Examining Daily Trip Chaining of Urban Women: A Study of Non-Working Women in Bandung City

Amelia HAYATI [a], Pradono PRADONO [b], Heru PURBOYO [c], Sri MARYATI [d]
[a,] *PhD Candidate, Institute of Technology Bandung, Bandung, Indonesia*
[b,] *Professor, Institute of Technology Bandung, Bandung, Indonesia*
[c,] *Associate Professor, Institute of Technology Bandung, Bandung, Indonesia*
[d,] *Associate Professor, Institute of Technology Bandung, Bandung, Indonesia*
[a] *E-mail:* **amelia.hayati@fe.unpad.ac.id**
[b] *E-mail:* **pradono@pl.itb.ac.id**
[c] *E-mail:* **heru.purboyo@pl.itb.ac.id**
[d] *E-mail:* **sri.maryati@pl.itb.ac.id**

Abstract: Nowadays, women are becoming increasingly confident to travel for work or any other activities. As a multi role person, women take many trips daily to ensure the wellbeing of their family. They conduct many activities, be it mandatory and discretional, such as doing a part time business, picking their children up, and being a part of their community. Each woman has different travel pattern in which they go from different place to another and make different number of stops. Thus, each woman forms distinct trip-chain. In this study, women's travel pattern, in the context of space and time were analyzed used space-time prism and cluster analysis. The results inferred that women's travel pattern in Bandung City-shows, how complex their daily trip chains are.

Keywords: Women Trip Chaining, Mandatory Activities, Discretional Activities, Cluster Analysis, Space- Time Prism.

1. INTRODUCTION

Better facilities in big cities in Indonesia made travelling easier for women. This better access to transportation help them significantly to fulfill their needs. Both working women and non-working women, especially, housewives felt grateful for this. In addition, the easier access to vehicle ownership increases the mobility of them to meet their family needs, such as dropping of and picking up their children, doing part-time business, shopping and even to just hanging out with their own community.

It has been discussed by Hyodo et al., (2005) that movement is not gender bias; men and women have equal access to travel. However, men and women, in fact, have a significantly different travel pattern (Min Yang, et al, 2013; Adetunji, 2013). Based on the number of stops and the journey/location range, women have travel patterns that tend to be very complex (Hyodo, et al, 2005; Subbarao, et al, 2013).

As known, travel demand is derived from the need to meet activity in many locations. In last decades, the increased economic and social welfare. These have drastically changed lifestyles, increased the activity and behavior of one's travel pattern. There have been lots of studies that analyze the how our activities shape travel patterns. One

of the most simple and popular method in travel pattern's theory is the trip based activity approach.

The trip-based activity approach approximates mobility phenomena by considering commuter journeys. The trip chaining approach can represent relationships between the different trips that constitute an individual travel chain, and thus considerably generalize conventional trip-based models. Trip-chain models have been studied for several years; however, they have been rarely implemented in real contexts and seldom in complex urban areas. However, the trip-chain approach does not address the fundamental factors that determine the actual configuration of round trip chains. To address such questions, it is necessary to explicitly consider the activities those individuals and households undertake, and that give rise to transportation demand (Bifulco, et al, 2010).

The aim of this paper is to examine the trip chaining complexity of non-working urban women based on their each-own daily travel pattern using Space-time prism method and cluster analysis. The activities to generate their trip chaining are divided into 2 types of activities: mandatory and discretional. Individual and household characteristics as socio-economics and demographic characteristics are considered in this paper because it significantly influence their activities and travel patterns (Puoc, et al, 2016; Subbarao, et al, 2013; Hanson, 2010; Bifulco, et al, 2010; McGuckin, et al, 2007; McGuckin, et al, 1999).

2. FRAMEWORK ANALYSIS

This research also consider the condition of mobility and accessibility owned by respondents from various aspects, such as individual characteristics, household characteristics, socio-cultural, vehicle ownership, as well as their spatial state that will be defined as variables that affect the model. The unit of analysis used in this study is the number of active adult women respondents who often travel with many stops, following the pattern of chain journey to fulfill the transportation needs of the household for the welfare of the family. Based on a sample of the population of women in Bandung City with an error rate of a maximum of 5%, through the Survey questionnaires transport model adopted from another country, which is the Victorian Integrated Survey of Travel and Activity (VISTA), within a certain time during this study. VISTA is known as an international questioner for travel behavior cases.

Cluster Analysis and Space-Time Prism conduct analysis of descriptive approach. This survey observed the daily trip data in details by in-depth interviews, related to the spatial conditions based on the distance to the different clusters. Respondents were surveyed for 3 days in a week, Monday, Thursday and Sunday. Monday and Thursday represent weekday and Sunday represent weekend. Data processing is performed by a simple method of 2 Dimensional (2D) graphic to describe the space-time journey of respondents and Spatial Mapping to describe the spatial location of women's trip chaining patterns.

