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Mongolia
Ulaanbaatar Urban Transport Capacity Development

2016 UB HH Travel Survey Report: Data Process and Phase One Results

Transport Demand Forecasting

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1 Introduction

This report provides a summary of the city-wide household travel survey, survey campaign work plan, survey process, data summary, data process, survey data expansion and validations in addition to the origin and destination pattern and trip distributions by purpose and mode, basic travel patterns and characteristics from the final travel survey database.

2 Survey Objectives and General Approach

This comprehensive household travel survey is to provide a solid base of information describing who is travelling, where they are going, what routes or modes are being used, why they are travelling and using the modes they use, and how changes in the system might affect their choices in the future. The survey provides a snapshot of transport in the City of Ulaanbaatar on a typical weekday, with information that will assist the City in assessing how growth and other emerging influences (such as congestion, gas prices, demographics, city policies and so on) could influence travel demands and user choices in the future. The survey will provide data that is critical to making wise decisions about transport investment choices for the future.

The survey is intended to capture one-day travel log in any weekday between Monday and Friday only and therefore the data collected will characterize travel patterns for an average weekday. The survey is not designed to collect travel information to assess weekend travel needs.

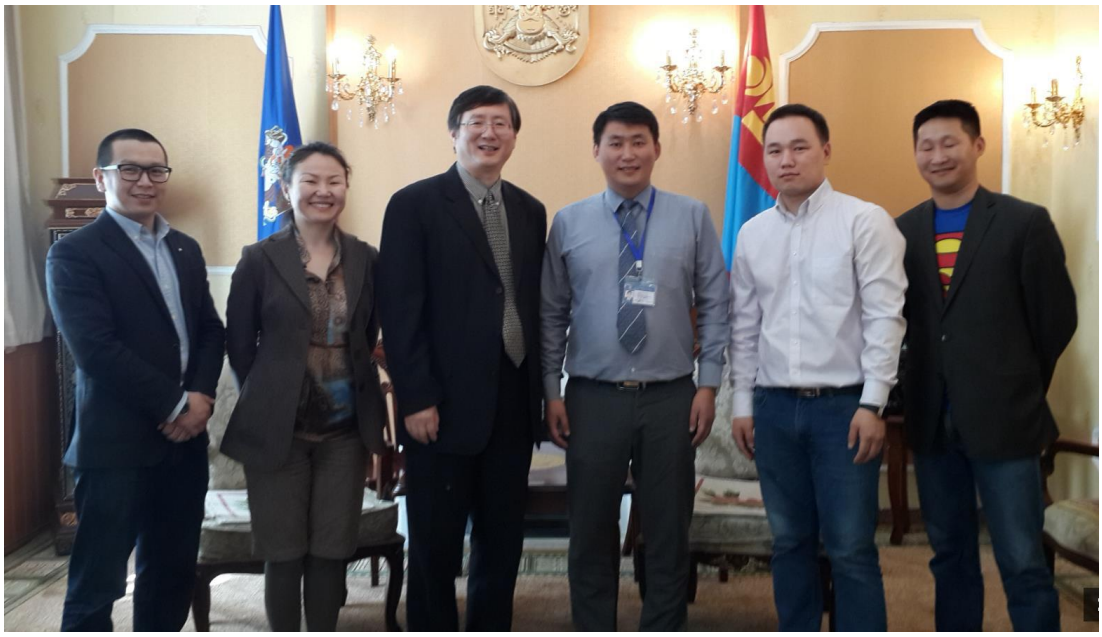


Figure 1: ADB Team meeting with Mr. Otgonbaatar, the Head of Project and Cooperation Department at Ulaanbaatar Governor's Office

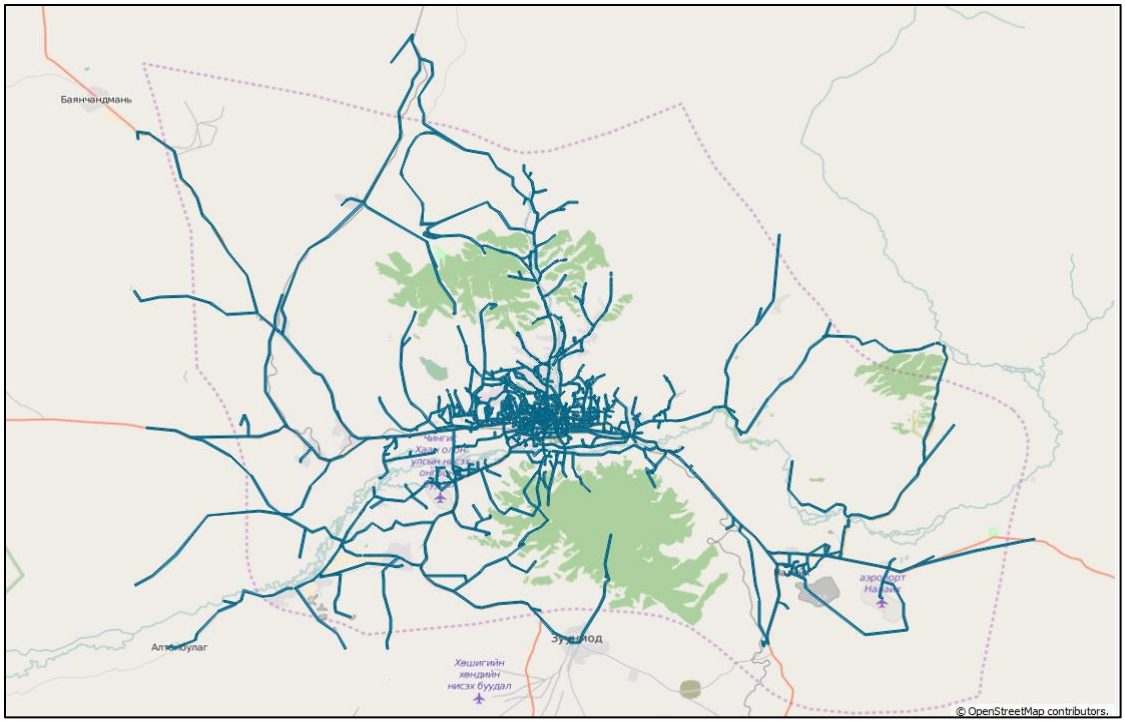


Figure 2: Survey Area in UB

2.1 Household Survey Contents

The area for the household travel survey data collection is shown in **Error! Reference source not found.**.

2.2 Survey Team

The survey team includes the ADB team and SkyTel survey team with supports from Mobicom and Unitel. ABD team is responsible for the sample design, training of the data collection process, while SkyTel is responsible for the mobile phone surveys and the final survey data.

2.3 Survey Schedule

The survey schedule is discussed in Section 4.2 as part of the survey specifications.

3 Survey Design

The samples are defined to be the survey data set which is estimated and determined based on 1% of total households in the UB area. This sample is used to estimate to estimate the universe of the entire UD travel patterns.

3.1 Geographic Distribution

The entire survey area includes 216 TAZs covering 209 TAZs in the modeling area and 7 external TAZs in addition to a City_Area_Zone layer with 25 zones and a Middle_Ger area with 12 zones.

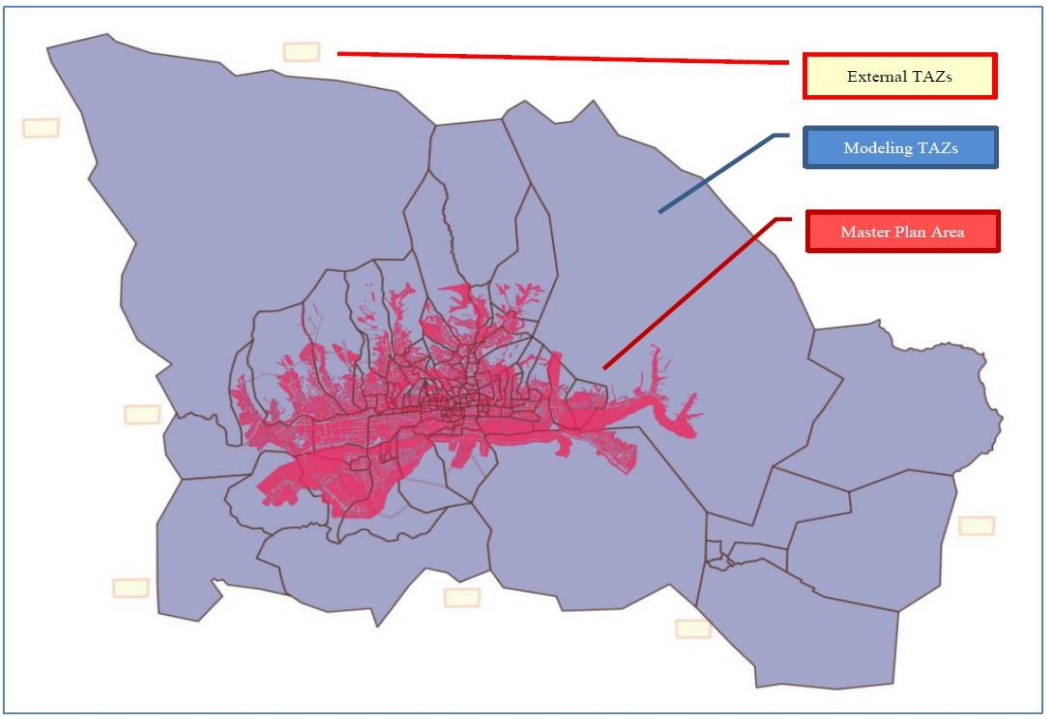


Figure 3: Survey TAZs of Demographic Modeling TAZs Area, Future Master Plan Area and External TAZs

3.2 Sampling Design and Selection Methodology

The sampling design and the selection methodology is discussed below.

1. Demographic data set is available for 2014 and 2015 in GIS shape format with the following demographic items:
    a. Farmer
    b. Population: 0-5
    c. Population: 6-18
    d. Population: 19-59
    e. Population: 60-above
    f. Student
    g. Pensioner
    h. Employed
    i. Unemployed
    j. Kinder_Child
    k. School_Child
    l. Khoroo_POP
    m. Household
2. Land-use data in GIS format with the Master Planning Agency was obtained on 30 June, in the format of Master Plan Land-use Categories by area for 2030.

3. There is a need to establish a functional relationship between these two categories (a and b) so that the land-use growth can be established between 2016 and 2030.
4. The number of samples in each TAZ are allocated to be 1% of total families in the demographic database.

4 Survey Method

4.1 Data in the Survey

This survey serves as the City's inventory of daily travel. One individual survey of an interviewee per household is conducted. Household Travel Survey Data is collected on a typical day for a daily travel taken in a 24-hour period for one day, and includes two main parts: one related to the household-related data and the other related to a daily travel of the interviewee. The Household Travel Survey Form is included in Attachment 6.

Part One contains demographics of the interviewee:

- Household Size
- Interviewee's Age (16 or higher)
- Interviewee's Income
- Interviewee's Education
- Interviewee's Employment
- Interviewee's Gender
- Interviewee's Home Location (It is not part of question and is provided by Skytel)

Part Two contains: Trip related data of a daily travel. One daily travel consists of a set of sequential trips. For each trip, there are

- Departure Location
- Departure Location Place Type
- Departure Time
- Arrival Location
- Arrival Location Place Type
- Arrival Time
- Trip Purpose
- Travel Mode
- Car Share Occupancy

These data are collected for: all trips, all modes, all purposes, and all areas of the city, urban and rural within the seven district areas – the six central districts plus Nalaikh.

The survey data is used to quantify UB travel behaviour, analyse changes in travel characteristics over time, relate travel behavior to the demographics of the traveller, and study the relationship of demographics and travels. The survey data is used primarily for gaining a better understanding of travel

behavior. The data enables City officials to assess program initiatives, review programs and policies, study current mobility issues, and plan for the future.

4.2 Survey Specifications and Sampling for Mobile Phone Companies

The HH Travel Survey specifications were as follows:

1. Survey method: Telephone /Outbound call interview
2. Survey dates and time: May 15-27 from 9:00 a.m. to 9:00 p.m. (The survey could only be conducted for a period from May 15 to 20. Another half of sample data may be collected later this year.)
3. The total samples: 16,000 UB citizens distributed for 209 traffic analysis zones (TAZ) (as intended: only 8000 were possible as the survey period was reduced from two weeks to one).
4. Sampling: Mobicom 45%, Unitel 35%, SkyTel 20% for the entire UB 7 districts
5. Time for each interview: average 12 minutes
6. Interviews/day: 1,600
7. Call records /notes: Provide randomly selected records in audio file format (*.vox)
8. Deliver an incentive package: MNT 5,000 as credit/top-up for each interviewee
9. SMS notifications: Confirmations from Interviewee before interview
    - Incentive package confirmation after interview
    - Home location in term of address, road intersection of two streets or land mark

A pilot survey of 820 samples was conducted before the major survey to test and improve the survey method. The results of this survey showed positive results of this method. However the samples are not included in this report.

4.3 Survey Outreach

The survey outreach is important for the success of the survey implementation and the quality. Here is a description of the outreach.

- A HH Travel Survey Form and Talking Note was provided in both English and Mongolia to the Governor's Office by the ADB team, and subsequently to Skytel, who carried out the interviews.
- ADB presented an overview of the first HH Travel Survey to the City Government Board meeting in terms of press release statement, HH travel survey form and survey interview talking note also the Travel Demand Forecasting Training Programme and its Participant Result.
- The City would support the HH Travel Survey campaign for a week via TV stations, Newspapers, Radio Stations and its administration channels including its Public Relation office. City will be responsible for all related costs. ADB will support all interview related operations including interview, incentive program, data processing and survey reports.
- The Survey campaign includes an announcement of the survey for a half page in newspapers, 15 seconds on radio stations every 2 hours, and 20 seconds on TV every day.
- The City Government and ADB approve all agreements for interviews, incentives and data processing.

4.4 Survey Training and Pretest

ADB provides an interview training to the mobile phone company with HH Travel Survey form and talking note. All interviews are limited to anyone over 15 years old. A mobile phone team has a pilot survey of 20 interviews within its own company staff with ADB staff as observers including all pre-survey text message and after-survey text message. The mobile phone team conducts the interviews and send an after-survey text message.

4.5 Quality Control

The ADB team receives all the survey data, and performs the quality control of the data before, during and after the data process.

4.6 Technical Concepts of the Survey Methodology Overview

Here is a summary of the survey method on sample size, travel log concepts and definition of trip purposes, which will be used for the data processing and the survey report.

Sample Size

The household travel survey was undertaken by a mobile phone company, using a random telephone survey of residents within the City area and the communities surrounding the city as defined in the seven districts, which are further divided from 152 TAZs into 209 Traffic Analysis Zones (TAZs). The survey was designed to obtain a sample of approximately 1% of the residents of the City. The survey was undertaken using computer-assisted randomizing techniques and tabulation methods to ensure that the survey captured a random distribution of residents from all areas of the city that reflects the demographic profile of the city. The number of interviewees in each of 152 large TAZs covering 209 smaller TAZs on the existing population with any age over 15-year-old. The basic travel survey included the collection of demographic and household information along with a series of well-rounded questions capturing the daily trips made by interviewees over the age of 15 years old, in each of the survey areas. Information was typically collected from one individual in the household and participants were asked to report on the trips made by the interviewee.

