.080*
Income (X5)	0.000	0.052	0.000	0.225	0.000	0.155
Car Own. (X6)	-0.036	0.773	-0.346	0.036*	-0.001	0.996
Motorcycle Own. (X7)	-0.147	0.220	0.018	0.900	-0.024	0.918
Origin (X8)	-0.087	0.160	-0.211	0.021*	-0.139	0.259
Participation (X9)	-0.225	0.083**	0.160	0.025*	0.553	0.066**
Transp. Mode (X10)	0.012	0.832	0.094	0.150	0.077	0.434
Num. of Acc. (X11)	-0.017	0.067**	-0.060	0.402	0.073	0.054**
Cost Alone (X12)	0.000	0.012*	0.000	0.071**	0.000	0.041*
Cost Group (X13)	0.000	0.039*	0.000	0.007*	0.000	0.099**
Time duration (X14)	0.006	0.005*	0.013	0.000*	0.015	0.000*
_cons	-0.665	0.322	-2.903	0.001	-4.780	0.000
The number of obs.				843		
Prob > chi2				0.0000		
Pseudo R2				0.7773		

Notes:
* Significance level 95%
** Significance level 90%

According to the results in Table 6, the significance level of all the patterns determined using MNL was found to be sufficient. The likelihood ratio indicator, pseudo $R^2 = 0.7773$, showed that 77.75% of the independent variables influenced the dependent variables. Moreover, the interval of acceptance value with $p > |Z|$ indicated that the significance level of the variables was in the range of 90%-95%. The Prob>chi2 value was also recorded to be 0.0000 and this showed that the variables considered significantly affected the patterns. Meanwhile, the results indicated that some independent variables considered in the estimation did not have a significant effect on each pattern. For Pattern 2, the variables with 95% significance level were found to be age, cost (alone), cost (group), and time activities while those with 90% were gender, education, participation, and number of accompanying members. For Pattern 3, the variables with 95% significance level were education, vehicle ownership, origin, cost (group), and time activities while those with 90% were age and cost (alone). For Pattern 4, variables with 95% were education, cost (alone), and time activities while those with 90% were number of accompanying members and time activities. This showed that gender, age, education, income, participation, the number of accompanying members, and time activities were the variables with significant influence on all the patterns while only 5% was associated with other factors.

In terms of activities, the trip chain pattern was found to have a quite different influence on the variables for afternoon activities as presented in Table 7. According to the results, the significance level of all the patterns determined using MNL was found to be sufficient. The likelihood ratio indicator, pseudo $R^2 = 0.6410$, showed that 64.10% of the independent variables influenced the dependent variables. Moreover, the interval of acceptance value with $p > |Z|$ indicated that the significance level of the variables was in the range of 90%-95%. The Prob>chi2 value was also recorded to be 0.0000 and this showed that the variables considered significantly affected the afternoon patterns.

TABLE VII
THE RESULTS OF VARIABLE SIGNIFICANCE ANALYSIS FOR THE AFTERNOON TRIP CHAIN

Variables	Coef.	p > |Z|	Coef.	p > |Z|	Coef.	p > |Z|
Base Category				**Pattern 1**		
Category		**Patten 2**		**Pattern 3**		**Pattern 4**
Gender (X1)	-0.05	0.086**	-0.091	0.760	-0.023	0.044*
Age (X2)	0.03	0.216	0.027	0.097	0.050	0.091**
Occupation (X3)	0.80	0.053**	0.303	0.406	1.056	0.014*
Education (X4)	-0.19	0.343	-0.216	0.246	0.150	0.479
Income (X5)	0.00	0.068**	0.000	0.013*	0.000	0.683
Car Own. (X6)	0.27	0.212	0.260	0.068**	0.061	0.776
Motorcycle Own. (X7)	-0.33	0.07*	-0.169	0.343	-0.160	0.014*
Origin (X8)	-0.08	0.341	-0.006	0.937	0.071	0.368
Participation (X9)	0.05	0.937	1.093	0.056**	-0.656	0.247
Transp. Mode (X10)	-0.11	0.446	-0.030	0.801	-0.093	0.503
Num. of Acc. (X11)	0.02	0.020*	-0.050	0.044*	-0.039	0.076**
Cost Alone (X12)	0.00	0.036*	0.000	0.078**	0.000	0.081**
Cost Group (X13)	0.00	0.043*	0.000	0.034*	0.000	0.07**
Time duration (X14)	-0.01	0.000*	0.003	0.03*	0.005	0.001*
_cons	1.19	0.421	-2.682	0.057	-2.163	0.149
Number of obs				843		
Prob > chi2				0.0000		
Pseudo R2				0.6410		