Logical Conceptual Framework

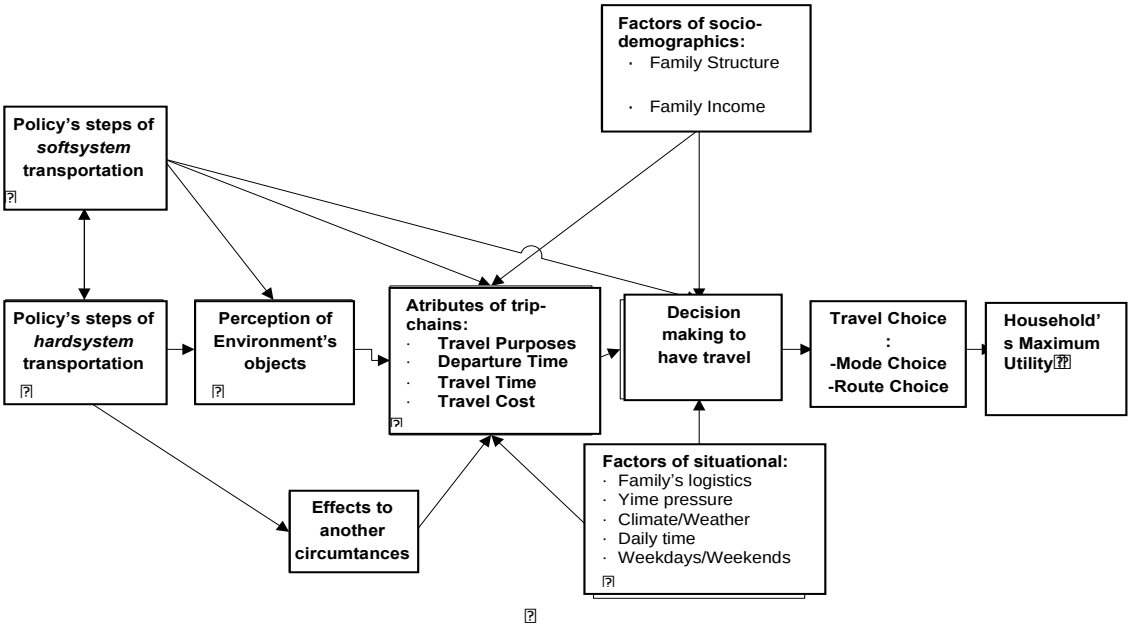


Figure 2.1. Modified from Bambergs, et al, 2011.

Research Framework

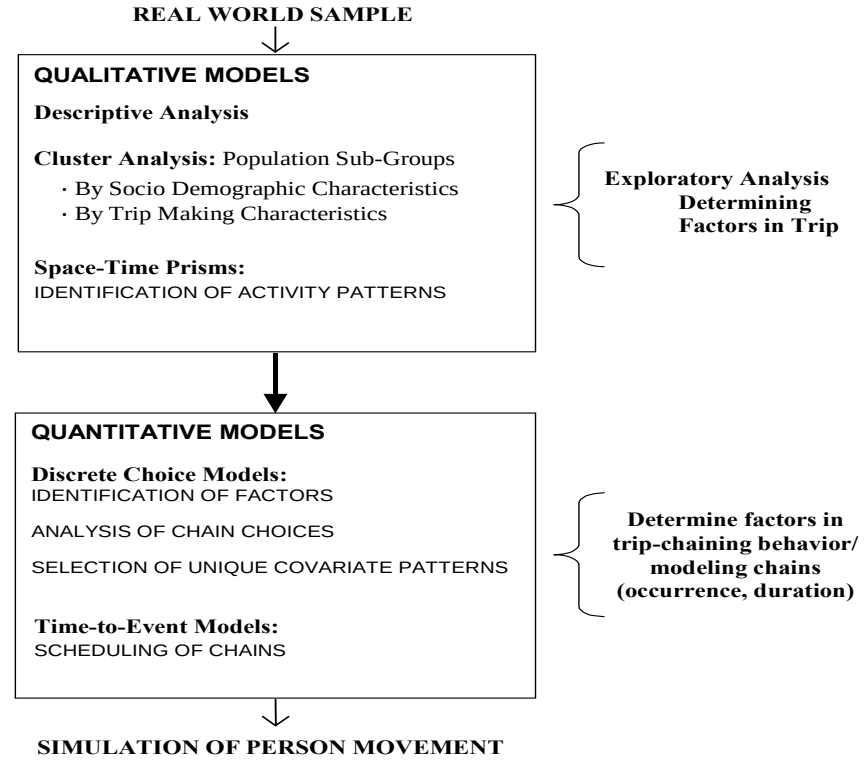


Figure 2.2: Framework for Integrated Fixed Activity Chaining Schedule (IFACS) (Al-Jammal and Parkany, 2003)

3. METHODOLOGY OF RESEARCH AND DATA

Based on Bandung City almost have radius area more than 15 Kms from the null km of the city center, so the primary survey was divided into 2 clusters. It consists first cluster (Cluster 1) is the radius area less than 10 Kms, and second cluster (Cluster 2) is the radius area more than 10 Kms until the boundary city area. This survey totally had got 466 respondents, which were 216 respondents from first cluster and 250 respondents from second cluster. The respondents were interviewed using questioner of VISTA (Victorian Integrated Survey of Travel and Activities, 2008, VTPI, **vista@transport.vic.gov.au**).

Research on activity-based travel demand can be divided into two parts based on the individual's involvement in a span of activity (Bhat and Koppelman, 2005b). The time span of activity is the occurrence of an activity at a certain time from start to happen until the end of the event, the mode that is used and the activity happened. Systematically derived demand of activity-based research is described in the following diagram:

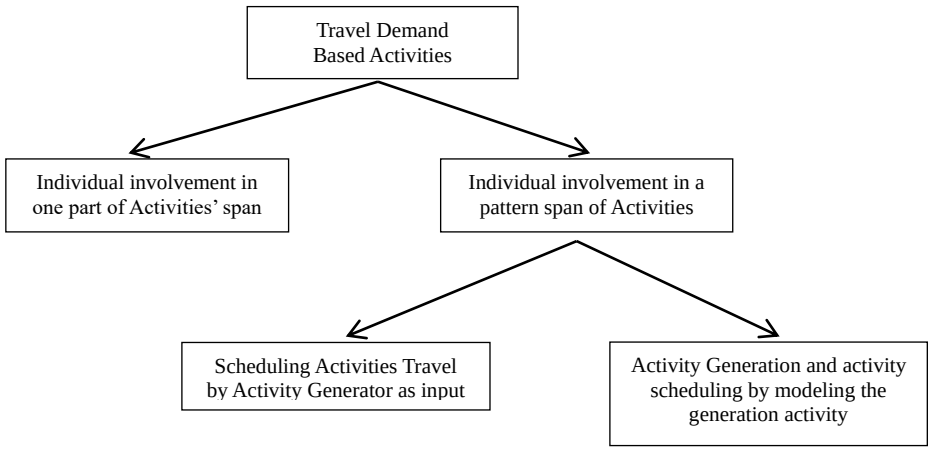


Figure 3.1. Travel Demand Based Activities
Source: Bhatt and Koppelman, 2005b

Constraints of space and time are an important factor in the decision making the trip to the next activity. The following diagram shows how time and space factor influence the travel patterns of individuals:

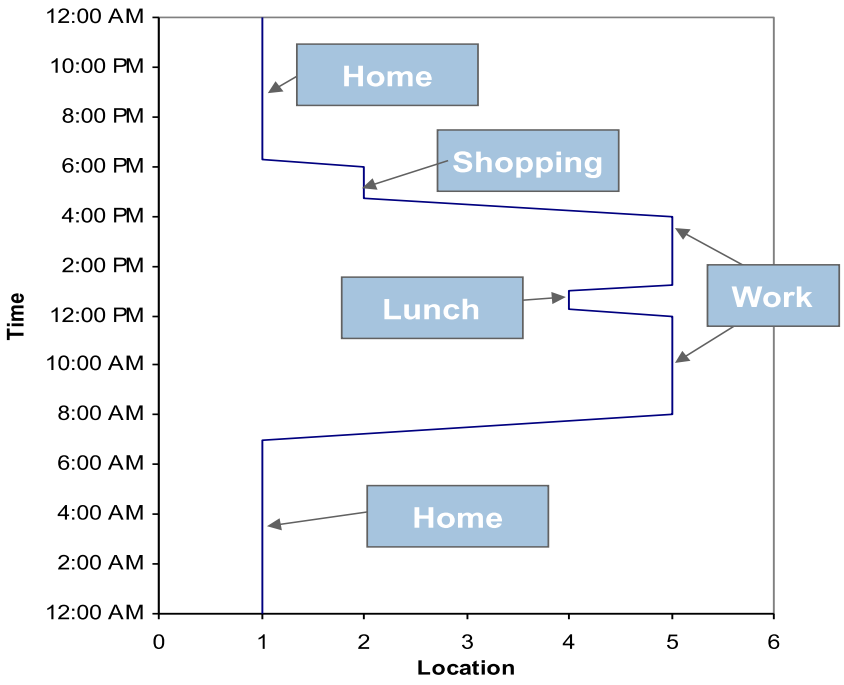


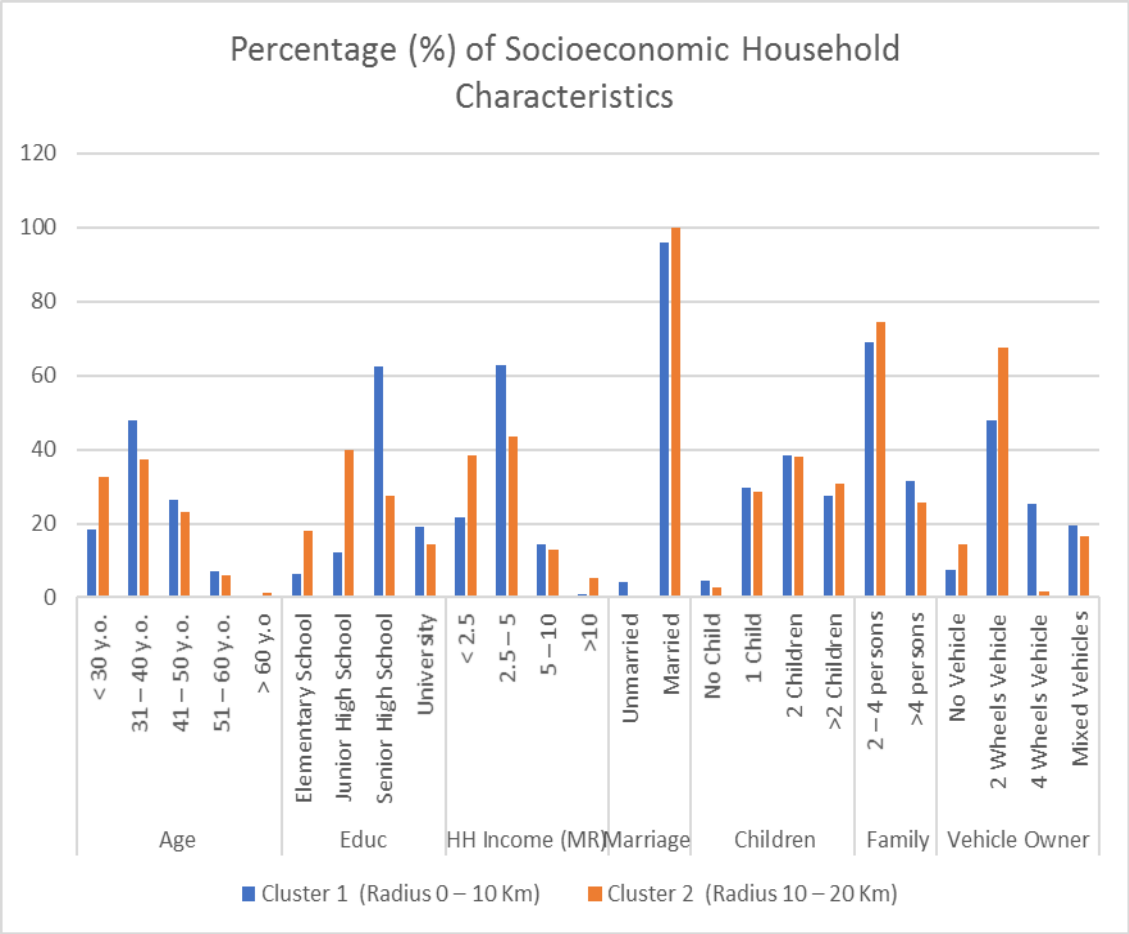
Figure 3.2. Patterns of Individual Travel Related to Space and Time
Source: Auld, J. (2007)

Two aspects of time are often taken into the duration of activity (activity-time use) and scheduling activity (activity timing). Transportation demand analysis approach based on activities, see the trip as derivatives to meet the needs of the activities that are spread in space (Jones, et al, 1990). This approach adopted a broad framework to understand the complex interaction between behavior and the activity of the trip.