In this survey, it is assumed that the total population in UB area is 1,316,942 (as in 2015). It was decided to have a sample of 1% of the population, resulting in 13,116 validated samples necessary and thus 16,000 interviews would be conducted. The average household size is 3.736 based on the GIS file of 2015. Due to the schedule issue, in fact 8,000 samples were obtained.

Travel Log in the Survey

The following sections describe the process to develop the selected definitions of trip and chain (travel) and intervening stops based on the travel log in the survey, which shows critical steps in the data analysis. A few definitions used in describing this tours chaining process for a typical day:

1. *Location (anchor):* A primary or substantial trip origin or destination such as home and work places
2. *Daily chain:* Total travel of a daily visiting anchor destinations, such as home and work, including both direct trips and chained trips with intervening stops. Note that it is possible to have the two anchor destinations be the same location, as in a home-to-home or work-to-work tour.
3. *Trip (direct trip):* A trip that travels directly between two locations (anchor destinations), such as a trip from home to work. A series of short trips linked together between anchor destinations, such as a trip that leaves home, stops to drop a passenger, stops for coffee, and continues to work
4. *Intervening Stop*: The stops associated with chained trips.

Thus, a daily tour consists of a set of sequential short trips. These travel log concepts can be shown in Figure 4Figure 4: A Log of One Day. In this example from the USA, the interviewee reported a total of seven separate trips:

- Trip 1: From Home by Purpose of Work with Modes of Car, subway and walk
- Trip 2 From Work place, make a trip for Purpose of Lunch and Modes of Walk
- Trip 3 From Restaurant, make a trip for Purpose of Work with Modes of Walk
- Trip 4 From Work Place, make a trip for Purpose of Shopping with Modes of Walk, Subway and Cars
- Trip 5 From Gas Station, make a trip for Purpose of Shopping with Modes of Car
- Trip 6 From Grocery, make a trip for Purpose of Social (Pick-Up) with Mode of Car
- Trip 7 From Daycare Centre, make a trip to Home for Purpose of Home (Residence) with Mode of Car.

Thus, in this example, Trip 1 was clearly a trip to work, but the trip from work to home was interspersed with stops for other purposes. The non-work stops along what is primarily a chain between the residence and the workplace complicates the analysis of the work commute. The miles and minutes of travel between the grocery store and the day care, for instance, can be estimated to a non-work trip purpose, so if we tried to directly measure the miles and minutes workers spend commuting, these trips would not be included.

These 7 trips can be combined into a tour. If we combine trip 2 and trip 3 together, we have one chain of lunch. If we combine trip 4, 5, we have another chain of shopping. In this study, we report all the trips with their departure/arrival locations, trip purposes, trip modes and departure/arrival times for our trip based model. All the relevant tours are not reported, which can be done later on if necessary.

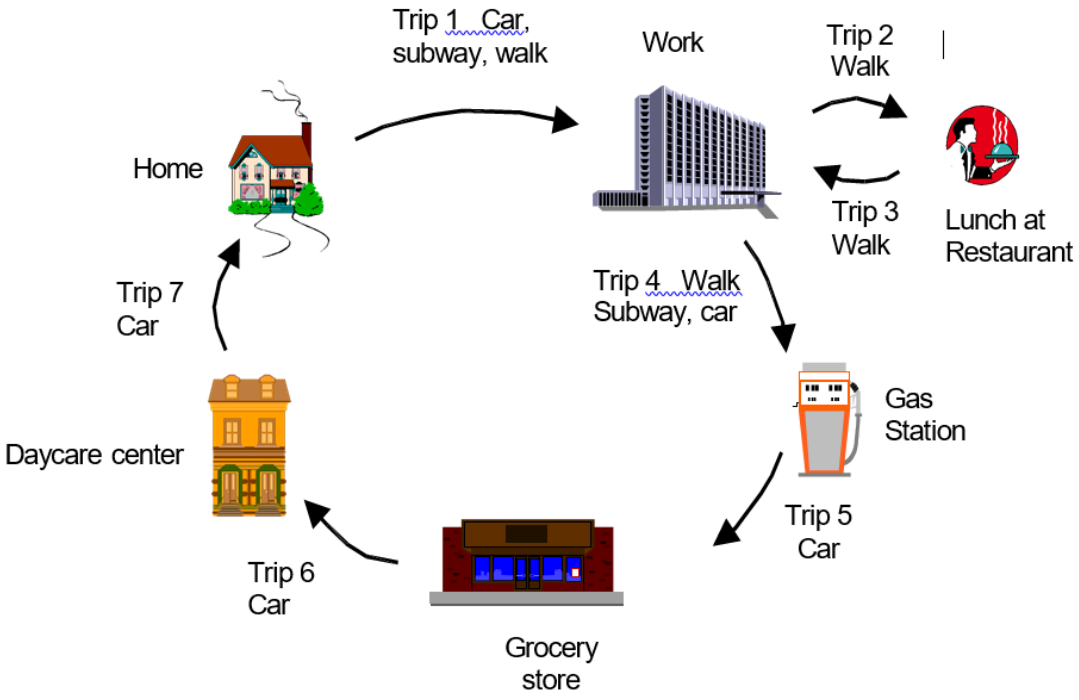


Figure 4: A Log of One Day Travel Tour

5 Interview and Data Process Procedures

A detailed interview procedure is described in Appendix: Outbound Interview Report HH Travel Survey, ADB. An internal data process linked to Skytel database is discussed in Appendix: HH Travel Survey, Project Document.

We define a tour of a person in a day as a set of sequential trips including locations, purposes, modes, departure and arrival times and so on. A trip is a movement from one location (in terms of TAZs or a GIS coordinates) to another.

It is necessary to establish a relationship between a Travel Log file of this HH Travel Survey, modeling Trip Purpose and modeling Trip Mode. There are traditionally coded six general modeling purposes for trips including:

1. Home-Based Work(HBW)
2. Home-Based Shop (HBShop)
3. Home-Based Social and Recreational (HBSoc)
4. Home-Based School (HBSch)
5. Home-Based Other trips (HBO) and
6. Non Home-Based (NHB).

We can define a relational table between the UB trip purposes and the modeling (aggregate) trip purposes as shown in Table 1 and the trip purposes in Mongolian and English in Table 2. The definition of a home-based trip is that either the origin or destination of the travel is the interviewee's home. The trip definition is any movement from one location to another. These definitions do not include any trip linking or chaining.

Table 1: Purposes and Modeling Purposes

		Modeling Purposes	
UB ID	UB Purpose in Survey	Home Based Purposes (For the first trip except HBO for the last trip)	Non-Home Based Purpose (For all second and next to last trips)
1	Return home	HBO	
2	Travel to work	HBW	NHB
3	Travel during work	HBW	NHB
4	Education	HBSch	NHB
5	Shopping	HBShop	NHB
6	Pick Up/Drop (escort)	HBShop	NHB
7	Personal Business	HBShop	NHB
8	Eat or drink	HBShop	NHB
9	Visit friends or relations (VFR)	HBSoc	NHB
10	Recreation or fitness	HBSoc	NHB
11	Medical	HBSoc	NHB
12	Short errand (ATM/Gas)	HBSoc	NHB
13	Civic or Religious	HBSoc	NHB
14	Entertainment	HBSoc	NHB

For the trip purpose definition, travel departure and arrival data are used to establish whether the trip began or ended at home/residence. A small percentage of trips that were not possible to categorize or coded are not counted. This primarily occurred when the person did not begin or end their day at home or traveled without modes or purposes or illogical travel times. When this kind of data were detected, the ADB team investigated and made necessary corrections or judgements to include or exclude them in the data process.

For example, a Home-Based Work trip (HBW) is coded when one end of the trip has Location Type =Home=Residence (Ger), Residence (Apartment) or Residence (House) and one end of the trip has any Location Type with a Purpose=Travel to work and Travel during work. Additional information can be used to validate the data process including departure and arrival times. For all other Home-Based trips, one end of the trip is HOME. For example, HBSHOP is a purpose with one end of the trip being Home and one end with purposes of a Shopping or Personal Business or Eat or drink or Short errand (ATM/Gas). HBSOCREC is a trip purpose with one end of the trip being Home and one end with a trip purpose of Visit friends or relations or Recreation or fitness, Medical, Civic or Religious or Entertainment. Home-Based School (HBSch) is a purpose with one end of the trip being Home and one end with a trip purpose of Education. Home-Based Other trips (HBO) is a trip purpose with one end of the trip being Home and the other end with not being in any of the above categories. Non Home-Based (NHB) is a purpose with

anything else (still defined in the purpose table) and a valid first departure Location Types (Not Residence).

Therefore, these data from the Survey will be used to identify the effect of changing the base population. For example, In the 2001 in USA, National Household Travel Survey (NHTS) shows that HBW trips account for 11.6 percent of all person trips by the sampled population in the NHTS—people aged 5 and older, but they are 13.3 percent of person trips by potential workers—people aged 15 and older, 19.2 percent of person trips by workers, and 21.8 percent of vehicle trips by workers. Including all stops of any dwell time, nearly 20 percent of the home-to-work travel has non-work segments and 30 percent of the work-to-home travel has non-work segments. These imbedded trips within the commute limit an estimation ability to estimate commute miles and minutes definitively, since regular stops within the commute (such as dropping children at school) may significantly affect route choice, time of day, trip length, and overall travel time. Table 3 shows a relationship between UB Travel Modes and modeling models

Table 2: Trip Purpose ID, Mongolian and English

Trip Purpose ID	Mongolian	English
1	Гэртээ харих	Return home
2	Ажилдаа явах	Travel to work
3	Ажлаар гадуур явах	Travel during work
4	Сургуульдаа явах	Education
5	Дэлгүүр орох	Shopping
6	Тосч авах, хүргэж өгөх	Pick Up/Drop (escort)
7	Хувийн ажлаар	Personal Business
8	Хооллох, гадуур гарах (Гадуур хооллох)	Eat or drink
9	Найз эсвэл хамаатныдаа зочлох	Visit friends or relations (VFR)
10	Дасгал, сургуулилт хийхээр	Recreation or fitness
11	Эмнэлэг орхоор	Medical
12	Ойр зуур гарч явах (АТМ, ШТС)	Short errand (ATM/Gas)
13	Шашны зан үйл хийхээр	Civic or Religious
14	Үзвэр үзхээр явах	Entertainment

Table 3: Travel Modes and Modeling Modes

UB ID	UB Modes	Modeling Modes	Modeling Aggregate Modes
1.	Bus/Trolleybus	Bus/Trolleybus	Transit
2.	Midi-Bus	Midi-Bus	Transit
3.	Micro-Bus	Micro-Bus	Transit
4.	Professional Taxi	Professional Taxi	Taxi
5.	Street Taxi	Street Taxi	Taxi
6.	Private car or van	DA	Auto
7.	Motorcycle	Motorcycle	Auto
8.	Bicycle	Bicycle	Bicycle
9.	Ped.	Ped.	Ped.
10.	Sharing Transport	S2, S3, Van	Transit

Table 4: Travel Mode ID, Mongolian and English

UB ID	UB Modes	Modeling Modes
1.	Автобус, Троллейбус	Bus/Trolleybus
2.	Дунд оврын автобус	Midi-Bus
3.	Микро автобус	Micro-Bus
4.	Албан такси	Professional Taxi
5.	Албан бус такси	Street Taxi
6.	Хувийн машин	DA, S3, S3, Van
7.	Мотоцикл	Motorcycle
8.	Унадаг дугуй	Bicycle
9.	Явган явсан	Ped.
10.	Хүний болон ажлын машинд дайгдах	Sharing Transport

Here is the data reduction process to obtain survey results and OD demands for the modeling developments.

1. Create HH Characteristics.xlsx using the Skytel file (survey file)
2. Generate all unweighted tables as defined in Section 5
3. Create travel logs in Travel Log_FINTRIP.xlsx using the Skytel.xlsx
4. Join these two tables (HH Characteristics.xlsx and Travel Log_FINTRIP.xlsx) in MS Access using Serial Number
5. Generate all tables in the joint table as defined from unweighted to weighted using the sample rates
6. Create aggregate tables for both modeling purposes and the modes (weighted)
7. Generate all tables in 6.7
8. Generate OD demands (TAZID_O, TAZID_D) by Aggregate Purpose, Mode and Time in Excel

Table 5 and Table 6 show UB Master Plan Land Use Categories which will be studied later, while Table 7 provides a relationship between the UB HH Travel Survey Location Types and Master Plan Land Use Categories.

Table 5: Master Plan Land Use Categories

#	Main Zones	#	Legends	Sub-zones	FAR	BCR
1	Residential Zones Орон сууцны бүс	1.1		Single family residential zone	0.4	0.2
		1.2		Low rise multifamily residential zone	0.6	0.2
		1.3		Mid-rise multifamily residential zone	1.2-2.1	0.4
		1.4		High rise, multifamily residential zone	3.2<	0.4
		1.5		Ger area zone Гэр сууцны бүс	0.1-0.25	0.125
2	Commercial Zones Олон нийтийн ажил хэргийн бүс	2.1		Commercial Zone Хотын олон нийтийн ажил хэргийн бүс (City level centers - Хотын түвшний төв)	10	0.5
		2.2		Commercial Sub-zone (District level centers - Дүүргийн төвшний төв)	5	0.5
		2.3		Sub-district Commercial Zone (Neighborhood level centers - Хорооллын түвшний төв)	2.5	0.5
		2.4		Various Commercial Zone Үйлчилгээний төрөлжсөн бүс	2.5	0.5
3	Industrial Zones Үйлдвэрийн бүс	3.1		Wholesales and Logistics Zone Тээвэр бөөний худалдааны бүс (логистик)	2.4	0.6
		3.2		Light Industrial Zone Хөнгөн үйлдвэрийн бүс	2.4	0.6
		3.3		Heavy Industrial Zone Тусгай үйлдвэрийн бүс	2.4	0.6
4	Green Zones / Ногоон байгууламжын бүс	4.1		Open Space / Задгай талбай	-	-
		4.2		Parks, Green Space Zone Цэцэрлэгт хүрээлэн, ногоон байгууламжийн бүс	-	-
5	Mixed Use Zones Холимог ашиглалтын бүс	5.1		Industrial and Residential zone Үйлдвэр суурин холимог бүс	2.5	0.5
		5.2		Commercial, Industrial and Residential Zone Худалдаа-үйлдвэр-суурин холимог бүс	2.5	0.5
		5.3		Commercial and Industrial Zone Үйлдвэр-худалдаа холимог бүс	2.5	0.5
6	Engineering Infra Zones Инженерийн шугам сүлжээний бүс	6.1		Engineering Infrastructure Zone Инженерийн дэрлэгт байгууламжийн бүс	-	-
		6.2		Engineering Lines and Networks Zone Инженерийн шугам сүлжээний бүс (roads, railway - авто зам, төмөр зам)	-	-
7	Special Purpose Zone Тусгай зориулалтын бүс	7.1		Special Purpose Zone Тусгай зориулалтын бүс	-	-
8	Summer House Zone Зуслангийн бүс	8.1		Summer House Zone Зуслангийн бүс	Currently located in the green zone of the City. It will stay as is as indicated in the Urban Development National Law. Нийслэлийн ногоон бүсэд байрлаж байгаа. Одоо мөрдөгдөж байгаа Хот байгуулалтын тухай хуулиар зохицуулж үлдэнэ.		
9	Agriculture Zone Хөдөө аж ахуйн бүс	9.1		Ag Zone Хөдөө аж ахуйн бүс		
TOTAL / НИЙТ					-	-

