2016•2017
SCHOOL FOR TRANSPORTATION SCIENCES
Master of Transportation Sciences

Master's thesis
Communication Patterns, Physical versus Digital

Supervisor :
Prof. dr. Gerhard WETS

Co-supervisor :
dr. ing. Petrus VAN DER WAERDEN

Muhammad Shaker
Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences

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Dedication

This thesis is dedicated to my beloved wife Ammara who helped me always to accomplish this research. I would also dedicate this thesis to my parents.

PREFACE

In modern era of information and communication technology (ICT), the communication technologies have reduced the physical movement among the members of social network. The individuals are getting more engaged in digital communication rather than physical movement. Being an urban planner and transport scientist I found this topic very interesting, as it will help to understand the communication pattern of individuals. The research is carried out to analyze the impact of social media in changing the communication pattern of an individual. The thesis is an essential requirement for Masters in Transportation Science at University of Hasselt. The transportation sciences cover all aspects related to transportation and road network. The reason of selecting this topic was highlighting the important issue being ignored previously.

The transport scientists and engineers while designing the road network mostly consider geometry, slop, grade separation and other engineering elements. However, this hidden aspect is ignored by the transport planners at the time of designing new road network. Owing to increase in social interaction of individual through digital communication the physical movement is increasing. Now the roads look more busier roads look than before. However, it was expected that the physical movement among certain members of social network will reduce by use of ICT. However, the use of social media and ICT has increased the number of physical trips, one reason is that ICT is not complete substitute for all activities. Some activities require physical movement. This part of research includes introduction, problem statement, research question, goal and objective of the study, research methodology and literature review. The findings of literature suggested methods to analyze the data collected through online distribution of survey. The generalized linear model is used for the estimation of significant effect of different variables.

First of all, I would like to thank almighty Allah for giving me strength to complete the research project.

I would like to say special thanks to my supervisor Prof. dr. Geert WETS, I would like to pay my heartiest gratitude to my mentor dr. ing. Peter VAN DER WAERDEN who guided me at every step to accomplish the research in an effective way.

I would also like to thank Mrs. Katrien DECLERCQ for her support and guidance in SAS software. I would also like to thank my teachers and colleagues who helped me to prepare this work at all stages during this study.

Finally, I would like to say thanks to my parents, siblings and my wife for their moral support and encouragement throughout this project.

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LIST OF ABBREVIATIONS

COMM	Communication
CRW	Consumer Review Websites
CSV	Comma Separated Values
Dist.	Distribution
EDI	Electronic Data Interchange
Freq	Frequency
GDP	Gross Domestic Product
GLMs	Generalized Linear Models
GLIM	Generalized Linear Interactive Modelling
GPS	Global Positioning System
IDs	Identification Documents
ICT	Information and Communication Technologies
IF	Internet Forums
Ilink	Inverse Link
KM	Kilometer
LBSM	Location Based Social Media
Lsmeans	Least Square Means
RFID	Radio Frequency Identification
SAS	Statistical Analysis System
SIM	Subscriber Information Module
SNS	Social Networking Sites
SPSS	Statistical Package for the Social Sciences
TMS	Transactive Memory System
URL	Uniform Resource Locator
USA	United States of America

SUMMARY

This research is about investigation on organization of communication pattern of individual in terms of digital and physical movement. The purpose of the communication technologies is to reduce the physical movement and to reduce the burden of travelling on roads. But the impact is different, it can be observed that the physical communication is increasing. The problem defined in this research is to identify how communication pattern of individuals effected because of these communication technologies. The research question is to find out how the communication pattern of individuals are organized and what are the characteristics of individuals that organize their communication pattern. The goal of the study is to have in depth knowledge of the understanding of the communication behavior of an individual. The objective of the study is to formulate model, to estimate the significance of characteristics of individuals associated to communication pattern of individual. The scope of the study is to investigate the share of physical and digital movement of an individual to his/her communication network.