Data of Socioeconomic and Trip Chaining

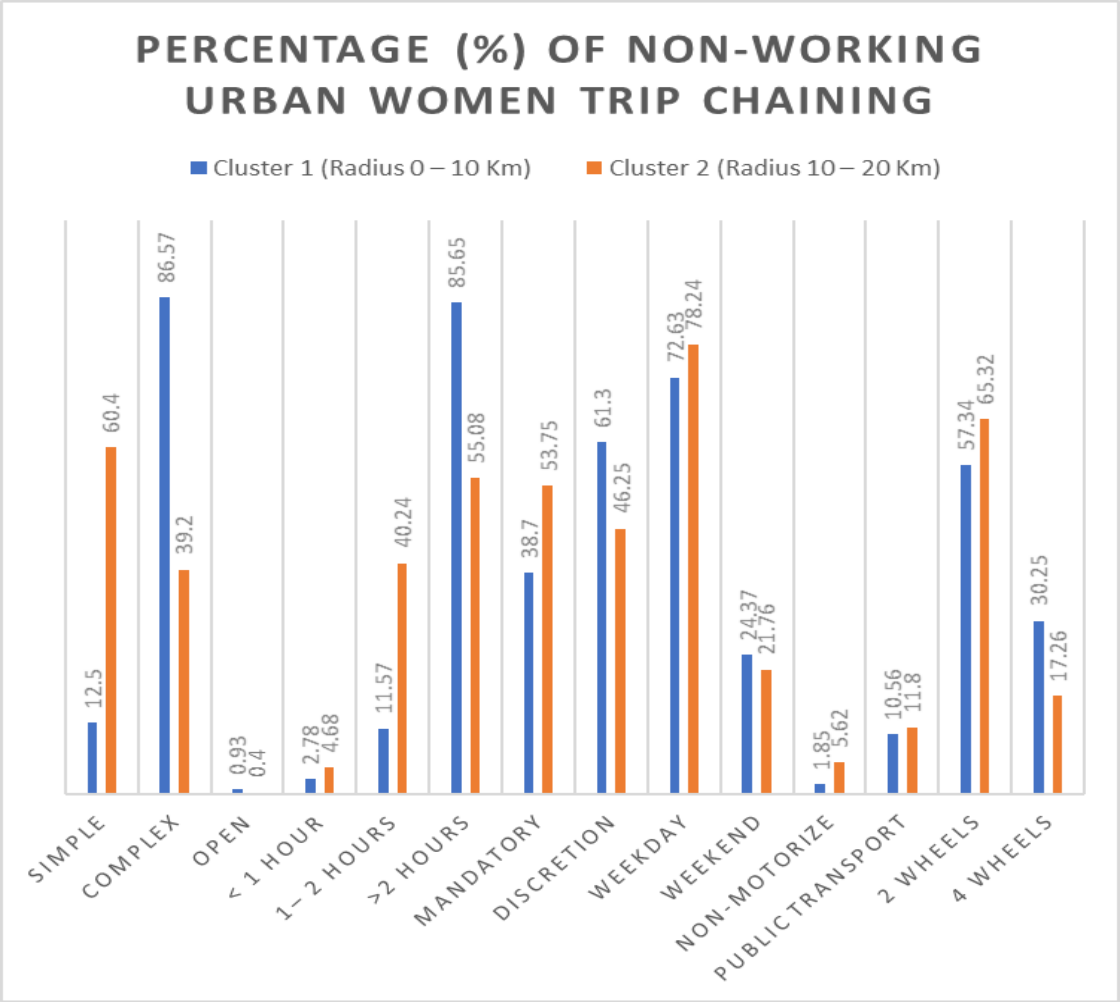
Percentage (%) of Socioeconomic Household Characteristics
For Non-Working Urban Women (N=466) *)

*) Result Processing



Percentage (%) of Non-Working Urban Women Trip Chaining*)

*) Result Processing



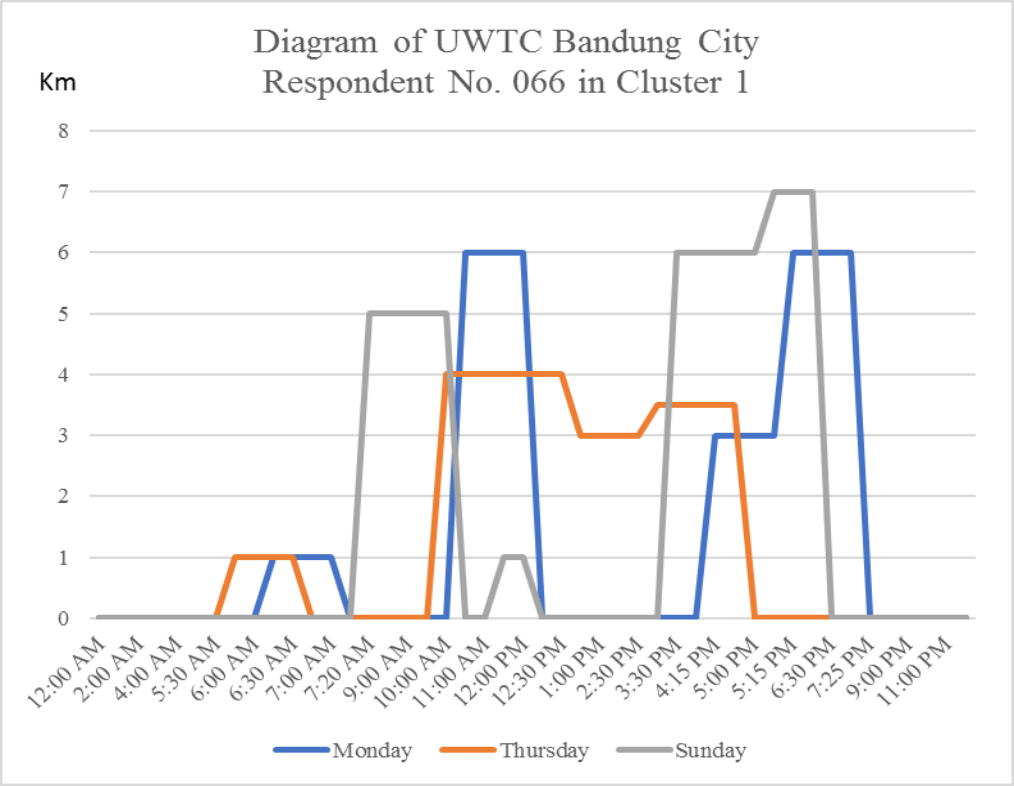
Space-Time Prism Diagram of Women Trip Chaining