Table 6: Master Plan Land Use Categories

Major Categories	LU ID	Description Sub Categories	Sequence ID
орон сууц	1101	орон сууц	1
	1102	амины орон сууц	2
	1103	зуслангийн сууц	3
	1104	гэр хорооллын сууц	4
	1105	үйлчилгээтэй орон сууц	5
	1106	ажилчдын түр байр	6
	1107	/үйлчилгээтэй амины орон сууц/	7
албан контор	1206	гадаадын элчин сайдын яам, төлөөлөгчийн газар	8
	1201	улсын яам, тамгын газар	9
	1202	олон улсын байгууллага	10
	1203	эрдэм шинжилгээний байгууллага	11
	1204	албан контор	12
	1205	төрийн байгууллага	13
	1207	үйлчилгээтэй албан контор	14
Боловсрол	1301	цэцэрлэг	15
	1302	дунд сургууль	16
	1303	сургуулийн дотуур байр	17
	1304	мэргэжлийн сургалтын төв	18
	1305	их дээд сургууль	19
	1306	хүүхдийн сургалтын төв	20
	1307	коллеж	21
Эрүүл мэнд сувилал	1401	эмнэлэг	22
	1402	эрүүл мэндийн төв	23
	1403	өрхийн эмнэлэг	24
	1404	эмийн сан	25
	1405	рашаан сувилал	26
	1406	биеийн тамир, спорт заал	27
	1407	асрамжийн газар	28
	1408	халамжийн төв	29
	1409	хүүхдийн зуслан	30
	1410	амралт	31
Үзвэр, үйлчилгээ	1501	музей	32
	1502	театр	33
	1503	цирк	34

Table 7: Location Type and UB Master Plan Land Use Categories (TBD)

	UB Location		UB Master Plan	UB Master Plan Sub Categories
ID	Mongolian	English		
1	Орон сууц (Гэр хороолол)	Residence (Ger)	Residential	1.5 Ger Area Area
2	Орон сууц (Орон сууц)	Residence (Apartment)	Residential	1.2 and 1.3 Multi Families
3	Орон сууц (АОС)	Residence (House)	Residential	1.1 Single Families
4	Зочид буудал	Hotel	Commercial	
5	Сургууль/Цэцэрлэг	School/Kindergarten	Special Purpose	
6	Коллеж/Их дээд сургууль	College/University	Special Purpose	
7	Эмнэлэг	Medical facility	Commercial	
8	Дэлгүүр/Худалдааны төв/Гоо сайхан	Market/Shop/Service (barber, beauty shop, etc)	Commercial	
9	Банк	Bank	Commercial	
10	Төрийн үйлчилгээ/Орон сууцны контор	Public service/Utility company	Industrial	
11	Ажил (Өөриийн)	Other Office Business	Commercial	
12	Үйлдвэр/Цахилгаан станц	Factory/Power station	Industrial	
13	Агуулах	Warehouse	Industrial	
14	Барилгын талбай	Construction site	Industrial	
15	Ресторан/Баар	Restaurant/bar	Commercial	
16	Үзвэрийн газар	Entertainment	Commercial	
17	Цэцэрлэгт хүрээлэн	Park	Green	4.2 Parks, Green
18	Зуслан/Лагер	Summer house	Summer House	Summer House
19	Фитнесс	Fitness	Commercial	
20	Бусад албан байгууллага	Other Office	Commercial	
21	Сүм/Хийд	Temple/Mosque/Church	Special Purpose	
22	Онгоцны болон галт тэрэгний буудал Авто-Вокзал	Airport/Train station/Long distance bus station	Special Purpose	

It is noted that the land use data categories and the modeling land use categories and their units are not be same. In this case we need to establish a set of conversion factors to convert the land use data between these two data sets.

6 Survey Results

This chapter contains the summary tables and figures of the survey and is based on unlinked trips as defined. The results represent all households in the dataset collected and prepared by the ADB team. These results can be obtained and refined based on any new supplementary household surveys. Survey results include survey and demographic characteristics, travel behaviors, location types, trip purposes, trip modes, time of day, spatial and non-spatial based trip distribution by model purpose and mode. As part of references, general comparisons are made between a city in US and the UB.

It is noted that the following results are provided based on a reduced 0.5% samples in the UB area instead of the suggested 1% due to the time schedule and administrative constraints. Some quality verifications are performed for the actual samples surveyed in each TAZ and adjustment and expansion factors and it is observed that the reduced sample percentages are still distributed to evenly to these TAZs and no expansion is necessary at phase one for any income and car occupancy related samples.

6.1 Respondent Related Survey and Demographic Characteristics

The UB household survey area is shown in Figure 5. It is noted that the ADB team uses the HH Travel Survey data to produce the unweighted tables as part of quality control of the data. Table 8 through Table 20. Table 8 summarizes key HH Travel Survey trip statistics regarding genders, educations, employment status, U-Money cards, drive license, the number of household cars, car availability, household size, household monthly income, distribution of sampled households, age distribution, and unemployment status. In UB, the household size for interviewees with ages over 15 or older is 3.93, a total number of trips reported is 23,223 with an average daily person and household trips 2.79 and 10.43 respectively. There are more females interviewed than males as shown in Table 9.

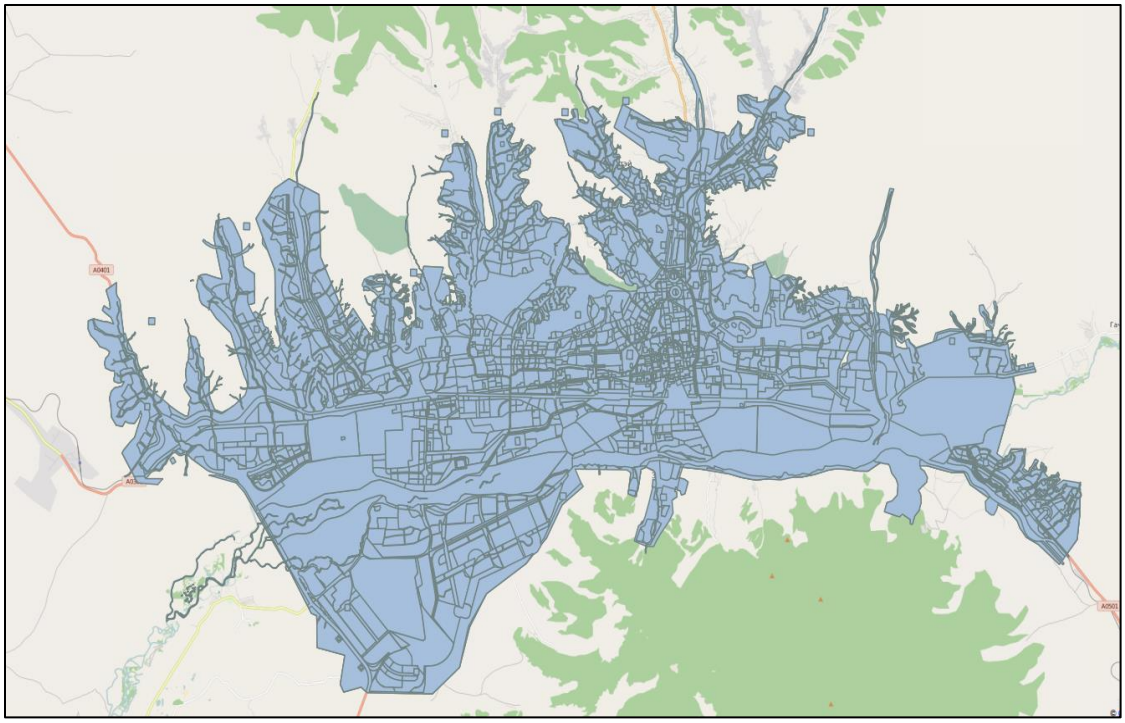


Figure 5: Map of the Household Travel Survey Study Area

Table 8: Key Household Travel Survey Trip Statistics (Adjusted)

Statistics	HH Survey
Household Size (15 and Older)	3.74
Total Household Trips	23,223
Transit Trip Percent	40.15%
Auto Trip Percent	44.14%
Bicycle Percent	0.37%
Ped. Percent	15.33%
Avg. Daily Household Trips	10.43
Avg. Daily Person Trips	2.79

Note: Unadjusted Household Size is 3.92.

Table 9: Gender Proportion

Sex	By number	Percent
Female	4917	61.5%
Male	3083	38.5%
Total	8000	100%

The percentage of respondents who reported were of education level university for 56.65 as may seen in Table 10.

Table 10: Education Proportion

Education Level	By number	Percent
Elementary/Secondary School	3447	43.1%
No education	24	0.3%
University or College	4529	56.6%
Total	8000	100%

While looking at employment status, 64% of respondents reported being employed. Table 11 illustrates the distribution of employment status.

Table 11: Employment Status Proportion with Employed and Unemployed

Employment Status	By number	Percent
Unemployed	1014	12.7%
Employed	5175	64.7%
Housewife or Housekeeper	651	8.1%
Schoolchild or Student	629	7.9%
Retired	531	6.6%
Total	8000	100%
If employed	By number	Percent
Government	1273	24.7%
Self-employed	1456	28.3%
Private sector	2418	47.0%
Total	5147	100%
If employed (Female)	By number	Percent
Government	824	28.0%
Self-employed	748	25.4%
Private sector	1376	46.7%
Total	2948	
If employed (Male)	By number	Percent
Government	463	19.9%
Self-employed	804	34.5%
Private sector	1062	45.6%
Total	2329	

Of the respondents who reported the use of U-Money Card is 56% as shown in Table 12.

Table 12: U-Money Card Proportion

U-Money Card	By Number	Percent
Yes	4491	56.1%
No	3509	43.9%
Total	8000	100%
U-money card (Female)		
Yes	2944	59.9%
No	1973	40.1%
Total	4917	
U-money card (Male)		
Yes	1547	50.2%
No	1536	49.8%
Total	3083	

Those who had a driver's license reported is 68%, while male licensed drivers reported is of 85.2% as compared to 14.8% for the female, as shown in Table 13.

Table 13: Drive License Proportion

Driving License	By Number	Percent
Yes	5475	68.4%
No	2525	31.6%
Total	8000	100%
Driving license (Female)		
Yes	2847	57.9%
No	2070	42.1%
Total	4917	
Driving license (Male)		
Yes	2628	85.2%
No	455	14.8%
Total	3083	

When household car ownership by the number of household cars, of those who responded, 34.6% is reported for no car (0). Thus, more than 66.5% of the respondents own more than one cars as seen in Table 14. There are 57.4 5 of respondents with a car available for travel and 34.4% with no cars as seen in Table 15.

Table 14: Household Car Ownership

Number of Household Cars	By Number	Percent
0	2769	34.6%
1	4607	57.6%
2	559	7.0%
3	65	0.8%
Total	8000	100%

There is 57.4% of respondents with a car available for travel and 34.4% with no cars as seen in Table *15*.

Table 15: Car Availability of the Travel Proportion

Was your car available to you yesterday?	By number	Percent
Yes	3003	57.4%
Yes, but couldn't use it (wrong license plate day)	430	8.2%
No	1798	34.4%
Total	5231	

Overall, 32.5% of respondents reported having 4 household members and just over 29% live in a large household of 5 or more persons. The results are presented in Table 16, which provides a distribution of the percentages of household size.

Table 16: Household/Household Size (Persons) Rates (Unadjusted)

Household Size (Persons)	By number	Percent
1	196	2.5%
2	837	10.5%
3	1981	24.8%
4	2598	32.5%
5	1534	19.2%
6	596	7.5%
7	169	2.1%
8	50	0.6%
9	25	0.3%
10	7	0.1%
11	6	0.1%
12	1	0.0%
Total	8000	
Average	3.92	

In looking at overall household monthly income distribution, a total of 67.3% of the respondents reported income in the range of less than 1,000,000₮, of these, 20.1% reported income as less than

500,000₮. The income range of 500,000₮ to 1,000,000₮ is the highest with 47.2% In the range of 1,000,000₮-1,500,000₮, 20.7% of the respondents reported income falling within that range; only 1.6% of the households reported income in the range 2,500,000₮ to more. Household income distribution is illustrated in Table 17.

Table 17: Household Monthly Income (MNT) Proportion

Household Monthly Income (MNT)	By number	Percent
0-500,000₮	1607	20.1%
500,000₮-1,000,000₮	3778	47.2%
1,000,000₮-1,500,000₮	1654	20.7%
1,500,000₮-2,000,000₮	644	8.1%
2,000,000₮-2,500,000₮	187	2.3%
2,500,000₮-more	130	1.6%
Total	8000	
Average		

Table 18 provides the distribution of the reported number of respondents in 7 districts. 24.6% of the respondents reported is in Bayanzurkh, while only 2.2%reported is within the district Nalaikh.

Table 18: Distribution of Sampled Households by District

District	Total Household	Percent
Sukhbaatar	868	10.9%
Bayangol	1610	20.1%
Songino Khairkhan	1797	22.5%
Nalaikh	173	2.2%
Chingeltei	775	9.7%
Khan-Uul	813	10.2%
Bayanzurkh	1964	24.6%
Total	8000	

The largest percentage of respondents was represented by the age group of between 25 and 54 years (working age group) at 78.2%. The next largest group was those younger between 18 and 24 with 24.2%. 7.4% and 2.0% of the respondents are between 55 and 64 and 65 years of age or older respectively. Table 19 shows respondent age distribution.

Table 19: Age Distribution

Age	By Number	Percent
15-17	113	1.4%
18-24	875	10.9%
25-54	6257	78.2%
55-64	593	7.4%
65+	162	2.0%

Of the respondents who reported no employment, 86.5% were for "Fit to Work", while others were for "Disable/Sick). Unemployment status is shown in Table 20.

Table 20: Unemployment Status, if Does Not Work

Unemployment Status	Counts	Percent
Fit to work	806	86.5%
Disable/Sick	126	13.5%
Total	932	

6.2 Travel Behavior Related Information

Overall, households with a higher household income reported an aggregated higher trip rate in a range from 9.64 to 13.27. The trip rate of households reporting income of >2,500,001₮ is highest among all groups at 13.27, while 1– person households, that reported household income of between 500,001₮ and 1,000,000₮ show the smallest trip rate at 2.35. The average household trips by household size and household income are shown in Table 21.

It is interesting that a similar observation can be seen in California. The trip rate of households reporting income of between $150,000 and $199,999 is highest among all groups at 11.1, while 1-person households, that reported household income of between $200,000 and $249,999 show the smallest trip rate at 3.0. The total household average daily trip rate is very similar in the range between 9.30 and 10.94. The average household trips by household size and household income are shown in Table 22. This table serves as a validation of the survey results.