In depth literature is carried out to find out the suitable variables that effect the communication pattern of individuals and are of worth in organizing communication. As far as the information and communication technologies (ICT) are concerned, these technologies have impact on travelling behavior of individual. The literature review is carried out to explore the link between communication and travel behavior, communication process, and types of communication and its impact on travelling. The literature research also includes the reasons that reduce the physical movement of individuals. The situations/scenarios, in which physical movement is necessary and ICT cannot replace the physical presence, are also investigated and included in literature part of the research. The seven reasons that causes the increase the physical movement are discussed in detail in section of literature review. The impact of social media on routine travelling of individual is investigated. The aim of the literature

research was to identify the key variables that are important in influencing the communication pattern of individuals. These variables are frequency of communication, distance, location, cost, time, relationship, communication network and mode of communication.

This thesis includes the approach how the Qualtrics based questionnaire was distributed among respondents using revealed preference approach. The questionnaire was designed to collect information about socio-demographic characteristics of individuals, awareness about communication technologies and variables related information. These variables were asked in the form of questions from the respondents with multiple categories, and response was collected and organized by Qualtrics. The questionnaire was distributed to various countries using email IDs to students of Hasselt university. Another medium used to distribute questionnaire was Facebook and WhatsApp. The anonymous link of Qualtrics based questionnaire was distributed in many groups of Facebook and WhatsApp and response was collected.

The response collected through Qualtrics was converted into SAS data set after cleaning the incomplete response from respondents. The missing values from the data were removed and complete data for modeling the dependent variables was prepared. The generalized linear model with cumulative logit link was used to estimate the significant effect of different variables associated to individuals. After identifying the suitable model (i.e. generalized linear model) for analysis the model statement applied to SAS data set by using GENMOD process. The model predicted the significant variables that effect the frequency of physical and digital communication of individuals.

In the research work results obtained through model statement used in SAS are explained. The frequency of physical and digital communication was considered as dependent variable and effect of independent variables (distance, mode, time, location, cost, relationship, network) was analyzed. The probabilities of different categories of dependent variables regarding independent variables are also estimated and explained in analysis part of this research. The analysis of individuals communication with family, friends and colleagues was carried out separately based on separately asked questions. Then the results were compared with each other in detail. The analysis part also includes the socio-demographic characteristics of individuals and communication behavior of individuals. The significant effect of socio-demographic characteristics (age, gender and education) on frequency of communication is also estimated. The detailed description of results, estimation of variables and probabilities of dependent variables are explained in detail in analysis part of the research.

The conclusion is drawn on the basis of literature research and analysis of data collected through response. It is concluded that communication of individuals increases or decreases because of certain variables, but it is independent of communication network. The future research work is also proposed by extending the scope and vision of this research. The recommendations are based on research work and literature review.

CHAPTER NO. 01

Author: Muhammad Shaker

1. INTRODUCTION

The thesis is about the understanding of impact and effect of information and communication technologies (ICTs) on travelling behavior individuals. The thesis will discuss how the travel patterns of individuals have changed because of the involvement of social media and communication patterns. The thesis is more about the exploration of the share of physical and digital movement within one's social network. The aim is to identify whether there is an increase in travelling or a decrease because of the digital communication.

1.1. Background

A social network creates social activities and social activities generate around 25-40% of all trips. This finding is based on data from European countries noted by Axhausen cited in (Ronald, 2012). The individuals have their own preferences regarding trips based on social, economic, recreational, and personality likings and disliking's. However, these trips, irrelevant of individual's preferences, are changing constantly because of increase in technology and communication (Dal Fiore, Mokhtarian, Salomon, & Singer, 2014a). Most of the time people communicate by using mobile phones and social media (i.e blogs and micro blogs, social network sites, skype, facebook, whatsapp and twitter etc). But instead of decreasing the number of physical trips on road, the increase is observed. The reason behind increase is that, the instant plans are made by individuals on social media to meet physically and spontaneous implementation of these plans increases burden on roads. (Kay W. Axhausen, 2005) argues that with the increase in technology related to communication and transportation network affects travelling by the social groups largely. However, his concern is only limited to the long-distance travelling. It is obvious that with the transformation of poor road network to good road network the travelling increases. There was a time when people use to travel once in a year to other countries i.e. travelling long distance, because of less available technology. Now the air transport is also increasing day by day and number of trips are increasing. The physical movement of individuals within social network (friends, family, colleagues, close friends, parents, relatives and partners) has changed because of social media.