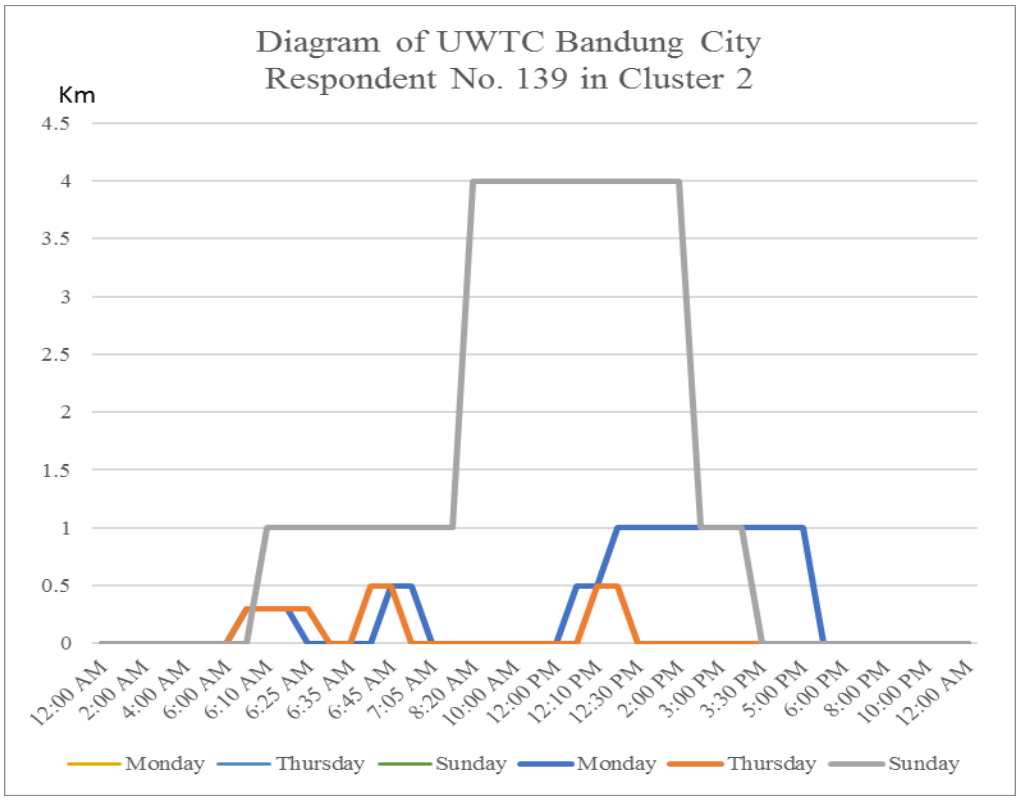
a. Respondent - Individual Daily Trip Chaining

In this section, one respondent from each cluster are used as examples. They were interviewed in-depth about the travel pattern they do every day either weekday or weekend. Travel pattern is the pattern of journeys undertaken since the respondent was out of the house until she returned home (commuter journey). Journey time range was observed since 5 A.M. until 9 P.M. These times are considered as the time where human are still active, while the rest out of the 24 hours are the time where they do not do activities that require travel.

For Weekday, Monday and Thursday were chosen as samples. Monday is considered a hectic day because it is the first day of work in each week. Thursday is considered less hectic because it is mid-week. Weekend was represented by Sunday, where nearly all the offices were closed and recreational areas or the malls are open and bustling.

To represent the first cluster, respondent number 66 was chosen ramdomly. The graphic of her trip chaining can be seen in (Apendix 1). The graph, explained how the daily travel patterns are represented on Monday, Thursday and Sunday, which is usually done over the years. The survey was conducted on Sunday to take the possibility of respondents are traveling out of the house, both for mandatory and discretional activities. Respondent 139 was chosen to represent cluster 2. (Appendix 2).





b. Respondent - Aggregate Daily Trip Chaining
In this section data from each cluster, (cluster 1 has 216, cluster 2 250 data) were combined unto one daily trip chaining graphs. (Apendix 3-8)