Table 21: Average Household Trips by Household Size and Household Income

Average Household Trip Rates	Household Size												
Household Income	1	2	3	4	5	6	7	8	9	10	11	12	Total
0-500,000₮	2.35	5.04	7.71	10.11	12.82	14.40	18.85	29.19	37.81	19.21	21.13	23.05	9.64
500,001₮- 1,000,000₮	2.84	5.48	8.29	11.06	13.89	15.61	19.47	18.49	25.93	25.61	34.33		10.74
1,000,001₮-1,500,000₮	2.40	6.02	8.41	12.01	14.73	16.97	20.96	15.36	21.61		21.13		11.69
1,500,001₮-2,000,000₮	2.88	5.94	9.46	11.80	15.12	17.18	20.84	21.13	17.29				12.29
2,000,001₮-2,500,000₮	6.72	5.98	10.05	12.20	16.86	17.29	15.12	34.57					13.14
>2,500,001₮	3.36	4.80	11.20	13.21	13.58	19.59	13.44	38.41	17.29	57.62			13.27
Ave. Trip Rate	2.60	5.46	8.36	11.25	14.10	15.92	19.49	21.51	28.00	27.44	25.24	23.05	10.94

Table 22: Average Household Trips by Household Size and Household Income in California, US

Average Trips				
Household Income	1–Person Household	2-Persons Household	3-Persons Household	4 or more Persons Household
Less than $10,000	3.5	6.0	11.6	19.0
$10,000 to $24,999	3.2	5.9	19.0	3.2
$25,000 to $34,999	3.1	5.2	9.5	18.4
$35,000 to $49,999	3.4	5.5	9.2	17.8
$50,000 to $74,999	3.2	5.8	9.1	16.6
$75,000 to $99,999	3.7	5.9	9.6	16.3
$100,000 to $149,999	3.6	5.8	9.9	17.0
$150,000 to $199,999	17.0[1)]	3.4	10.3	16.9
$200,000 to $249,999	3.0	5.8	10.3	16.9
$250,000 or more	4.9	5.7	10.0	16.4
Total	7.5	7.3	11.5	9.3

Note: [1)] This number seems an outlier.

6.3 Location Types

It is noted that the locations visited or stayed of these respondents are Residences (Gel)- 19%, Residence (Apartment)-23%, Other Office Business (16%) and Martket-10%. Table 23 shows a summary of the location distribution.

Table 23: Trip Distribution by Location Type

Location Place Type in Mongolian	Location Place Type in English	Number of Location Place Type	Percent of Location Place Type
Stay at Home		961	4%
Орон сууц (гэр хорооллын)	Residence (Ger)	4362	19%
Орон сууцны контор-Төрийн үйлчилгээ	Public Utility	471	2%
Ажил	Other Office Business	3657	16%
Үйлдвэр, цахилгаан станц	Factory/Power Station	44	0%
Агуулах	Warehouse	15	0%
Барилгын талбай	Construction	34	0%
Ресторан, баар	Restaurant/BAR	183	1%
Үзвэрийн газар	Entertainment	94	0%
Цэцэрлэгт хүрээлэн.	Park	123	1%
Зуслан (лагер)	Summer House	137	1%
Фитнесс	Fitness	50	0%
Орон сууц (Орон сууцны хороолол)	Residence (Apartment)	5444	23%
Орон сууц (Орон сууцны хорролол гэх мэт)	Residence (Apartment)	17	0%
Бусад ажил оффис	Other office/business L6	481	2%
Бусад хүний ажил оффис	Other office/business L6	561	2%
Сүм хийд	Temple/Mosque/Church	58	0%
Онгоцны болон галт тэрэгний буудал Авто-Вокзал	Airport/Train Station	404	2%
Орон сууц (АОС)	Residence (House)	236	1%
Зочид буудал	Hotel	33	0%
Сургууль-Цэцэрлэг	School/Kindergarten	1768	8%
Коллеж, их дээд сургууль	College/University	553	2%
Эмнэлэг	Medical facility	819	4%
Дэлгүүр, худалдааны төв үйлчилгээний төв(үсчин гоо сайхан гм)	Market	2412	10%
Банк	Bank	305	1%
Grand Total		23223	100%

6.4 Trip Purposes

This section summarizes findings from the trips collected for trip purposes. A total of 22,258 respondents were collected. Findings are based on unweighted data. 36% of trips are of “Return Home” and 21% of trips are of “Travel to Work” or “Travel during Work”, while trips of “Personal Business” is within 15%. Table 24 provides further details on trip purpose distribution.

Table 24: Survey Trip Purpose

Purpose in English	Count of Trip Purpose	Percent
Return Home	8024	36%
Recreation or Fitness	106	0%
Medical	658	3%
Short errand (ATM/Gas)	131	1%
Civic or Religious	33	0%
Entertainment	52	0%
Travel to Work	3886	17%
Travel during Work	892	4%
Education	589	3%
Shopping 1	587	3%
Shopping 2	732	3%
Pick Up/Drop	1928	9%
Personal Business	3251	15%
Eat or Drink	215	1%
Visit Friends or Relations	1174	5%
	22258	100%

6.5 Mode Choices

On average, approximately 34% of trips made is made with mode "Bus/Trolleybus, while 38% with "Private Car or Van". It is noted that there is few bicycle (bike) trips and there is 15.3% of trips with mode "Ped.". Table 25 presents the average number of respondents by travel mode.

Table 25: Trip Distribution by Travel Mode (unweighted)

Mode	Numbers by Mode	Percent by Mode
Bus/Trolleybus	7,683	34.5%
Sharing Transport	618	2.8%
Midi-Bus	90	0.4%
Micro-Bus	544	2.4%
Professional Taxi	108	0.5%
Street Taxi	1132	5.1%
Private Car or Van	8568	38.5%
Motorcycle	15	0.1%
Bicycle	83	0.4%
Walk	3412	15.3%
Total	22253	100.0%

6.6 Time of Day

In examining hourly trip distributions, the highest peak times of travel were from 7 am to 8 am (9.27%) and 5 p.m. to 6 pm (9.24%). These results are shown in Figure 6 and Table 26 utilizing a 24-hour time interval of day. It is interesting to note that departure hours in California are one hour and three hours earlier in a.m. and p.m. which is due to the longer travel times in California in general as seen in Figure 7.

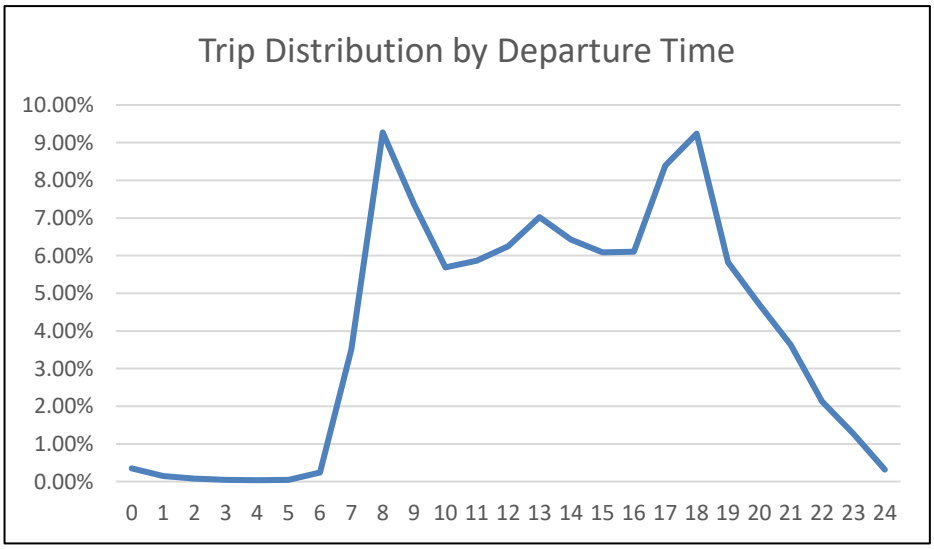


Figure 6: Trip Distribution by Time of Day Based on Departure Hours

Table 26: Hourly Trip Distribution by Departure Hour

Departure Time	Auto	Bike + Ped	Transit	Grand Total
0	0.6%	0.2%	0.1%	0.3%
1	0.3%	0.0%	0.0%	0.1%
2	0.1%	0.1%	0.0%	0.1%
3	0.1%	0.0%	0.0%	0.0%
4	0.1%	0.0%	0.0%	0.0%
5	0.1%	0.0%	0.0%	0.0%
6	0.3%	0.1%	0.2%	0.2%
7	2.9%	1.0%	5.2%	3.5%
8	9.4%	6.3%	10.3%	9.3%
9	7.5%	6.9%	7.4%	7.4%
10	5.4%	4.1%	6.7%	5.7%
11	5.3%	6.0%	6.4%	5.9%
12	5.8%	7.3%	6.4%	6.2%
13	6.4%	9.3%	6.8%	7.0%
14	6.0%	7.5%	6.5%	6.4%
15	6.0%	6.9%	5.9%	6.1%
16	5.6%	7.8%	6.0%	6.1%
17	7.8%	11.4%	7.9%	8.4%
18	9.0%	9.3%	9.4%	9.2%
19	5.9%	6.0%	5.7%	5.8%
20	5.0%	3.9%	4.7%	4.7%
21	4.4%	3.3%	2.9%	3.6%
22	3.3%	1.7%	1.0%	2.1%
23	2.3%	0.7%	0.3%	1.3%
24	0.6%	0.1%	0.1%	0.3%
Total	100.0%	100.0%	100.0%	100.0%

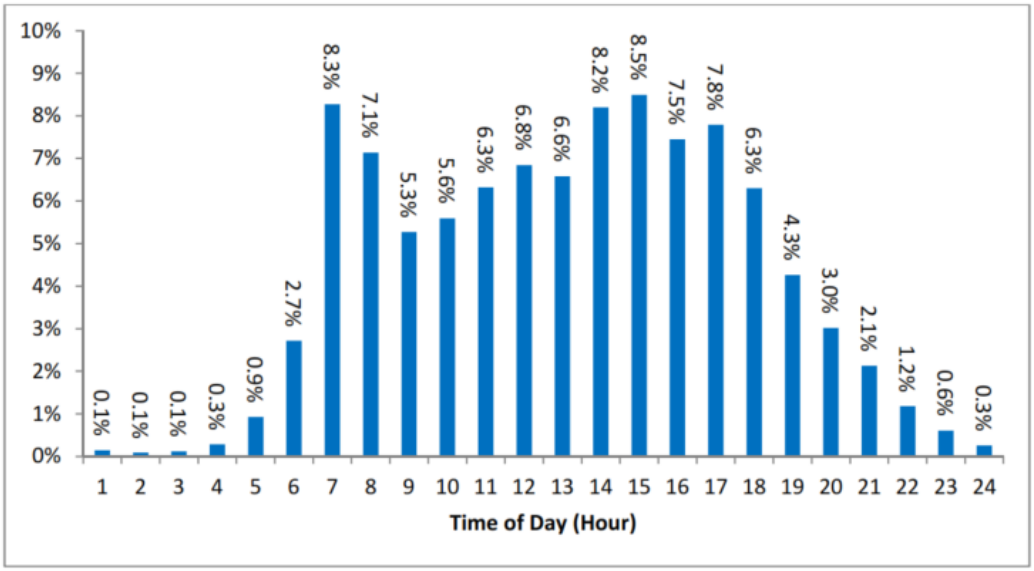


Figure 7: Hourly Trip Distribution by Departure Hours (California, US)

6.7 Non-Spatial Trip Based Distributions of Survey Trip Characteristics by Model Purpose and Mode

This section summarizes findings from all trips collected from the survey only. A total of 22251 trips were collected from the respondents. Findings are based on unweighted data. The corresponding relationships between the trip purposes defined the survey form and the modeling process are shown in Table 27. It shows that 36.42% and 37.63% of all trips are of trip purposes “Home-Based Other” (HBOther) and “Non-Home-Based” (NHB) while 13.27% is of “Home-Based Work” (HBWork).

The estimated trip percentages travelled over each time interval for each purpose in bars are shown in Figure 8. It is noted that a little more than 15% trips with purpose HBOther occur at 6:00 p.m., while NHB trips-10% take place between 1:00 p.m. and 5:00 p.m.

Table 27: Trip Distribution by Model Purpose

Trip Purposes (in Survey)	Aggregate Modeling Purposes	Trip Counts	Percent
Pick Up/Drop, Short Errand (ATM/Gas), Medical	Home-Based Other Trips (HBOther)	8103	36.4%
Education	Home-Based School (HBSch)	457	2.1%
Shopping	Home-based Shop (HBShop)	587	2.6%
Recreation or Fitness, Civic or Religious, Entertainment, Personal Business, Eat or Drink, Visit Friends or Relations	Home-Based Social and Recreational (HBSoc)	1778	8.0%
Travel to Work, Travel during Work	Home-Based Work (HBWork)	2952	13.3%
Return Home, All purposes in all Trips except the First and Last trip	Non-Home-Based (NHB).	8374	37.6%
	Total	22251	100.0%

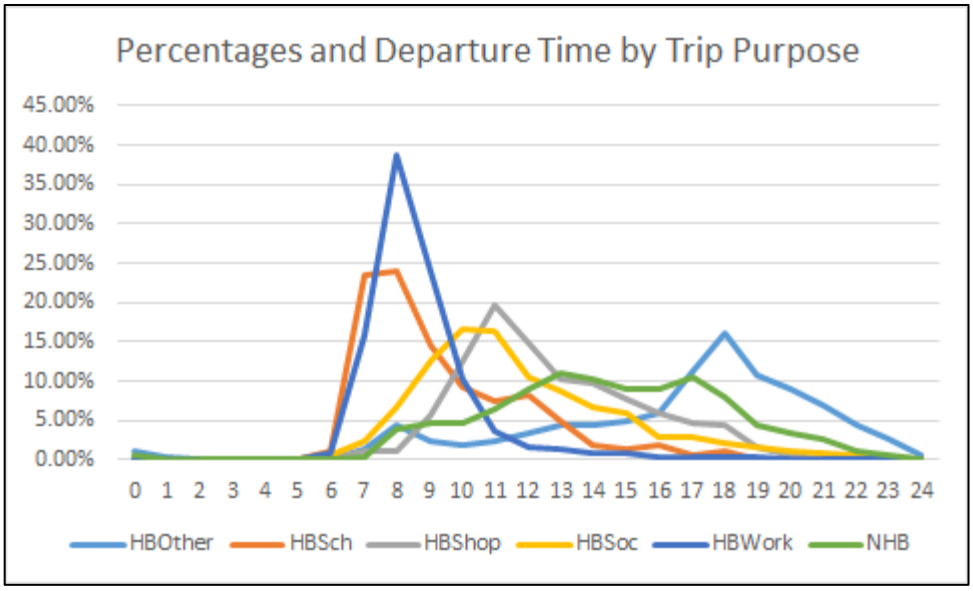


Figure 8: Trip Percentage and Departure Time by Trip Purpose

Figure 9 shows estimated trip percentages travelled over travel time interval for each purpose in bars. It is noted that within 10 min interval, the highest trip percentage is for HBShop, while within 50 min interval the highest trip percentage is for HBWork and the lowest is for HBShop in UB.

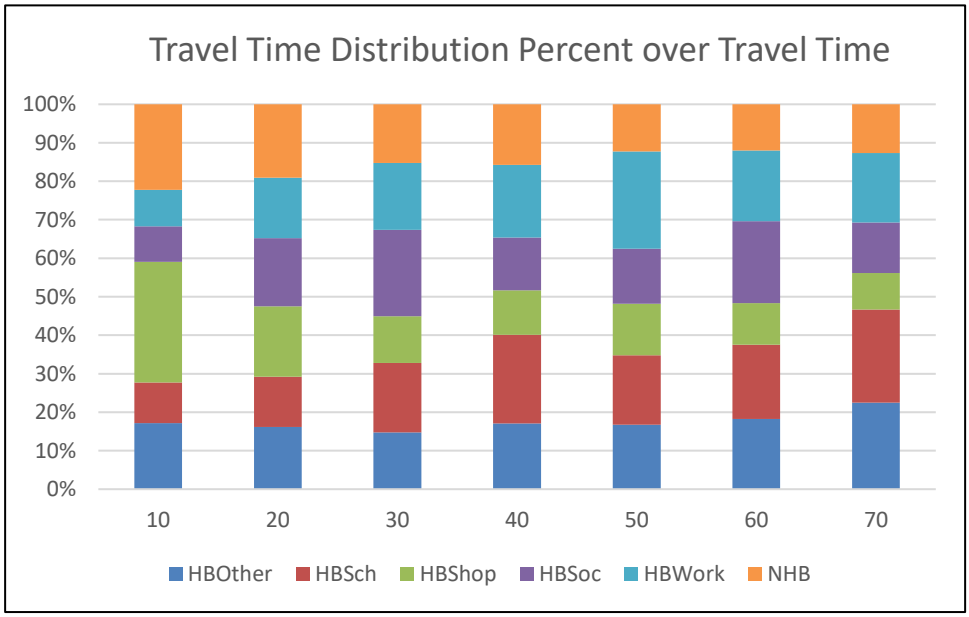


Figure 9: Travel Time Distribution Percentages over Travel Time (min.)