According to the findings, not all the variables considered had a significant influence on all the afternoon patterns. For example, the variables with a 95% significance level in Pattern 1 were vehicle ownership (motorcycle), number of accompanying members, cost (alone), cost (group), and time activities while those with 90% were gender, occupation, and income. For Pattern 3, those with a 95% level were vehicle ownership, number of accompanying members, and cost (alone) while 90% was recorded for income, number of family members, cost (group), and time activities. For Pattern 4, the variables with 95% level of significance were gender, occupation, vehicle ownership, and time activities while those with 90% were age, number of family members, and cost (alone). This showed that the variables with significant influence on all the patterns were gender, age, occupation, education, income, vehicle ownership (motorcycle), and participation while only 5% were linked to other factors.

The variables with the most significant effect on the trip chain have been previously identified to include distance, time, and cost [34]. Another study conducted in developing country, also showed that the trip chain choice of individual trips was mostly influenced by individual characteristics such as age and gender [35]. The consideration of these findings and several other relevant studies [36], [37], [38]. led to the adoption of cost and time as the attributes to be used in the next modeling of the trip chain pattern in line with the scope of this study.

B. Trip Chain Pattern Model

The trip chain model for morning activities with four trip patterns, two trip attributes, and five independent variables is presented in the following Table 8. According to the parameter estimation of the model in Table 8, the cost was found not to have a significant influence on the trip chain pattern as indicated by the P>|Z| value of 0.357.

TABLE VIII
THE TRIP CHAIN PATTERN MODEL IN THE MORNING

Variables	Coef.			P>|Z|		
Attributes						
Cost (X12)	-0.0017845			0.357		
Time (X14)	-0.0002975			0,000		
Base Category	Pattern 1					
Category	Pattern 2		Pattern 3		Pattern 4	
Variable	**Coef.**	**P>|Z|**	**Coef.**	**P>|Z|**	**Coef.**	**P>|Z|**
Independent						
Gender (Male) (X1)	0.079	0.658	0.186	0.090*	0.139	0.662
Age (X2)	0.006	0.539	0.009	0.462	-0.001	0.040*
Education (Bachelor) (X4)	0.219	0.320	0.365	0.170	0.568	0.151
Income (X5)	0.000	0.074**	0.000	0.022*	0.000	0.039*
Participation (Group) (X9)	-0.625	0.09*	0.017	0.970	-0.624	0.041*
Number of acc. (2) (X11)	0.046	0.060**	0.016	0.043*	-0.013	0.084**
_cons	-0.827	0.039	-2.475	0.000	-3.520	0.000
Prob > chi^2	0,0000					
Total Obs_	3372					
Total Case	843					

Using Pattern 1 as a base category, it was also discovered that there was no simultaneous relationship between cost and trip chain pattern. This showed that visitors tended to avoid the pattern with the long chain trip and high cost as indicated by the (-) sign in the coefficient. Meanwhile, time was observed to have a significant effect on the trip chain pattern as indicated by the P>|Z| value of 0.000 with a (-) sign. This showed that visitors had the tendency to avoid longer trip chains as the duration of activities increased.

The variables with a high level of significance in Pattern 2 were income, participation, and the number of accompanying members. According to the results, the participation variable had a (-) sign and this showed that visitors visiting as groups preferred Pattern 1 over Pattern 2. Meanwhile, the number of accompanying members with a (+) sign indicated that a group of visitors with less than 2 members preferred Pattern 2 over Pattern 1. Based on income, individuals with higher incomes were observed to have a tendency to select Pattern 2.

The choice model for Patterns 3 and 4 was found to be quite similar. In Pattern 3, the significant variables were gender, income, and the number of accompanying members. The males were found to have a tendency to select Pattern 3 over Pattern 1 as indicated by the (+) sign. Moreover, those with more income also preferred Pattern 3 to Pattern 1and a similar trend was further observed for groups of visitors with more than two people. For Pattern 4, the significant variables were found to be age, income, participation, and the number of accompanying members. The coefficient for age had a (-) sign and this showed that the visitors preferred Pattern 1 to Pattern 4. Meanwhile, income and number of accompanying members variables had a (+) sign, indicating the preference for Pattern 4 over Pattern 1. The trip chain patterns for the afternoon activities were also modeled and presented in the following Table 9.