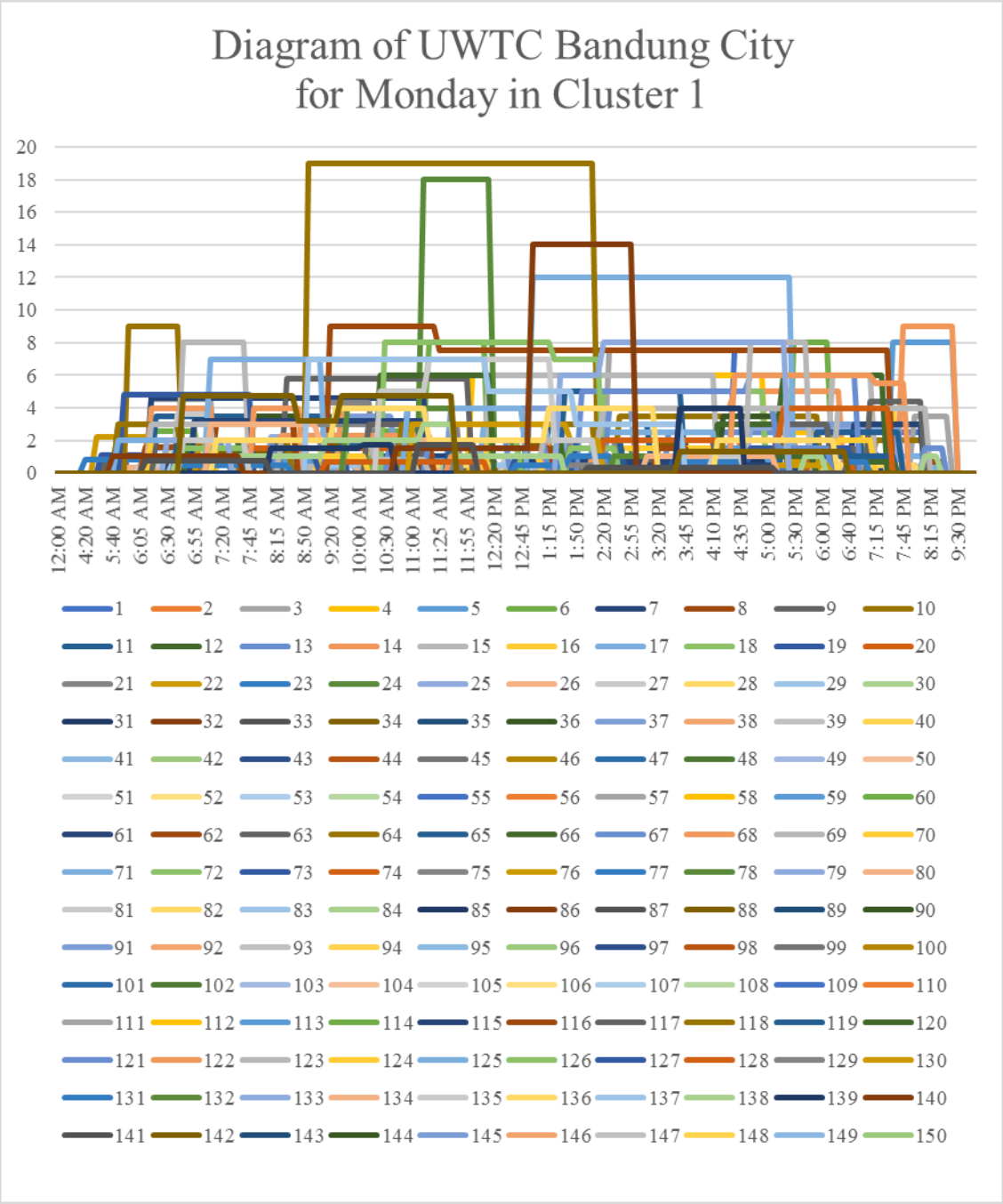
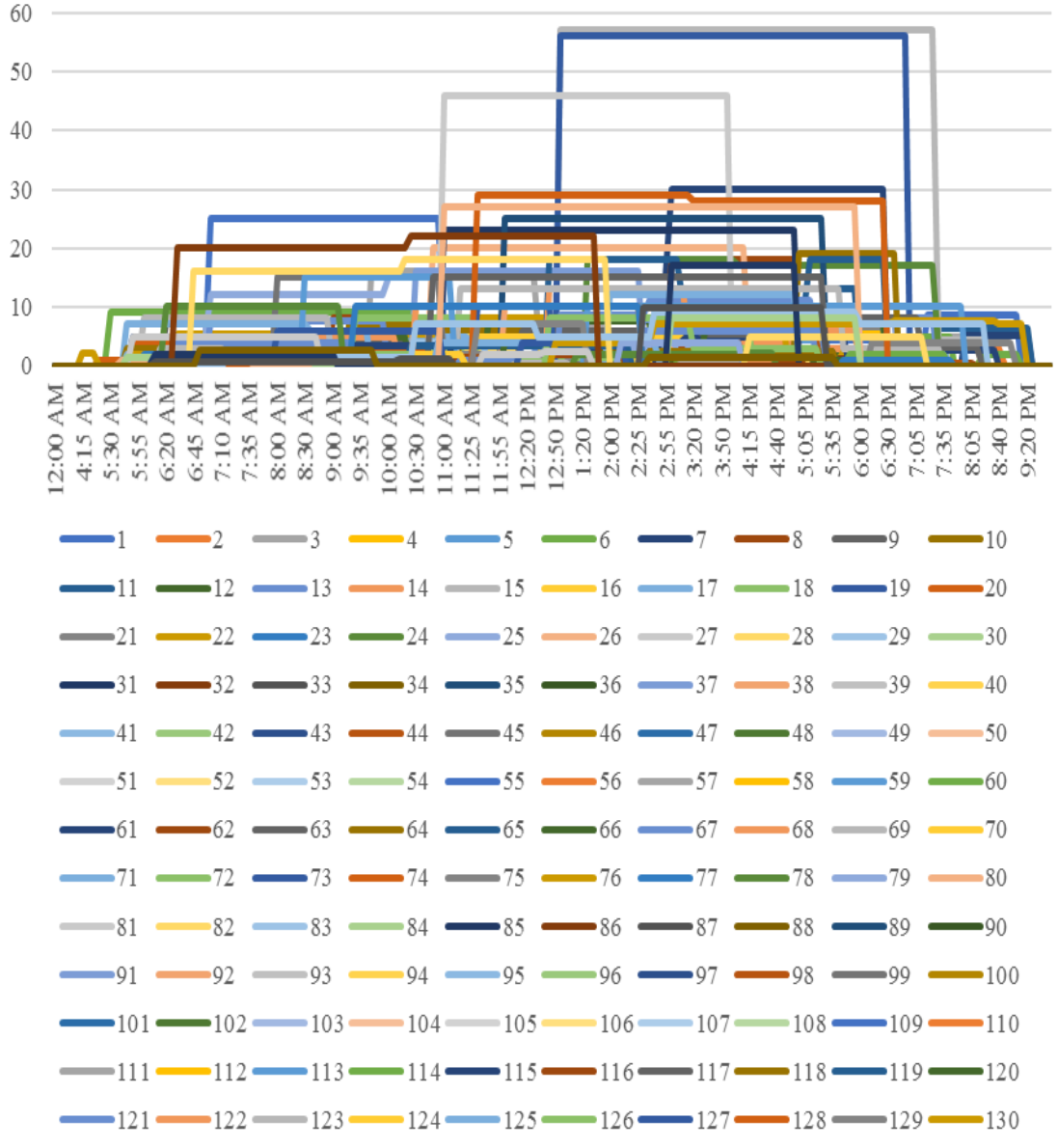


Diagram of UWTC Bandung City
for Monday in Cluster 1
20
18
16
14
12
10
8
6
4
2
0
12:00 AM
4:20 AM
5:40 AM
6:05 AM
6:30 AM
6:55 AM
7:20 AM
7:45 AM
8:15 AM
8:50 AM
9:20 AM
10:00 AM
10:30 AM
11:00 AM
11:25 AM
11:55 AM
12:20 PM
12:45 PM
1:15 PM
1:50 PM
2:20 PM
2:55 PM
3:20 PM
3:45 PM
4:10 PM
4:35 PM
5:00 PM
5:30 PM
6:00 PM
6:40 PM
7:15 PM
7:45 PM
8:15 PM
9:30 PM
1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150