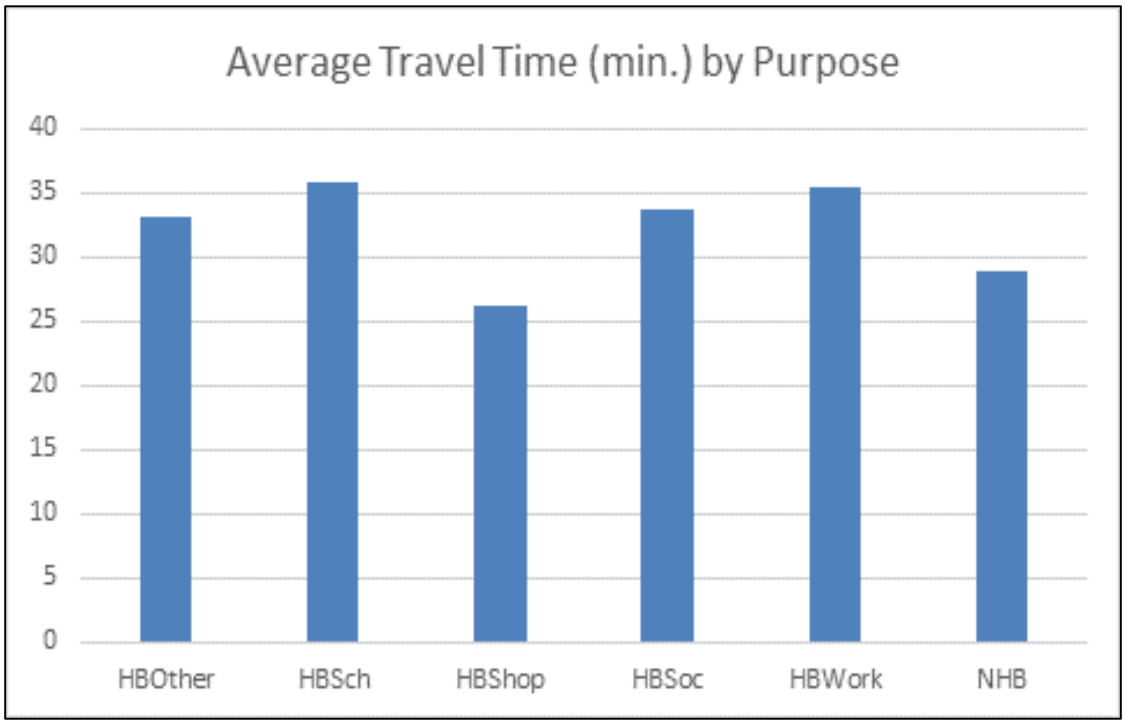


Figure 10: Average Travel Time (min.) by Model Purpose

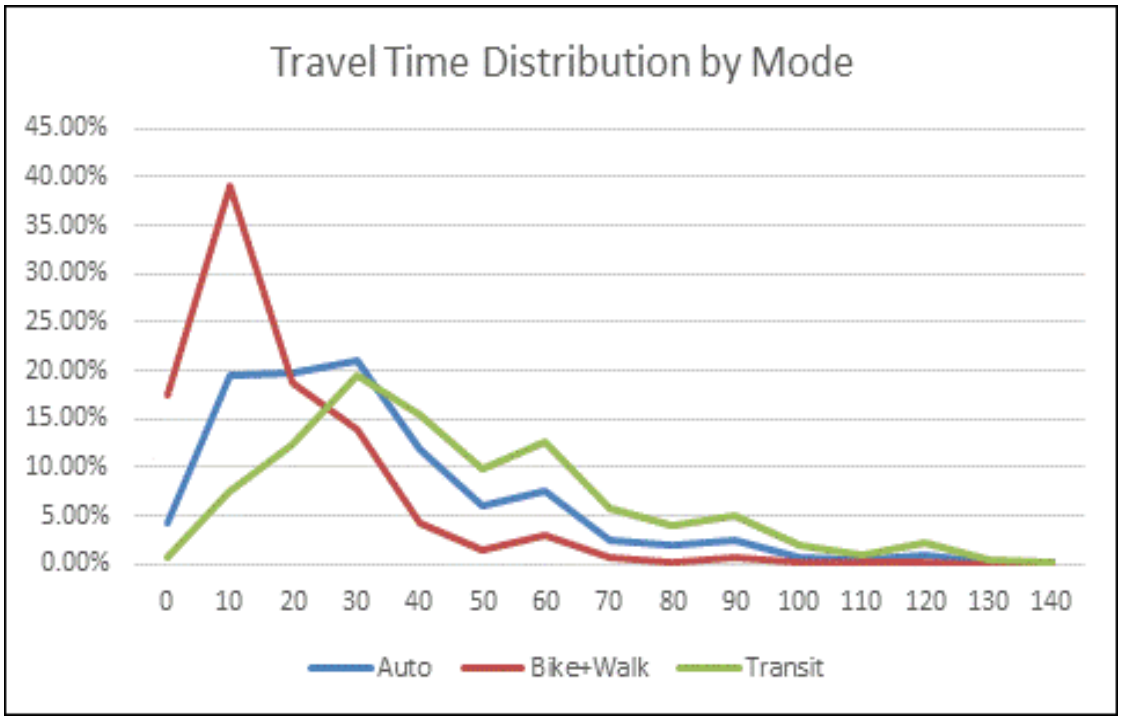


Figure 11: Distributions of Travel Time Duration (min.) by Model Mode

Figure 10 shows that the travel times of both HBSchool and HBWork are about the same. The HB School related trips are mainly made by the university and college students who might take buses to school, while the trips of HB Work may take auto vehicles to work. Estimated trip percentages travelled over each travel time for each mode in curves as shown in Table 29. It is noted that the trip percentage of Bike+Ped. is getting smaller and smaller quickly after 10 min from 40% of all modes within the travel time of 10, while the trip percentage for Auto is higher than Transit within 30 min and vice versa after min. For those who reported travel modes, the most popular mode of access for departing trips was auto driver (44%) and passenger (40%), as seen in
Table *28*. The average travel times for modes Auto, Bike+Ped. and Transit are 34 min., 18 min. and 48 min. respectively as shown in Table 29.

Table 28: Trip Distribution by Model Mode

Mode	Counts	Percent
Auto	9808	44%
Bike + Ped.	3495	16%
Transit	8935	40%
Grand Total	22238	100%

Table 29: Average Travel Time (min.) by Mode

	Auto	Bike + Ped.	Transit
Ave. Travel Time (min)	34	18	48

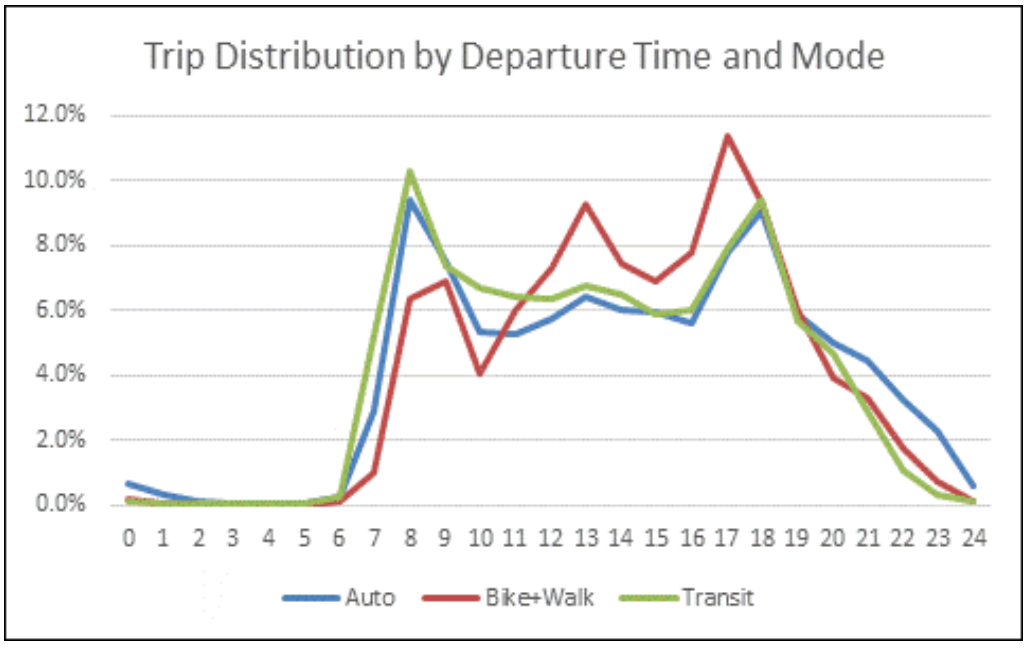


Figure 12: Trip Distribution by Departure Times (hr.) and Model Mode

Departure times for all Auto and Transit modes take place at 8 a.m. and 6:00 p.m., while the departure time for Bike and Ped. occurs one hour earlier at 5.00 p.m.

6.8 Spatial Based Trip Distributions of Survey Trip Characteristics

In this section, the travel demands estimated by a factor of 200 for each reported trip are shown in the US area by modes (Auto, Transit, Bike+Ped) and purposes.

Figure 13 shows total demands by modes located at each centroid of TAZ where TAZ boundaries are displayed as well. The desire lines of all daily origin and destination (OD) demands (larger than 500) are shown in Figure 14. In addition, the desire lines of all daily OD demands are shown in Figure 15 through Figure 18 from a TAZ in each of west, south, east and north area of UB. These demand patterns can be used to analyze any new transit lines to see if these suggested lines may serve the current OD demands.

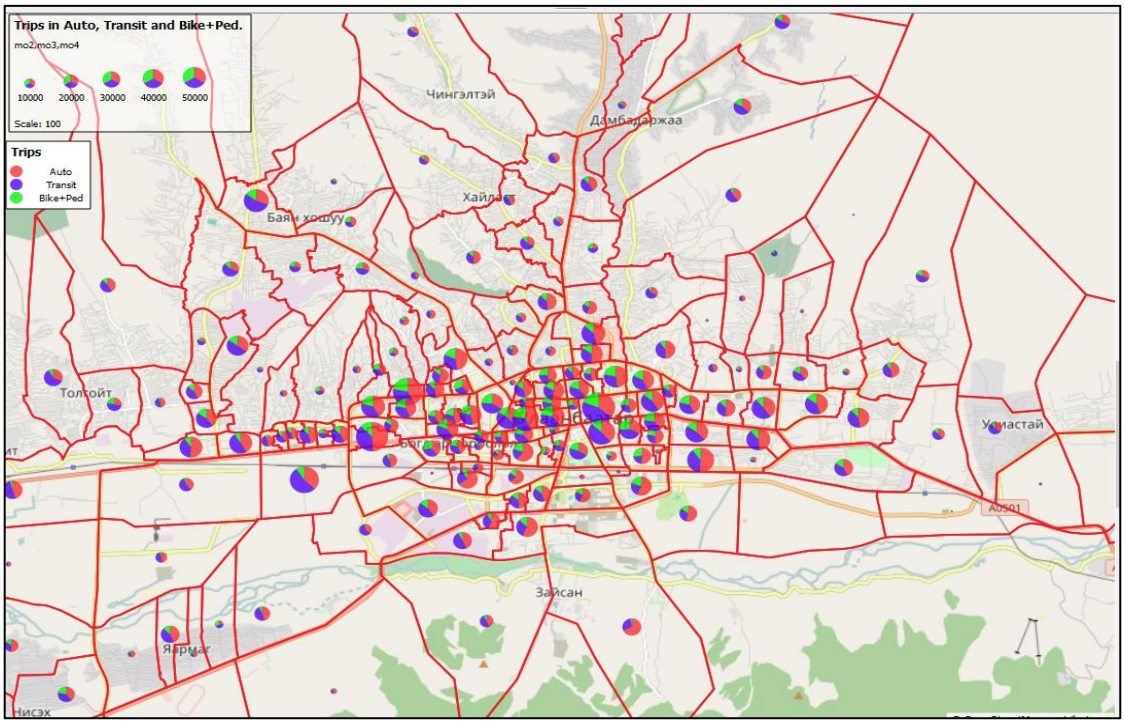


Figure 13: Total Demands Generated by Modes: Auto, Transit and Bike + Ped.