Physical movement is considered as the movement from one location to another location by consuming money, energy, and time. The definition of physical movement seems to be quite simple in its nature, but it is the combination of multiple elements. Some important elements are the purpose of trip, the mode chosen for the trip, the timing of the trip, and the origin and destination of the trip. These elements generate multiple travel patterns and behavior (Dal Fiore et al., 2014a). The travel demand behavior assumes that the demand for any of the trips is measured from the activities included i.e. people moving from home to school, to shopping, or for other recreational or social events. The increase in information and communication technology has changed the nature and purpose of the travelling. This change is because of different social activities, planned and organized on social media via (digital) communication. Therefore, this sector requires more attention and analysis (P. L. Mokhtarian, Salomon, & Handy, 2006a).

The focus of the study is to discover, analyze and investigate how individual interact with each other with their social network (friends, family and colleagues) either physically or digitally. If the communication is digitally then how travel pattern of individual has changed because of this communication. Has the physical movement to socially connected people decreased or increased because of social media and digital communication? The social media has impact on the daily routine

and movement of individual, to explore and identify what are the attributes increasing or decreasing the physical movement and what are the reasons for increase in digital movement? How often people plan to communicate each other by physical movement and how often they contact via social media. In previous times, as there was no advanced source of communication among people digital movement was not possible, the meeting was fixed in advance by individuals. The people came to meet each other at fixed time and schedule as per plan. There was less traffic on road because of lesser planned activities and non-availability of digital communication. But this trend has been changed; people make plans by using social media i.e. Facebook, Skype, Whatsapp, and other social media (Blogs, micro bogs and SNS).

The study also focuses on the influence of social media on travelling pattern of individual because of increasing ICTs. New changes and adjustment in travel patterns are now happening because of information and communication technologies (ICTs) e.g. laptops, mobile phones, and tablets (Cohen-Blankshtain & Rotem-Mindali, 2016). With the increase in awareness at social media most of the time individual do not have any plan to move somewhere, but promotions and cheaper tickets attracts individual to visit new places. As one is attracted by a company's offer, he invites his/her friends and somehow it generates trips. Sometimes people come to know about the educational, professional, and business conferences from social media and they plan to attend the conferences. Individuals especially youngsters rely on ICT, as it helps them to perform the tasks from different locations. These locations can be home, office, cafe's, and other points. The tele-communication has also reduced the number of trips, as people try to manage the things without physical appearance avoid traveling. However, there can be less-formal trips as the trips from fixed location are replaced by multiple work locations (Dal Fiore, Mokhtarian, Salomon, & Singer, 2014b). The market for online shopping should decrease the number of trips to markets. But at the same time, it can be observed that people ask for more deliveries of valuable from market to home which generate trips on road. The research work will help to find out the impact and effects of technology on travel pattern of individuals.

1.2. Problem Statement

Social network contains not only the family members but it also consists of friends, friends of friends, people having the same area of interest, colleagues, partners, society members. As the individual is part of a social group his/her travel behavior or pattern may be influenced by following the other members in group (Urry, 2003). The individual and other socially attached members may get influenced by the behavior of other members in group and the travel behavior of individual changes. At some time, it may increase the physical movement and it might increase the digital movement by the increase in social contact through social media. (Arentze & Timmermans, 2008) performed numerical simulations and presented that, attachment of an individual to social networks may lead to addition of ambitions and dissemination of knowledge, this incursion of knowledge by the social contact may change the travel pattern of individual.