Diagram of UWTC Bandung City for Sunday in Cluster 1



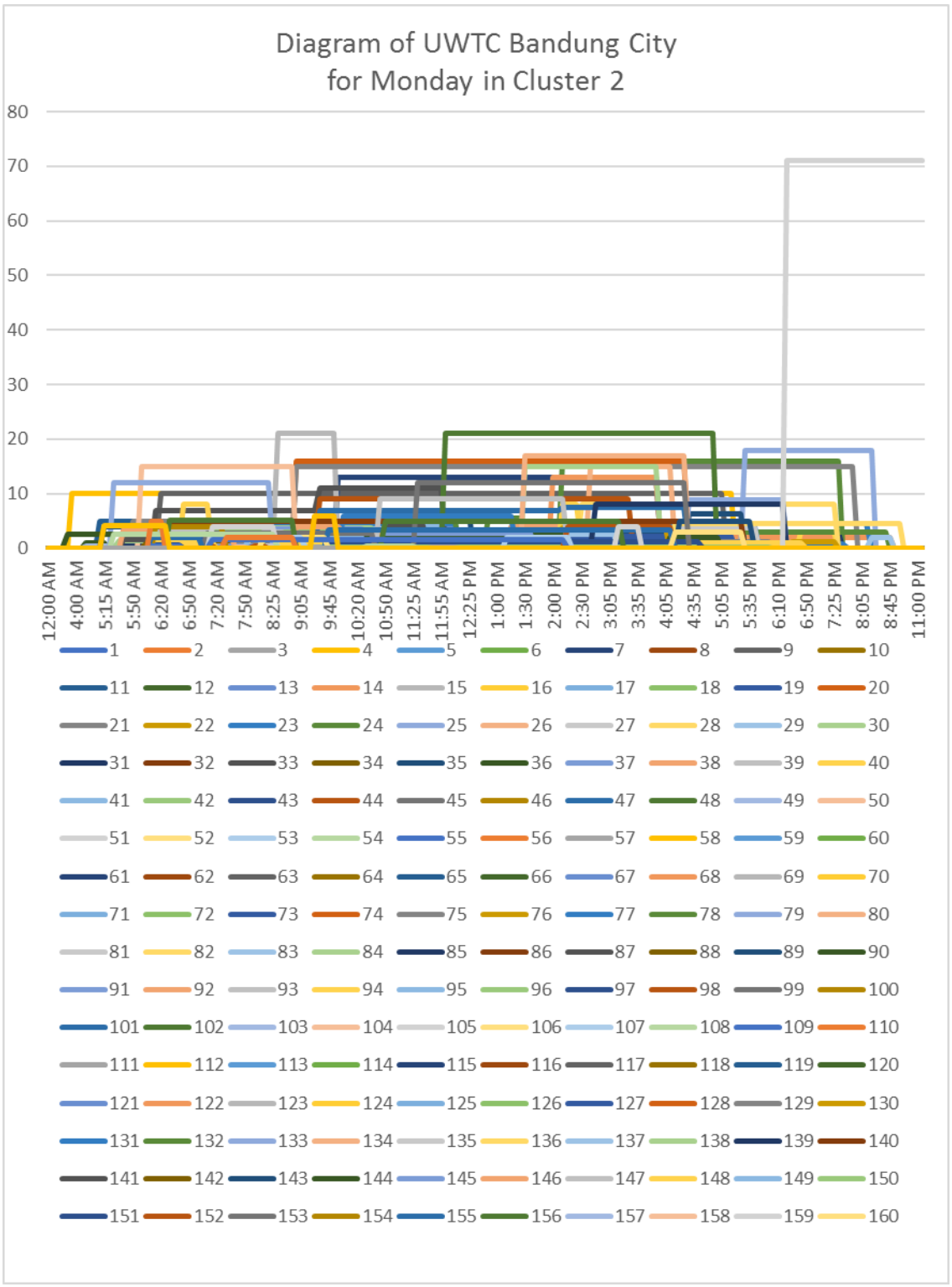


Diagram of UWTC Bandung City
for Monday in Cluster 2
80
70
60
50
40
30
20
10
0
12:00 AM
4:00 AM
5:15 AM
5:50 AM
6:20 AM
6:50 AM
7:20 AM
7:50 AM
8:25 AM
9:05 AM
9:45 AM
10:20 AM
10:50 AM
11:25 AM
11:55 AM
12:25 PM
1:00 PM
1:30 PM
2:00 PM
2:30 PM
3:05 PM
3:35 PM
4:05 PM
4:35 PM
5:05 PM
5:35 PM
6:10 PM
6:50 PM
7:25 PM
8:05 PM
8:45 PM
11:00 PM
1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120
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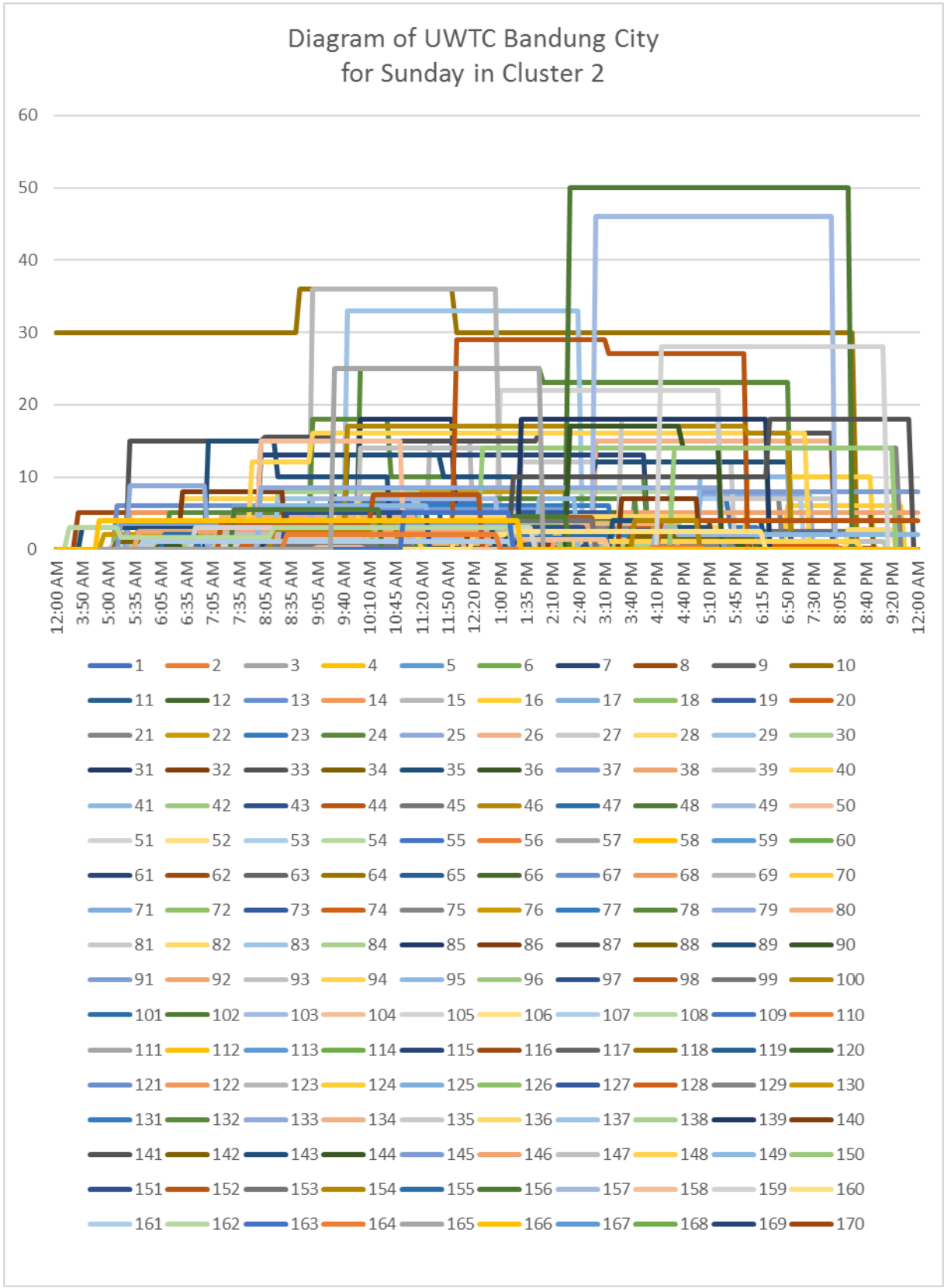
Diagram of UWTC Bandung City
for Sunday in Cluster 2
60
50
40
30
20
10
0
12:00 AM
3:50 AM
5:00 AM
5:35 AM
6:05 AM
6:35 AM
7:05 AM
7:35 AM
8:05 AM
8:35 AM
9:05 AM
9:40 AM
10:10 AM
10:45 AM
11:20 AM
11:50 AM
12:20 PM
1:00 PM
1:35 PM
2:10 PM
2:40 PM
3:10 PM
3:40 PM
4:10 PM
4:40 PM
5:10 PM
5:45 PM
6:15 PM
6:50 PM
7:30 PM
8:05 PM
8:40 PM
9:20 PM
12:00 AM
1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40
41 42 43 44 45 46 47 48 49 50
51 52 53 54 55 56 57 58 59 60
61 62 63 64 65 66 67 68 69 70
71 72 73 74 75 76 77 78 79 80
81 82 83 84 85 86 87 88 89 90
91 92 93 94 95 96 97 98 99 100
101 102 103 104 105 106 107 108 109 110
111 112 113 114 115 116 117 118 119 120
121 122 123 124 125 126 127 128 129 130
131 132 133 134 135 136 137 138 139 140
141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160
161 162 163 164 165 166 167 168 169 170