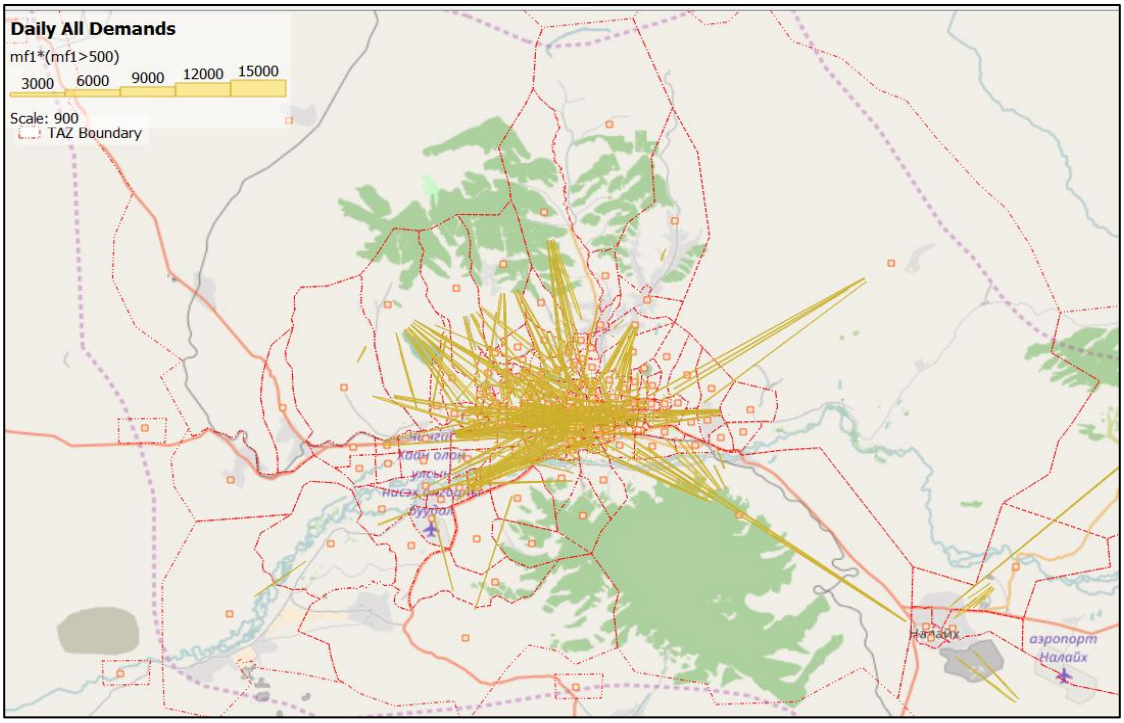


Figure 14: Desire Lines of All Daily Demands (>=500)

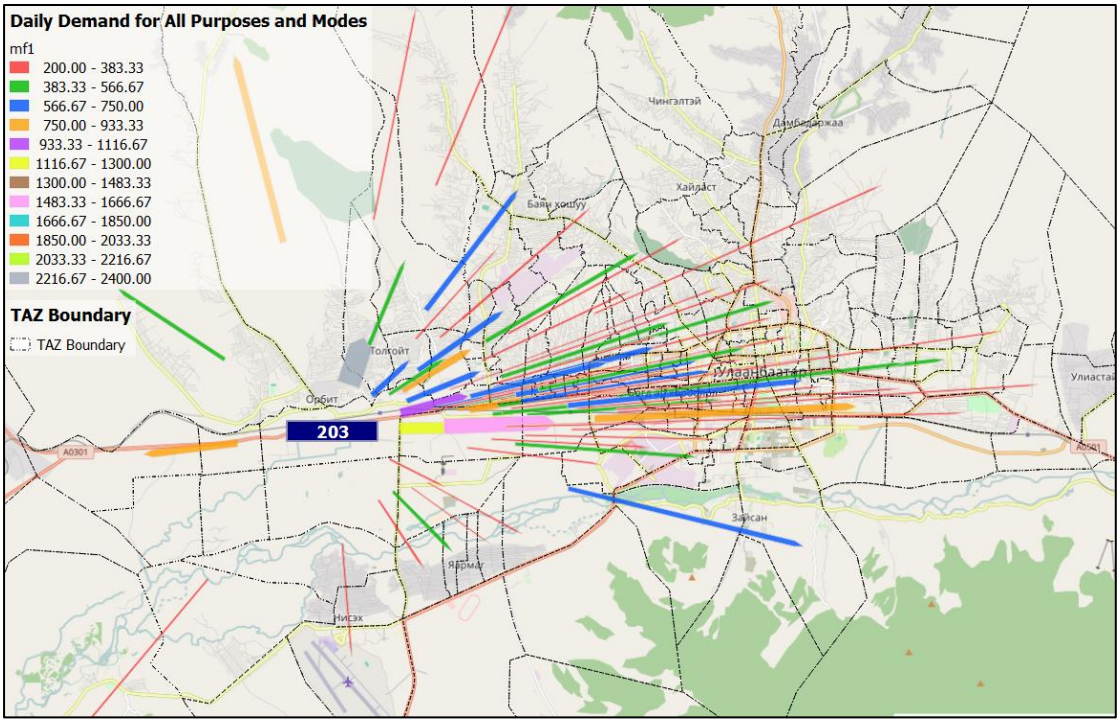


Figure 15: Desire Lines of All Daily Demands from Origin 203 (West) to All Other Destinations

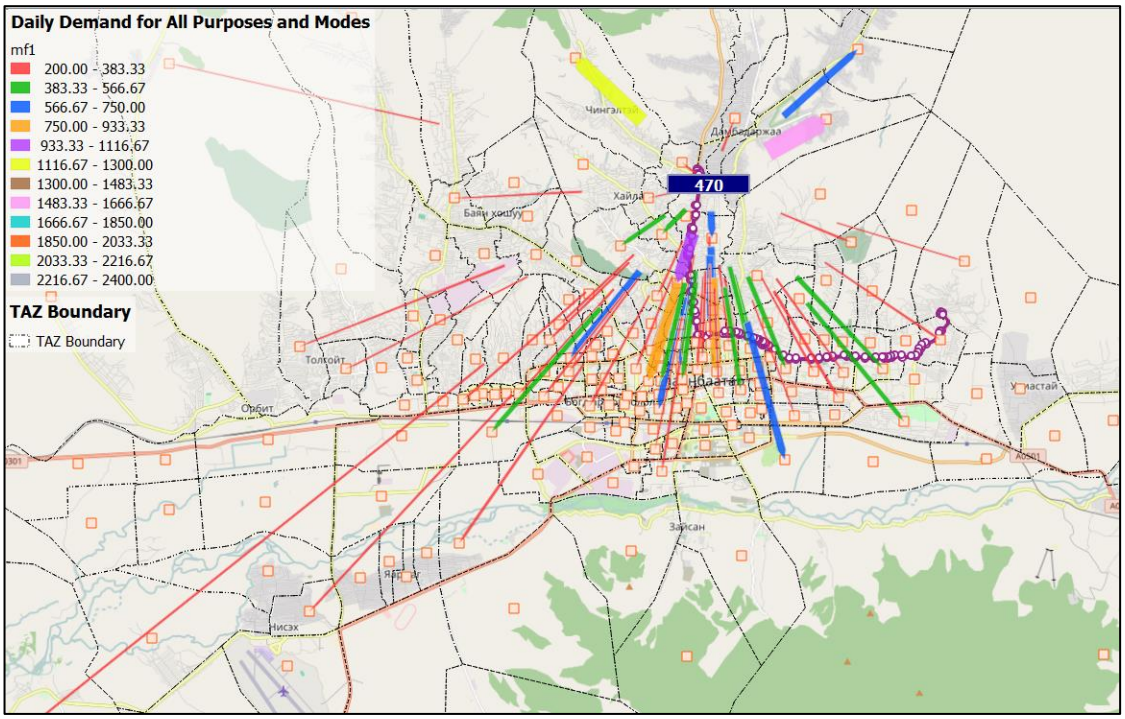


Figure 16: Desire Lines of All Daily Demands from Origin 470 (North) to All Other Destinations

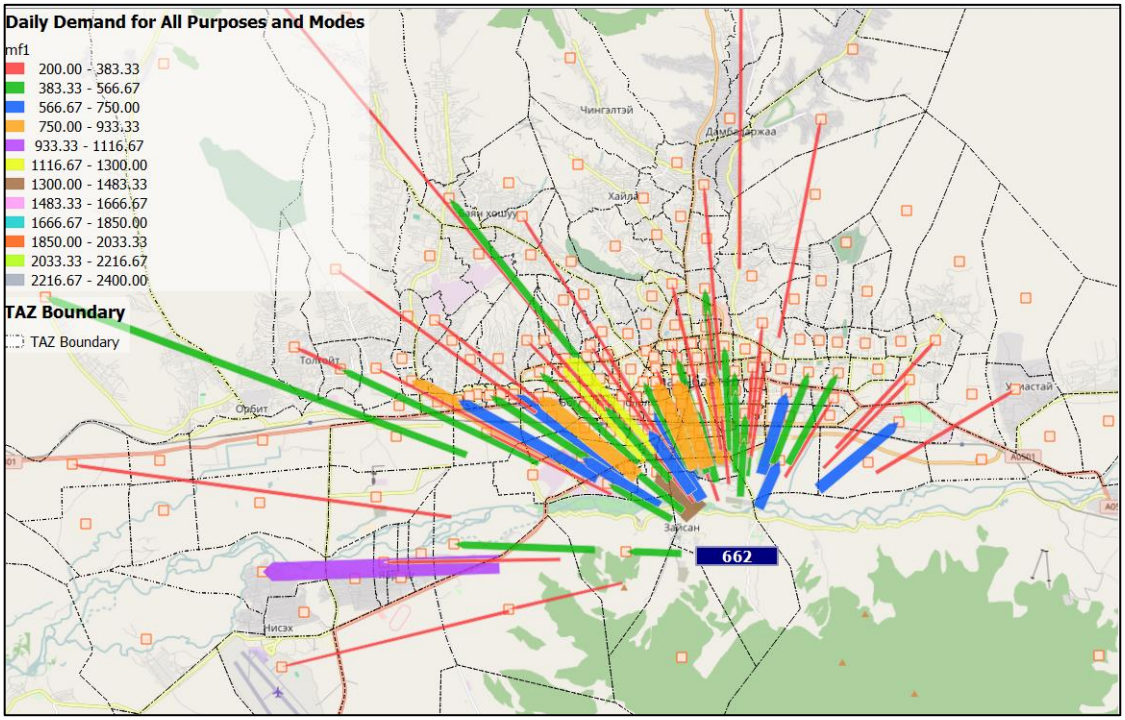


Figure 17: Desire Lines of All Daily Demands from Origin 662 (South) to All Other Destinations

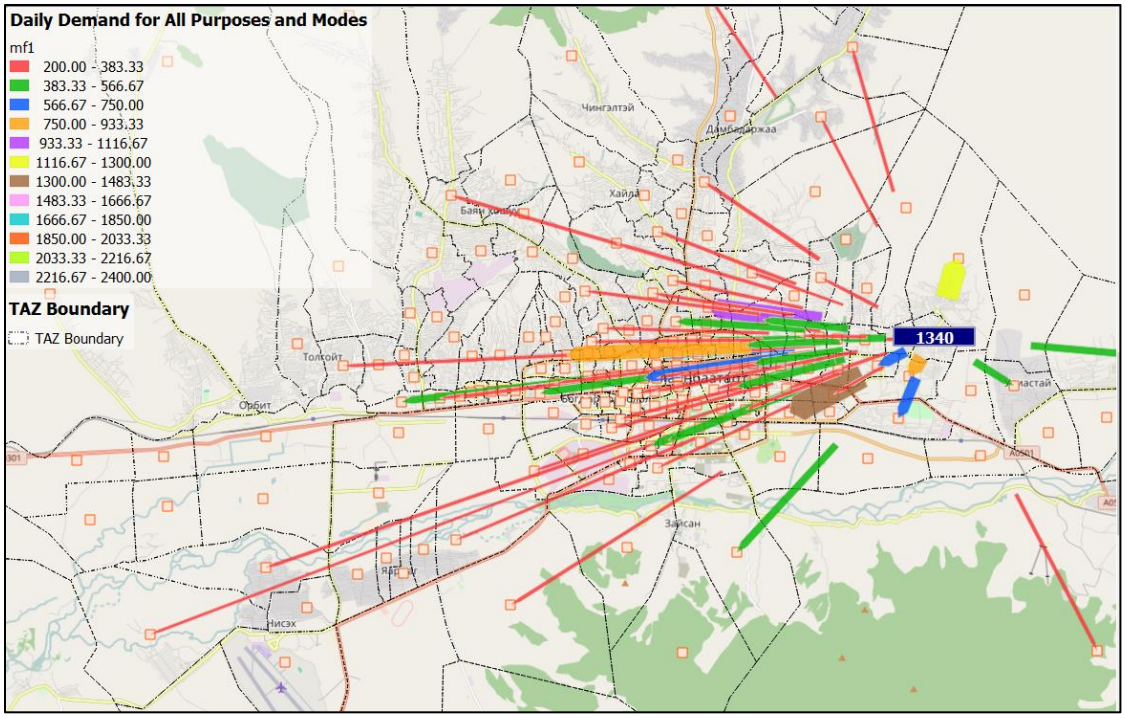


Figure 18: Desire Lines of All Daily Demands from Origin 1340 (East) to All Other Destinations

6.9 Result Comparison with a Similar City Reno in US

It is interesting to make a comparison between UB and a US city with similar household size as shown in Table 30 and Table 31. They show that both cities have very similar average personal, household daily trip rates, while on the other hand, UB has less household trip percentages for HBWork and a combined other HB purposes 12.62% and 46.20% as compared to 14.92% and 50.70% in Reno. Thus, both cities have some similarities and differences.

Table 30: Trip Rates in UB of Mongolia and Reno of US

City	Personal Ave. Trip Rate	Average Household Size	Daily Household Trip Rate
Reno in US[1)]	2.69 (2006)	3.74	10.05
UB in Mongolia Household Size from City's GIS)	2.79	3.74	10.43
UB in Mongolia Household Size from the Survey)	2.79	3.93	10.96

Note: [1)] HH Survey in Washoe County, US in 2004.

Table 31: Trip Percentages by Purpose in UB of Mongolia and Reno of US

City	Household Trip Percentages by Purpose						
	HBOther	HBSch	HBShop	HBSoc	HBWork	NHB	Total
Reno in US	1.5	0.82	2.05	0.72	1.5	3.45	10.04
	14.92%	8.20%	20.38%	7.20%	14.92%	34.37%	
	50.70%				14.92%	34.37%	
UB in Mongolia							10.43
	34.38%	2.47%	2.54%	6.81%	12.62%	41.18%	
	46.20%				12.62%	41.18%	

7 Conclusions and Recommendations

In this report, the survey objectives and general approach are discussed. The survey design and method are also documented. The interview and data process procedures are defined. Survey results are reported in tables and figures, which seem reasonable and logical for the UB area at the aggregated level not at the specific TAZ level due to the sample size, that is, 0.5% of total families surveyed.

This survey was conducted for the first time in the UB area and will serve an important benchmark for the household travel characteristics in this area. Basically, this survey shows that the daily person trip rate and household trip rate are 3.93 and 10.96 respectively, which are comparable other cities.

Household socioeconomic characteristics that affected the different trip purposes and modes and the timing of trips made by households in the UB area are analyzed and reported. These findings will help get a better idea of travel behaviors in the area. A daily household trip rate of 10.94 varies by income, trip purpose and household size. This behavior is very similar but a little higher than in some cities in China and US.

On the other hand, household demographic characteristics show the different patterns of trips made everyday by purpose and mode. This survey shows that for home-based work, and home-based school trips, the socioeconomic characteristics of households explained a significant amount of the variation in trip making. Home-based work (HBWork) related trips are 13.3%, while the non-home based (HBOther) trips are 36.4%. The Home-base school (HBSch) is only 2.1%, which could show that only college students were counted. Other trip purposes (home-based shopping, recreation, and non-home-based non-work trips) show larger variations in the number of trips as compared to other cities. For example, home-based-shopping related (HBShop) trips are only 2.6%, which is very low as compared to other cities in China and US. This might mean lower services of the shopping centers and services are provided in the area and in the winter. It is interesting to see if this rate would be higher in summer.

The choice of transportation mode (walk, bike, school bus, transit, private vehicle, or other) and whether people decided to carpool or drive alone also reflected the UB travel conditions. The share of the auto

mode related trips is 44%, while that of the transit mode related trips is 40%, which is higher than many cities in China. Thus, an effective BRT system and conventional transit network would help attract more transit related trips and therefore possibly reduce the auto related trips.

In hourly trip distributions, the highest peak times of travel were from 7 a.m. to 8 a.m. (9.27%) and 5 p.m. to 6 p.m. (9.24%). It is interesting to note that departure hours in California are one hour and three hours earlier in a.m. and p.m. which is due to the longer travel times in California in general. Thus, this travel behavior is unique in the UB area.

Respondents estimated travel times for trips reported in this survey. It is noted that the transit mode related trips take an average of 48 minutes as compared to 34 minutes of the auto mode related trips. This shows that the auto mode is still an attractive mode for travel with less travel time especially in the winter time.

This survey shows that average travel times of both HBSchool and HBWork are about the same. The HB School (HBSch) related trips are mainly made by the university and college students who might take buses to school, while the trips of HBWork may take auto vehicles to work. Travel times for non-home-based work (NHB) related trips and home-based shop are 29 minutes and 26 minutes respectively. These travel behavior trends were comparable to other cities as well.