TABLE IX
THE TRIP CHAIN PATTERN MODEL IN THE AFTERNOON

Variables	Coef.			P>|Z|		
Attributes						
Cost (X12)	-0,0004115			0.772		
Time (X14)	-0,0003833			0,000		
Base Category	Pattern 2					
Category	Pattern 1		Pattern 3		Pattern 4	
Variable	**Coef.**	**P>|Z|**	**Coef.**	**P>|Z|**	**Coef.**	**P>|Z|**
Independent						
Gender (Male) (X1)	0,037	0,914	-0,221	0,058*	-0,002	0,096**
Age (X2)	0,037	0,071**	-0,019	0,018*	-0,007	0,024*
Occupation (Student) (X3)	-0,813	0,088**	0,502	0,072**	0,333	0,059**
Education (Bachelor) (X4)	-0,314	0,516	0,077	0,884	0,767	0,178
Income (X5)	0,000	0,441	0,000	0,659	0,000	0,336
Motorcycle Own (X7)	-0,177	0,372	0,169	0,429	0,041	0,855
Number of acc. (<2) (X11)	-0,051	0,536	-0,029	0,039*	-0,080	0,017*
_cons	-0,014	0,988	-1,984	0,065	-2,901	0,015
Prob > chi^2	0,0000					
Total Obs	1500					
Total Case	375					

According to the parameter estimation model, the total cost was not significantly affected by the trip chain pattern as indicated by the P>|Z| value of 0.772. This showed that the visitors tended to avoid the patterns with long trip chains or negative (-) coefficients. Meanwhile, time was observed to have a significant effect on the trip chain pattern as indicated by the P>|Z| value of 0.000 with a (-) sign. This showed that visitors had the tendency to avoid longer trip chains as the duration of activities increased.

On the choice of trip chain models, Pattern 2 was used as the base category and it was discovered that the significant variables of Pattern 1 were aged (+) and occupation (student) (-). This showed that older visitors prioritized Pattern 1 over Pattern 2 while students had the tendency to select Pattern 2 over Pattern 1. Meanwhile, Pattern 3 showed a positive coefficient for gender, indicating that males were more likely to choose Pattern 2 over Pattern 3. Furthermore, as age increased, there was a higher likelihood of selecting Pattern 2 over Pattern 3. Interestingly, students displayed a higher preference for Pattern 3 compared to Pattern 2, etc.

Lastly, Pattern 4 was observed to be significantly affected by gender, age, occupation, and the number of accompanying members. The males exhibited the tendency to select Pattern 2 over Pattern 4. It was also discovered that older visitors preferred Pattern 2 over Pattern 4 while the group of visitors with more than 2 people tended to select Pattern 2 over the Pattern 4.

C. Sensitivity of Time Activities in Trip Chain Patterns

The sensitivity was measured to further explore the changes in the variables influencing the probability of choice for the patterns. The process involved using a statistics program to calculate the proportion of probability to select each type of pattern. The result showed that the probability to select Pattern 1 was approximately 37.40%, Pattern 2 was 35.90%, Pattern 3 was 20.38%, and Pattern 4 was 6.32%. These were further analyzed using the time activities attribute by increasing the time scenario from 50 minutes to a maximum of 500 minutes, and the findings are presented in the following Fig. 5.