The main problem is to explore how individual interact with his family, friends and other members of social network. The increase in communication technologies has led to a change in travel patterns of individuals, most of the time people convey messages or greetings by using online/digital communication. The need of the hour is to identify, what is the nature of trips generated because of social interaction? Either the trip generation is only for recreational purpose or family gatherings? How often people meet each other and what kind of trips are generated when new member enters the social network. Is there increase in physical and digital movement because of involvement of individual to

new social network? (location change). What kind of communication generates physical movement and what kind of communication is done by digital movement?

Individual living at longer distance from their parents and family and social network use digital movement more as compare to physical movement. People avoid travel physically to meet parents and friends at longer distance. The communication network has affected and reduced the physical trips among people (Urry, 2003).The problem to find out what trips do still exist and what trips have changed because of social interaction on communication network. It is all about exchange from physical movement to digital movement and vice versa.

Another problem is related to investigate the influence of social media in changing the travel pattern of individual. It is stated that are there is increase in business-related trips because of social media awareness. Social Media can be defined as the group of applications that are totally based on internet. These applications are built on the philosophical and technological fundamentals of Web 2.0, it allows the users to create personal content and biography and at the same time exchanging with others. (Kaplan & Haenlein, 2010a). Social media has helped people to know more about the advancement around the world, but the question is that, how the social media has changed the travel pattern of individuals? How it effects the daily routine of individual? Is there increase in travelling because of promotions and ads on social media or decrease because of digital contact using social media.

The use of information and communication technology among the people guides the people to make alternative route to travel from one place to another place. However, this is helpful for short-term mobility decisions (Ettema, Arentze, & Timmermans, 2011). It is good if few people use the alternative routes. But, if many of the people try to use the same alternative for moving from one place to another, then it can create congestion and burden on roads. There is a need to identify whether the communication has improved the travel pattern or has it disturbed the routine traffic by the provision of alternative routes to reach the destination.

One of the problems is that researchers did not have a depth study about how the social media change the travel patterns of individual from one place to another for different events planned by social communication (Urry, 2000). There is need to find what is the interaction between communication and travel pattern. Communication network creates information for people, and information distribution on social media changes individual's attitudes and understandings, that change the travel pattern. (Arentze & Timmermans, 2008). But at the same time, it has enhanced the number of trips creating congestion, pollution, emission, and accidents. The problem is still to analyze the impact of communication networks on travel patterns, as technology is beneficial for longer distance it helps to communicate digitally rather than physically and reduces the trips among people.

1.3. Research Questions

How are the communication patterns of individuals organized in terms of digital and physical movements and is the frequency of a movement related to characteristics of individuals, social network, and content of communication?

1.3.1. Sub Questions

The research sub-questions are as under.

    i.   Does physical movement change because of communication?

    ii.   How does communication network affect the travel pattern of individual?

1.4.   Goal and Objectives of Study

The goal of the study is to formulate a model, based on literature research and findings of the questionnaire analysis, that will help to understand the interaction and relationship between communication and travel pattern of individual. The objectives of the study are as listed below.

1. To review the literature on communication of individual with others in terms of social network, mobile phones and internet.
2. To analyze the relation between social network and travel patterns.
3. To review the current situation of communication among individuals for various activities.
4. To identify how the travel pattern is affected by the location of participants (i.e. individuals) of social network.

1.5.   Scope of the Study

The scope of the study is to explore more about the physical movement and digital communication. How individuals communicate information and personal talking within individual's social network using information and communication technology. More specific, the scope of study is to explore and identify the share of physical and digital movement in a social network and the corresponding travel patterns. The research can be helpful in understanding the travel pattern of individuals influenced by communication networks.

1.6.   Justification of Research

The communication plays an important role in developing the strong relationship between the members of social network. The communication can be both in terms of physical and digital depends upon the nature and strength of relationship among social network. There is increase information and communication technologies in recent years. These technologies have changed the travel patterns of individuals and enhanced the source of communication, these technologies also enhanced traveling around the globe. The research is unique of its nature and limited research has been carried out on this topic. Developing positive results may enhance the scope of this topic. Choosing this topic for research work was interesting as it helped in investigating the impact of technology on communication and corresponding traveling. It is important to carry out this research work as it can also help in learning the travel pattern around the globe, and to understand how it can bring changes in present transport system using technology.