The survey is used to generate origin and destination demands by model mode and purpose in Excel, which can be imported into any demand forecasting software. The survey data and many results are organized in Excel called “Survey Data and OD Demands”.

In this survey, although the ADB did its best to prepare the survey and process the survey data, there were many lessons learned and recommendations for any future survey improvements. This section presents the collective lessons learned and recommendations for the next 0.5% samples or more.

1) Survey Administration and Governance: To conduct the survey, transportation planning agencies around the UB came together with the ADB team to pool their resources to develop a common survey that could be used for many purposes in the future. Having a single, common survey meant that a single contractor would be responsible for data collection, which ensured that the survey methods were consistent, as were the resulting data and data elements. A single city effort also allowed participating agencies to share and build staff experience and expertise and share the costs of survey development. From a governance and process point of view, there were many aspects that worked well, such as:
    a. The City government, ADB and local mobile phone company participation developed to support the survey --having an City government ensured survey decisions and process were discussed and made by the appropriate and informed group.
    b. The use of expert advisors, the ADB team to provide technical guidance in the development of the survey design and results throughout the survey process and data process.

c. There were some aspects of the survey administration that did not work as well as they could have, and recommendations for future studies include.

Recommendation 1: Ensure that the contracting process allows for flexibility and change, especially in this survey or surveys that span a long period.

Recommendation 2: Extend the survey timeline to: a) add more time for coordination and decision making when there are many partner agencies, and b) add more time between the pretest and the main survey to permit thorough review and changes to be made and re-tested, if needed.

2) Public Outreach: The need for public outreach and awareness of the survey effort cannot be overemphasized. Travel behavior surveys ask questions that are considered intrusive by many potential respondents, and having a level of awareness that the survey is a legitimate effort can only assist in increasing the response rate. This is especially true for groups that are typically under-represented, including travelers that are young, and/or low-income in the UB area.

Recommendation 3: Incorporate a comprehensive outreach program into the survey design and process early on, whether the outreach is to be conducted by the sponsoring agency (UB City) or by a survey contractor.

The outreach effort, whether executed by sponsoring agency staff or by the ADB team, should be part of the survey design planning. If agency public relations staff are to execute the outreach, these staff should be part of the survey design team and play an active role in the survey from the beginning of the design discussions through to the end of data collection.

3) A Full Survey with 1% of Households as Samples: In Phase One, 0.5% of households were surveyed du to the time available.

Recommendation 4: Perform another survey for another half samples with the same methodology and data process procedure as Phase Two, together with surveys of traffic counts in early 2017. Other survey sources may include web-based surveys and cell phone data.

4) Applications of the Survey Data: The preliminary results show that the survey information can be well used for the analysis of the existing and future transit lines and even road planning purposes. In addition, a new UB model will be developed based on this set of data and can be calibrated to these observed travel data.

Recommendation 5: Conduct additional reviews of these results and in addition, perform transit and traffic assignment and compare to the existing traffic and transit counts as part of model calibrations. Thus, a UB transportation model for the existing year can be established and analyzed in detail, even the existing land use data for the modeling purposes are not available yet.

5) Updates of the Survey Data on A Regular Basis: This survey data can be updated on a regular basis, say, every year as a minor update and every five years as a major update.

Recommendation 6: Build up a local knowledge on travel patterns and identify the annual or five-year changes in these patterns to support the transportation investments and the travel demand forecasting model as well using travel data sources including web surveys and mobile data from mobile phone companies.

8 References

1) California Department of Transportation, 2010-2012 California Household Survey, Final Report, Version 1.0, June 14, 2013.
2) Skytel, HH Travel Survey-Project Document, May 29, 2016
3) Skytel, Outbound Interview Report-HH Travel Survey, ADB, May,26, 2016

9 Appendices

9.1 Outbound Interview Report-HH Travel Survey Document

OUTBOUND INTERVIEW REPORT

HH Travel Survey, ADB

Contents

Улаанбаатар

2016.05.26

SUMMARY

Survey method:	1. Telephone /outbound interview 2. SMS confirmation from Interviewee before interview
Survey dates and times	2016/05/17 10:00 -2016/05/21 21:00
Sampling size	8000 successful interview: • Skytel -20%, • Unitel -35%, • MobiCom -45%
Average call duration	14 minutes per interview
Average duration for TAZ code registration	Additional 3 minutes per interview
Phone number for outgoing call	+976-9000 1020
Phone number for SMS survey	131090

SMS QUESTIONNAIRE FOR CONFIRMATION FROM INTERVIEW BEFORE INTERVIEW

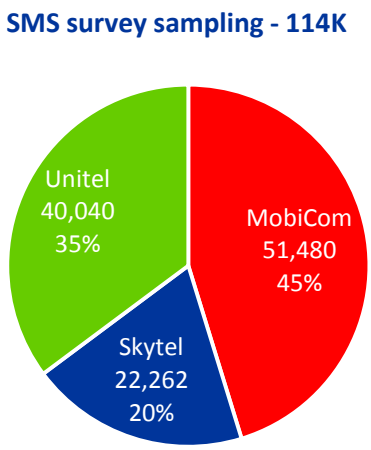
Below two SMS questionnaires were broadcasted to 113,782 active customers of Skytel, Unitel and MobiCom in order to qualify and select customers for telephone/outbound interview which distributed in 182 khoroo of 9 districts in Ulaanbaatar.

SMS questionnaire:

SMS1: Ta Niisleliin teevriig saijruulah zorilgotoi zorchih hudulguunii sudalgaand oroltsoj 5000 negj uramshuulal avaarai. Oroltsoh bol tiim gsn sms ilgeene uu.

SMS2: Sudalgaand oroltsoh burtgeld hamragdlaa. Ta uuriin orshin suugaa duureg horoony medeellee ilgeene u. Hariu sms unegui. (Jishee ni: BGD-5 Khoroo)

Totally, 18.4K customers responded to the Questionnaire completely and those qualified customers were selected for further telephone / outbound interview.



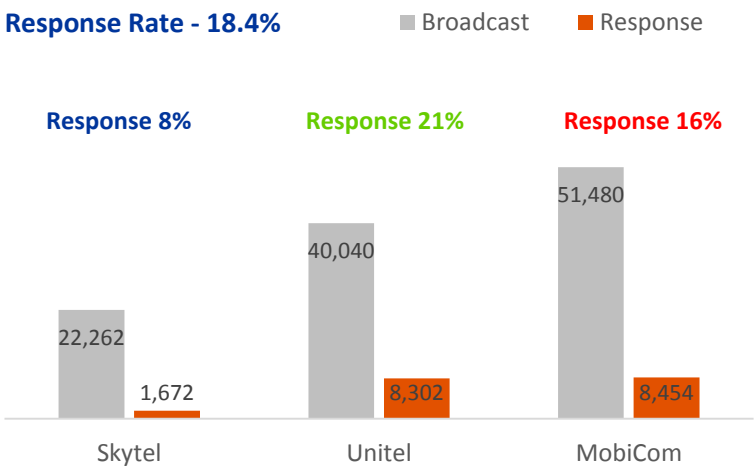


Table 1: SMS survey sampling distribution by Districts

Districts	Total		Skytel		Unitel		MobiCom	
	Broadcast	Response	Broadcast	Response	Broadcast	Response	Broadcast	Response
Sukhbaatar	10,556	2867	2245	204	4,064	815	5,225	870
Bayangol	19,734	4904	4227	319	7,598	1,182	9,768	1,544
Songinokhairkhan	22,386	6386	4838	356	8,619	2,116	11,081	1,762
Nalaikh	3,159	661	672	18	1,216	200	1,564	150
Chingeltei	11,661	3425	2475	221	4,489	1,123	5,772	1,005
Khan-Uul	10,504	2933	2238	146	4,044	923	5,199	886
Bayanzurkh	26,000	7035	5567	408	10,010	1,943	12,870	2,237
Total	**104,000**	**28,211**	**22,262**	**1,672**	**40,040**	**8,302**	**51,480**	**8,454**

* Broadcast – Total number of customers who received SMS questionnaire

** Response – Total number of customers who responded completely to the SMS Questionnaire

TELEPHONE /OUTBOUND CALL CONNECTION REPORT

Totally, 11.5K outbound calls made to customers and connected to 9.6K customers. Below Graph and table shows the Connection rate of total outbound calls.

Connection Rate

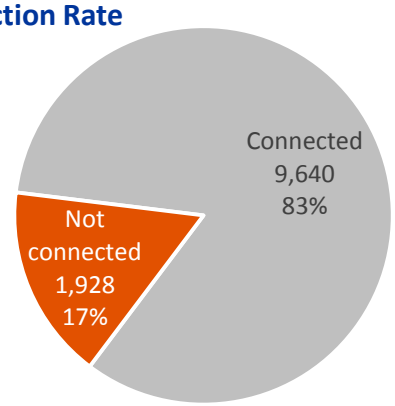


Table 2: Connection report

Total call attempts	11,568
Connection total	9,640
~ Successful interview	**8,000**
~ Unsuccessful	1,640
Calls not connected	1,928
~ Out of network	326
~ No answer	1,602

During the outbound calls, totally 1,640 customers refused to answer the interview and the reason of refuse is shown in table 3.

47% of total respondents refused to answer the questions, 39% of them said busy at the moment and other reasons are consisting 14%.

Table 3: Reason for unsuccessful interview

Reason	Unsuccessful interview	Percentage in total
Refused to give personal information	5	-
Driving at the moment	6	-
Requested to call back	7	-
Rural customer	9	1%
Voice is not clear	14	1%
Rearranged time for interview	21	1%
Not in UB at the moment	21	1%
Calls disconnected during interview	50	3%
Under 15 years old	93	6%
Busy	638	39%
Refused to answer questions	776	47%
Total	1640	100%

TELEPHONE / OUTBOUND INTERVIEW

Outbound call interview was conducted from 8,000 qualified and selected customers during 17-21 May, 2016 as planned initially. 3,960 interviewees from total are MobiCom customers, 3,080 are Unitel and 960 interviews are Skytel customers.

Number of Successful interviews

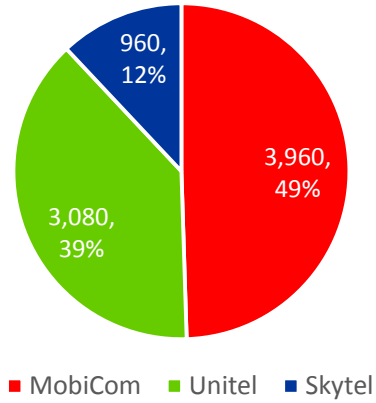


Table 4: Interviewees' location distributed by districts

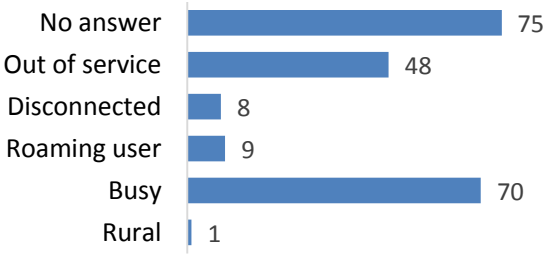
Districts	Total	Skytel	Unitel	MobiCom
Sukhbaatar	868	125	319	424
Bayangol	1610	179	616	815
Songinokhairkhan	1797	192	662	943
Nalaikh	173	8	84	81
Chingeltei	775	125	298	352
Khan-Uul	813	107	324	382
Bayanzurkh	1964	224	777	963
Total	**8,000**	**960**	**3080**	**3960**

In addition, according to the request of ADB team, 50 successful interviews were conducted from randomly selected MobiCom customers, whose phone number prefix is between 9900xxxx-9909xxxx.

Table 5: Random calls to MobiCom customers

Connection total	261
~ Successful interview	50
~ Unsuccessful /interview refused	88
~ Not connected	123

Not connected calls



--- END ---

9.2 HH Travel Survey-Project Document

HH Travel Survey

Project Document

@Version: 1.03

Ulaanbaatar, Mongolia

2016.05.09

HH TRAVEL SURVEY

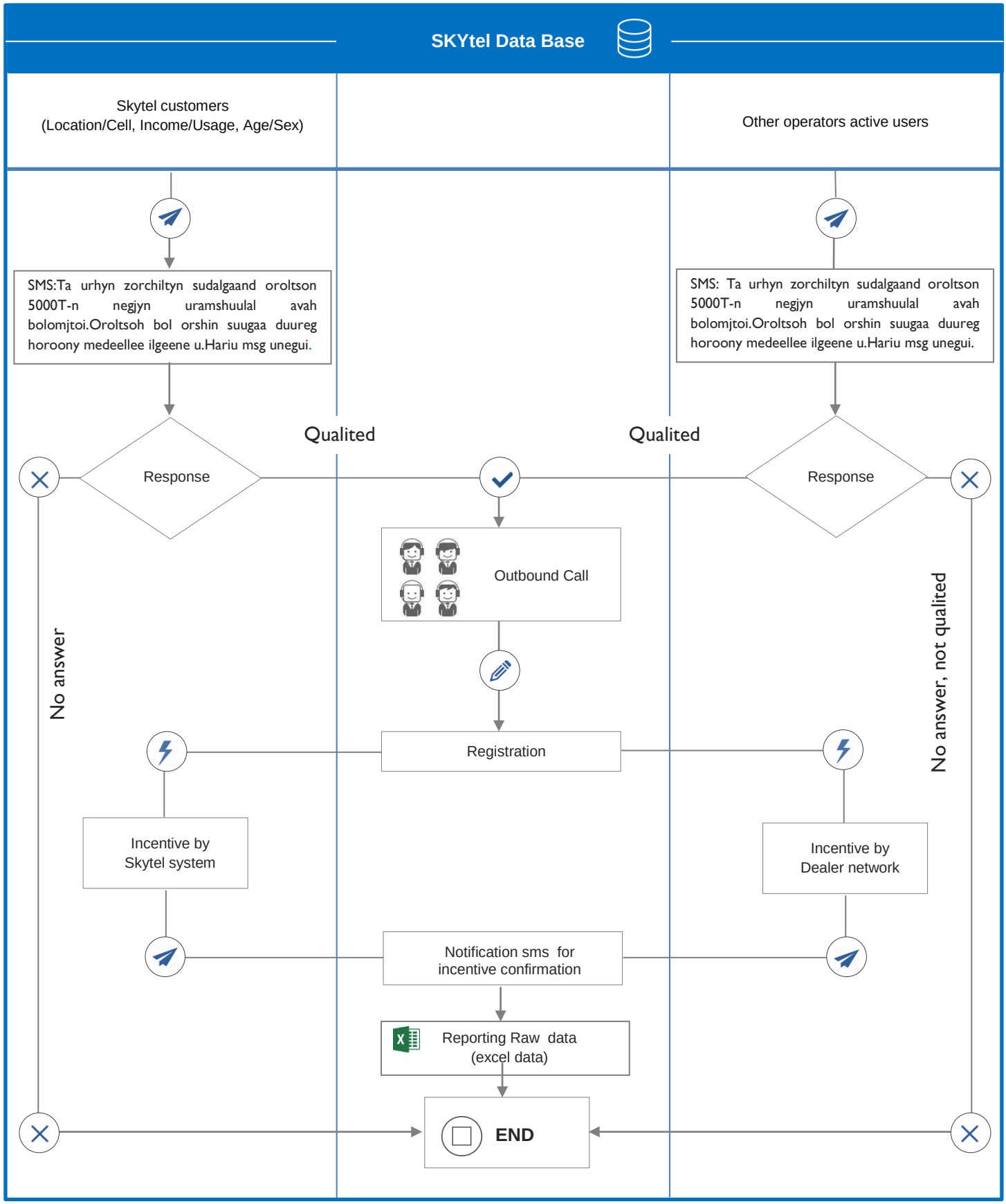
Survey method:	Telephone /Outbound call interview
Survey dates and time:	May 16-23 from 9:00 a.m. to 9:00 p.m
The total samples:	8,000 UB citizens distributed for traffic analysis zones (TAZ)
Sampling:	Mobicom – 45%, Unitel – 35%, SkyTel – 20%
Time for each interview:	average 14 minutes
Interviews/day:	1,600
Required seats /booths:	40-50 seats /7 days
Call records /notes:	Provide randomly selected records in audio file format (*.vox)
Deliver an incentive package:	MNT 5,000 as credit/top-up for each interviewee
SMS notifications:	- confirmation from Interviewee before interview
	- Incentive package confirmation after interview

SMS SURVEY TEXT:

SMS1: Ta Niisleliin teevriig saijruulah zorilgotoi zorchih hudulguunii sudalgaand oroltsoj 5000 negj uramshuulal avaarai. Oroltsoh bol tiim gsn sms ilgeene uu.