4. DATA DESCRIPTION

a. Data of Socioeconomics of Household Characteristics

Women travel patterns could not be separated from household needs. Household socio-economic conditions affected the daily activities and travel of woman as a housewife (Mc Guckin, et al, 1999; Mc Guckin, et al, 2010; Bifulco, et al, 2010; Subbarao, et al, 2013; Puoc, et al, 2016). From the data, it is known that both in cluster 1 and 2, the most active women are those in the productive age between 31-50 years. From education level point of view, women in the city of Bandung are dominated by high school graduates. Meanwhile, income is dominated by mid-economy class. In accordance with the initial goal of this paper, almost all of the respondents were married a housewife. The number of children is dominated by 2 children. This is in accord with government programs on family planning. It has an impact on the dominance of the number of family members, which is 4 people consisting of, father, mother and two children. Ownership of vehicle at is dominated by 2-wheeled vehicles in both clusters. This is because this kind of vehicle provide ease of access, speed and lower maintenance cost.

b. Data of Urban Women Trip Chaining

Fulfilling the needs of the activity encourages travel patterns. More than 50 percent of women in the world have travel in the form of trip chaining pattern (Kalter, et al, 2010; McGuckin, et al, 2010; Hanson, et al, 2010, Subbarao, et al, 2013; WRI, 2015). From the survey data, there is a significant difference between the travel patterns of women in Cluster 1 and Cluster 2. For the complexity of travel, women in Cluster 1 were more complex. Women in Cluster 1 also spent more time in one place (over 2 hours long). Based on the activity conducted both clusters shows similar characteristics which is discretional activity. Weekday travel patterns were busier. This happens in all clusters. As for ease of access, speed, practical as well as ownership, then the mode of two-wheeled vehicles is very dominating because it supports the women's movement in Bandung nowadays.

Based on the modeling using space-time prism analysis, (appendix 3-8), we can see the complexity of the daily travel patterns of women in the two clusters. Travel patterns of women individually in Cluster 1 is more complex and the average distance of the journey is longer than cluster 2. This is similarly shown from, the combined travel patterns of all respondents from each cluster. For both weekday and weekend, Cluster 1 has a more complex journey patterns with longer duration of activity and travel distance than Cluster 2.

5. CONCLUSION

Everywhere the woman must be multi-role person to meet the needs of the family. Therefore she must be mobile even though she is non-working women or as housewife. Based on the needs of his activities, the travel pattern of women who become housewives is very complex. It happens because he stops a lot in his single journey in a day. It takes explicitly to consider the personal and household activities taken that determine the increase in transportation demand. Social, economic and lifestyle changes in the city of Bandung make housewives in the city become more confident to go outdoors and traveling to meet the needs of the family. The analysis in this paper shows that the type of activity, cluster type, transportation mode of

choice and individual characteristics such as age, education level has a significant impact in forming a trip chain. Because of Bandung City is a quite large city, the region is divided into two clusters to examine the respondents. Cluster 1 is the center of the city and cluster 2 is around cluster 1 that is still included in Bandung City district. Through the space-time prism method and cluster analysis, we have that the women in cluster 1 take more complex of their daily trip chaining and longer distance for their own trips. The analysis recognized that decision making of trip chain choice undertaken across different age groups varies significantly. It happens to the productive age of women city about 31 – 50 years old. For the complex travel-pattern they did, most of discretion activities and it took more than 2 hours long in the weekday. For the ease of access, cost and traffic jam, most of them are using motorcycle to take their mobility.

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