1.7.   Research Methodology

Literature review on the topic will be carried out, based on the literature review the suitable characteristics of individuals will be identified. These attributes with certain levels will be asked from the respondents. The revealed preference survey will be used and response collected will be analyzed on SAS software using generalized linear model with cumulative logit link. The methodology in detail is described in section 3 of this report. However, the flow chart of methodology is shown in **FIGURE 1-1**.

Author: Muhammad Shaker

Topic Selection

- Topic selected from the list provided by research institute of Uhasselt
- Interest of researcher

Developing Theoretical Background

- Literature review
- Communication types and its impact on travelling
- Used methods and techniques

Problem Identification

Research Question

Defining Research approach

Background Survey

Revealed preference survey

Questionnaire distribution and Collecting data

Data preparation

Model Selection (GLM)

Conclusions and Recommendations

Data Analysis

Documentation

- Report Writing & Referencing

FIGURE 1-1 Brief description of research methodology (source: author's own, 2016.)

1.8.   Structure of Thesis

The report includes seven chapters having a comprehensive and adequate illustration of the introduction, literature review, research methodology, focus group study, data analysis, conclusions, and recommendations.

Chapter 1: The first chapter describes the main concerns related to the introduction of the research work including statement of problem, objectives, research question, scope of study, justification, limitations, research methodology, and structure of report.

Chapter 2 The second chapter includes literature review on communication in terms of social network, mobile phones, and internet and its impact on travel pattern and behavior of individual or whole community.

Chapter 3 This chapter illustrates the "research methodology", a step by step approach to meet the goal and objective of research.

Chapter 4 The fourth chapter is about "data collection and questionnaire design". It includes the data collection method and questionnaire design.

Chapter 5 The fifth chapter is about the "data preparation and interpretation of model".

Chapter 6 The sixth chapter incorporates the data analysis socio-demographic and model estimation using GENMOD process.

Chapter 7 The seventh chapter "Conclusions and Recommendations" is the most fruitful part of the research.

CHAPTER NO. 02

2. THEORETICAL BACKGROUND

2.1. Communication and Travel Behavior

Communication is a symbolic process in which the reality is developed, sustained, refurbished, and transformed to others. (De La Fuente, Budarick, & Walsh, 2012).The process of conveying and transmitting any information and common understating of individual from one person to another is known as the communication. (Keyton, 2010). The word communication is derived from communis a Latin word meaning common. The definition of communication demonstrates that, if no common understanding result from the exchange of information between individual it cannot be considered as communication (Lunenburg, 2010). The increase in new 'mobile communication technologies' has regenerated interest about travelling among communication researcher. (De La Fuente et al., 2012). Communication is necessary factor in communicating the information related to travelling, because the smooth communication is critical in transformation of knowledge. Travel related information can be delivered or shared on internet via articles, personal chats and messages and threads; these can be further categorized into formal and informal communication.(N. Chung, Lee, & Han, 2015).

2.1.1. Communication Process

FIGURE 2-1 reflects the communication process. The sender and the receiver are common elements of the communication. The sender is the one who starts communication and want to deliver information available to the receiver. The receiver is the person to whom the message is conveyed or delivered. In the process of conveying message the sender encodes the information by selecting suitable words, symbols and other representations to deliver the message. The message is the output of encoding of the sender, it can be verbal or written form. The medium used for communication between sender and receiver can be face to face, telephonic, via internet (email, Facebook and twitter) and written
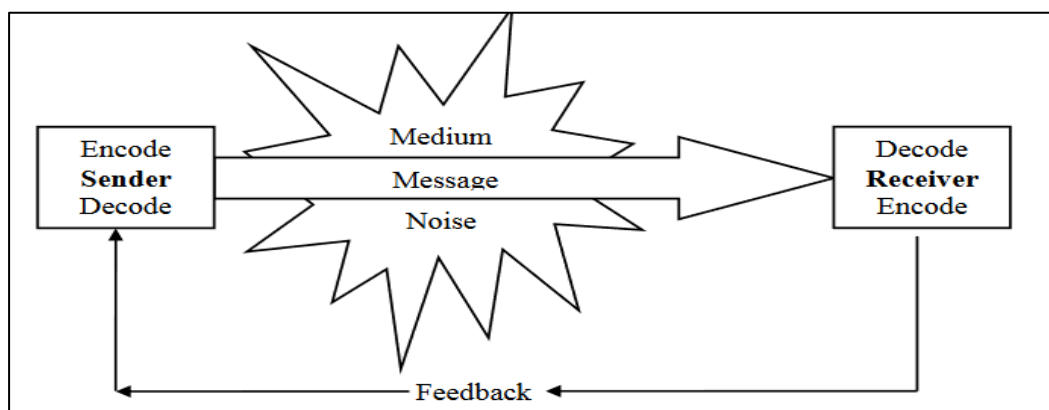
FIGURE 2-1 Communication process (Cheney, Christensen, Zorn Jr, & Ganesh, 2010)