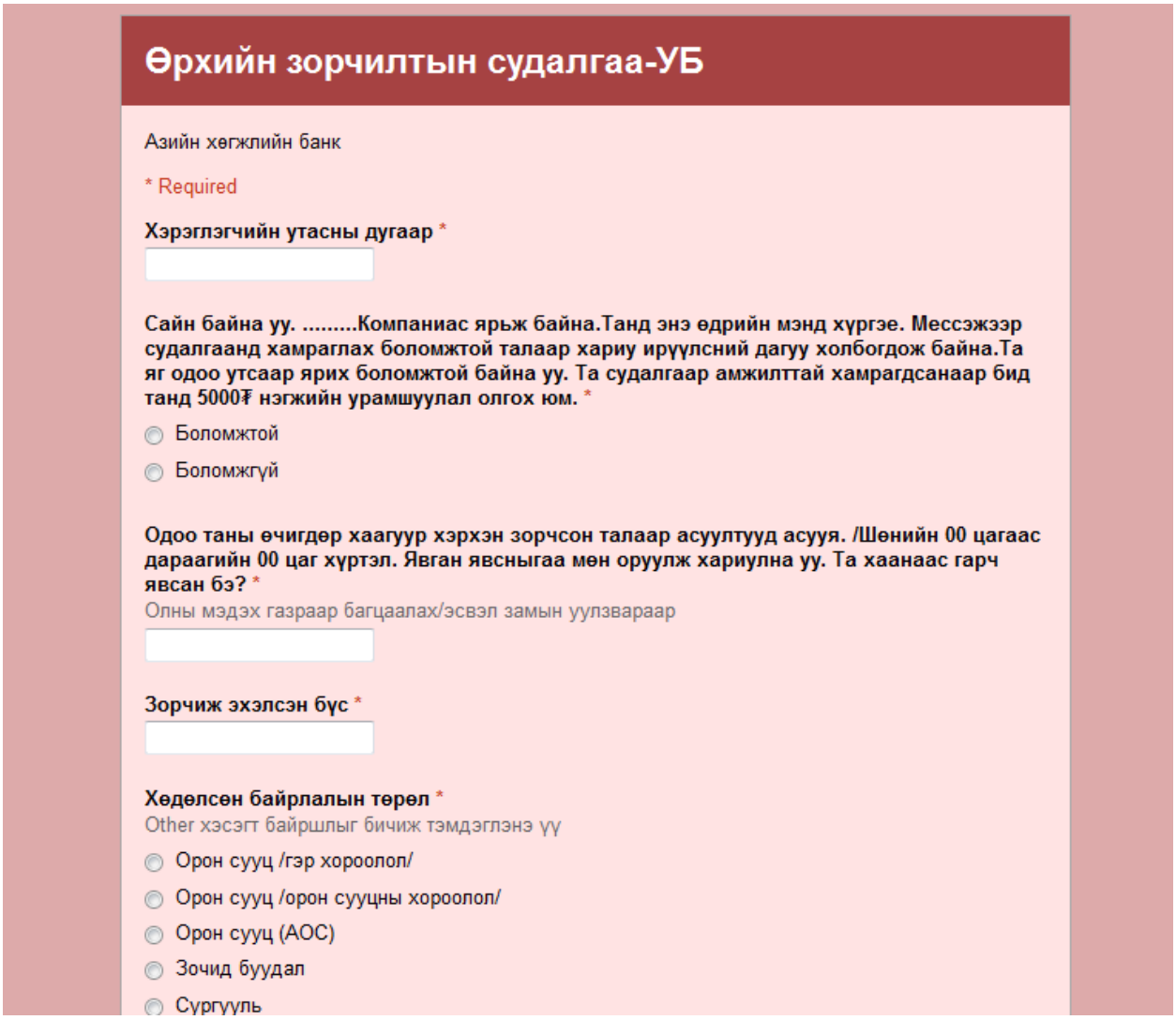
SMS2: Sudalgaand oroltsoh butgeld hamragdlaa. Ta uuriin orshin suugaa duureg horoony medeellee ilgeene u. Hariu sms unegui. (Jishee ni: BGD-5 Khoroo)

DATA COLLECTION PROCEDURE



OPERATOR INTERFACE /SAMPLE

The questionnaire will be inserted into outbound survey SW as shown in below picture and the SW enables to make survey notes in same format. After completing survey, inserted data will be converted into excel file for reporting.



Өрхийн зорчилтын судалгаа-УБ

Азийн хөгжлийн банк

* Required

Хэрэглэгчийн утасны дугаар *

Сайн байна уу. .....Компаниас ярьж байна.Танд энэ өдрийн мэнд хүргэе. Мессэжээр судалгаанд хамраглах боломжтой талаар хариу ирүүлсний дагуу холбогдож байна.Та яг одоо утсаар ярих боломжтой байна уу. Та судалгаар амжилттай хамрагдсанаар бид танд 5000₮ нэгжийн урамшуулал олгох юм. *

- Боломжтой
- Боломжгүй

Одоо таны өчигдөр хаагуур хэрхэн зорчсон талаар асуултууд асууя. /Шөнийн 00 цагаас дараагийн 00 цаг хүртэл. Явган явсныгаа мөн оруулж хариулна уу. Та хаанаас гарч явсан бэ? *

Олны мэдэх газраар багцаалах/эсвэл замын уулзвараар

Зорчиж эхэлсэн бүс *

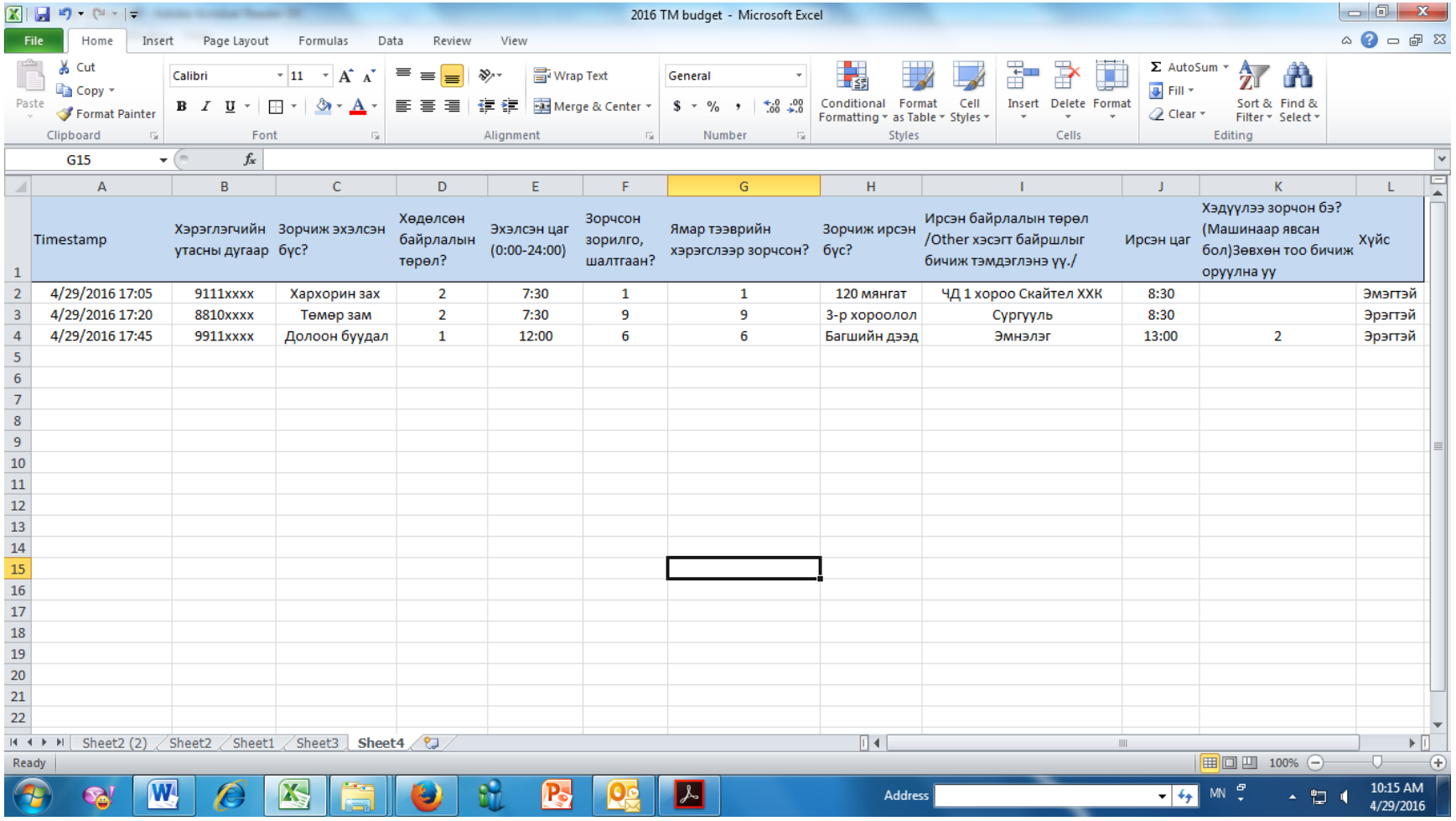
Хөдөлсөн байрлалын төрөл *

Other хэсэгт байршлыг бичиж тэмдэглэнэ үү

- Орон сууц /гэр хороолол/
- Орон сууц /орон сууцны хороолол/
- Орон сууц (АОС)
- Зочид буудал
- Сургууль

REPORTING SAMPLE

Below excel file sample shows how survey SW convert the data for reporting



HH TRAVEL SURVEY-SERVICE FEE&RELATED COST

1. Outbound Call Survey Service Fee

Outbound Call charge	Unit fee/min (MNT)	Call duration /min	Sampling size	Total service fee	
				VAT not included	VAT included
Skytel					
Postpaid	200	14	160	407,273	448,000
Prepaid	100	14	1,440	1,832,727	2,016,000
Other operators	300	14	6,400	24,436,364	26,880,000
Total Outbound charge				26,676,364	29,344,000

2. SMS for interview confirmation

Confirmation sms	Unit charge (MNT)	Unit	Number of sms	Total service fee	
				VAT not included	VAT included
Mobile Terminated			104,000		
Skytel	50	2	20,800	1,890,909	2,080,000
MobiCom	40	2	46,800	3,403,636	3,744,000
Unitel	25	2	36,400	1,654,545	1,820,000
Moblie Originated					
Skytel	20		2,080	37,818	41,600
Mobicom	40		4,680	170,182	187,200
Unitel	25		3,640	82,727	91,000
Total SMS confirmation cost				7,157,091	7,872,800

3. SMS for incentive confirmation

Confirmation sms	Unit charge		Number of sms	Total service fee	
				VAT not included	VAT included
Skytel	22		1,600	32,000	35,200
Other operators	40		6,400	232,727	256,000
Total SMS confirmation cost				264,727	291,200

4.SMS special number cost

SMS Special number-Mobicom	Unit fee		# of units		Total
Connection fee	99000		1	90,000	99,000
Deposit	66000		1	-	
monthly fee	22000		1	20,000	22,000
SMS Special number-Unitel	99000		1	90,000	99,000
Deposit	66000		1	-	
monthly fee	22000		1	20,000	22,000
Total				220,000	242,000

5. Other cost -

Other	Unit fee		# of units	Total service fee	
				VAT not included	VAT included
TAZ registration	160		24,000	3,490,909	3,840,000
Total				3,490,909	3,840,000

6. Total

	VAT not included	VAT included
Total Service Fee *	**37,809,091**	**41,590,000**

* Incentive cost for interviewees is not included.

HH TRAVEL SURVEY - PROJECT TEAM EXPERIENCE

Project Team Leader

Name:	UYANGA Urtnasan
Job position:	Manager, Customer Service and Information Department, Skytel Group
Education	- Bachelor of Communication Engineer, University of Science and Technology, 1997-2001
Carrier in Telecom	- Manager, Customer Service and Information Department, Skytel Group, 2008-2016 - Senior Specialist, Contact Center, Skytel LLC, 2002-2007
Working experience in related field:	- Project team leader, Project – Strengthening Skytel Group Contact Centers capability, 2015 - Project team member, Project - introducing ISO 9001-2008 service standard - Introduced Telesales and outbound service to Skytel Group, 2009 - Project team member, Project - introducing Customer service Billing System, 2005-2006

2. Project Team Co-Leader

Name:	TUNGALAG Bat-Ochir
Job position:	Senior Specialist of Telemarketing Section, Customer Service and Information Department, Skytel Group
Education	- Bachelor of Business Administration (BBA), 2006-2008, Mandakh Burtgel Institute, Mongolia - Master of Business Administration (MBA), Institute of Finance and Economy, Mongolia
Carrier in Telecom	- Manager of Customer Service Department, Unitel LLC, 2006 – 2014 - Senior Specialist of Telemarketing Section, Skytel Group, 2014 - 2016
Working experience in related field:	- Coordinator of internal Outbound and telemarketing campaigns in Unitel LLC, 2006-2014 - Project member for conducting Customer Satisfaction surveys of Skytel Group, 2014-2016 - Introduced Telemarketing service of Skytel for Corporate (B2B) market, 2014-2016

3. Project Team Co-Leader /Consultant

Name:	KHERLENBAT Choijildavaa
Job position:	Consultant, Contact Center of Skytel Group
Education	- Master of Business Administration (MBA), University of Mysore, India - Bachelor of Tourism Management, 1996-2000, National University of Mongolia
Carrier in Telecom	- Consultant for Contact Center of Skytel Group, 2016 - Senior Manager, Customer Care Sector, MobiCom Group, 2014-2015 - Manager, Contact Center Business Division, NTC, MobiCom Group, 2011-2014 - Senior Specialist, Contact Center, MobiCom, 2008-2010 - Research Specialist, Contact Center, MobiCom, 2005-2008
Working experience in related field:	- Project team leader, Project – Establishing Directory Assistance 1199 service, 2015 - Project leader, Projects on conducting Outbound surveys cooperating with research agencies - Project team member, Project - Child helpline-108, 2014 - Project team member, Project – Call Center of State Department of Social Insurance, 2014 - Project team member, Project - UB City Call Center -1200, 2010 - Project team member, Project – Introducing Outsourcing Contact Center Solution in Mongolia, 2009

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