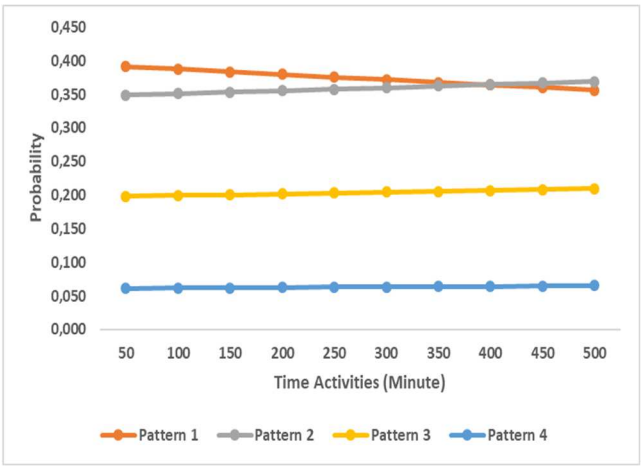

Fig. 5 The sensitivity of time activity in relation to the morning patterns

According to Fig. 5, the probability of selecting Pattern 1 decreased as the duration of activities increased. An increase in the duration of activities by 50 minutes reduced the probability of selecting Pattern 1 by an average value of 0.39%. Meanwhile, the preference for Patterns 2, 3, and 4 increased with an average value of 0.22%, 0.13%, and 0.02%, respectively, when the duration or time of activities increased.

A similar method was applied to determine the sensitivity during the afternoon and the results are presented in the following Fig. 6. It was discovered that the probability to select Patterns 1 to 4 was averagely 22.66%, 34,63%, 23.64%, and 19.07%, respectively. This was observed to be different from the trend in the morning. The probability to select Pattern 1 decreased by 0.23% while Patterns 2, 3, and 4 increased by 0.09%, 0.07%, and 0.06%, respectively, when the duration of activities was extended. It was also shown that the trip chain pattern choices are increased simultaneously with time activities of visitors in Lego-Lego.

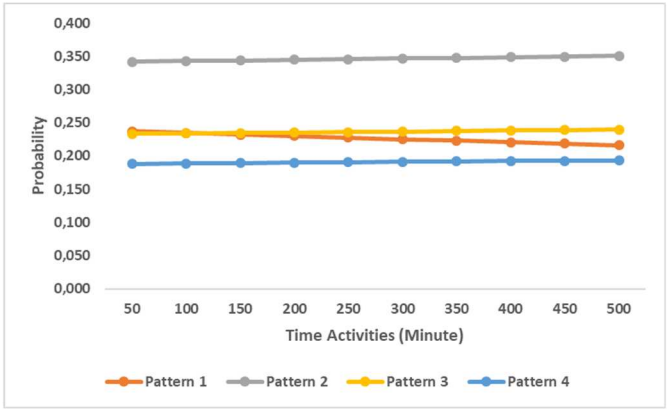

Fig. 6 The sensitivity of time activity in relation to the afternoon patterns.

The results generally showed that the significance value for the trip chain patterns in the morning was quite different from the afternoon when the time of the activities was considered. This was further confirmed through direct observation.

IV. Conclusion

In this study, the variables or factors significantly influencing the trip chain pattern of visitors in Lego-Lego were analyzed. This was considered important due to the high influx of visitors which led to traffic congestion and long queues of vehicles in the area. Therefore, efforts were made to solve this problem and develop appropriate prevention strategies. The process involved interviewing the visitors at Lego-Lego in the morning and afternoon during weekends. The data retrieved were analyzed using multinomial logistic regression to determine the influencing factors as well as multinomial conditional logistics to model the trip chain patterns with due consideration for the cost and time activities.

The result showed that the most significant variables influencing the decision of the visitor to follow a trip chain pattern in the morning were quite different from those in the afternoon. The variables with significant influence on the morning activities include gender, age, education, income, participation, and the total number of accompanying members. Meanwhile, those linked to afternoon activities include gender, age, occupation, education, income, vehicle ownership (motorcycle), and the number of accompanying members. The base category in the morning was found to be Pattern 1 while the afternoon had Pattern 2.

The choice for the trip chain pattern in the morning was observed to have different basic categories compared to the afternoon but the phenomena were quite similar. It was also discovered that the influence of cost activities was different as indicated by the P>|Z| value of 0.357 recorded for the morning and 0.772 for the afternoon. Consequently, visitors tended to avoid trip chain patterns characterized by lengthy durations and high costs. Time activities were also observed to play a crucial role in influencing the choice of trip chain patterns. This was indicated by the fact that the visitors avoided activities requiring longer duration. These findings can serve as the basis to design facilities to meet travel demand based on activity patterns.

Generally, urban relaxation facilities such as Lego-Lego offering a multitude of activities were found to be instrumental in meeting the activity demands of residents and attracting a larger number of people to engage in multi-activity trip chains. Therefore, analyzing the trip chain patterns can assist urban planners in efficiently integrating land use and catering to the traffic management needs associated with the development of public spaces.

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