report. The receiver decodes the message (received by use of different media) to purposeful information. The noise is the hurdle that disrupt the delivery of message or communication. Last step in the **FIGURE 2-1** is the feedback which is the receiver's response to the sender about the understating of message conveyed by sender. It helps the sender to understand whether the message was conveyed properly or not. (Cheney, Christensen, Zorn Jr, & Ganesh, 2010).

2.1.2. *Types of Communication and its Impact on Travelling*

Communication can play an important role to share or deliver travel information, because smooth communication is critical in information transmission (Szulanski, 1996). There are two types of communication i.e. formal and informal ((Dittrich & Giuffrida, 2011) and (Kim & Benbasat, 2012)) Both these types are affective in constructing transactive memory system (TMS). (Choi, Lee, & Yoo, 2010).TMS is meta-memory that is created within a social group of individuals in a collective way, the process includes the encoding, retrieval and knowledge sharing by communication (Wegner, 1987). Specialization, credibility, and coordination are the three sub-dimensions of TMS. Specialization is the degree of dissimilarity and competence of the information provided by the user of group about transportation. Credibility is the confidence level of users about the travel information provided by them. And the coordination is the understanding between different users of the social media (Akgün, Byrne, Keskin, Lynn, & Imamoglu, 2005), (Wegner, 1987) and (Li & Huang, 2013).

Formal communication is controlled and arranged (Dittrich & Giuffrida, 2011). (Kim & Benbasat, 2012) defines formal communication as such type communication having organized contents and useful values. In social media the text messages that are on bulletin boards are organized in regular shape and with limited words are formal communication (N. Chung et al., 2015). Informal communication is unrestricted, unpredictable and free (Dittrich & Giuffrida, 2011). According to (Kim & Benbasat, 2012) informal communication is the type of communication which do not have any structured contents and have hedonic values. The replies of text messages on bulletin board and some other instant texts are examples of informal communication. (N. Chung et al., 2015)

Social media is linked to the behavior of traveler as they share information about the planning of trip (pre-travel stage), sharing the online experience about the journey (i.e. beautiful places, delays, road network, congestion and pollution). Individuals can convey messages on-travel stage and important information to others about one's personal experience about the journey or trip after-travel stage(J. Y. Chung & Buhalis, 2008). The traveler while conveying information use both type of communication i.e. formal and informal. Since this link is good between the social media and traveler, but at the same time increases the trips if some good experience is shared on social media. If the experience shared by the individual is restricting the other member on same network, it may help to reduce the number of trips.

2.1.3. *Communication Minimizing the Resistance to Travelling*

ICT can minimize the travelling resistance in many ways. Firstly, the individual planning to move somewhere may get access to many ICT devices before starting trip. This is done via web based information or via mobile devices. Secondly, information shared on individual mobile sources can reduce the resistance during travelling i.e. 'en-route' information. It provides the details about the accidents on roads, delays and construction works on road. It can also provide information to car users if it is linked with satellite navigation through internet (Van Wee, Geurs, & Chorus, 2013). ICT has played an important role in facilitating the individuals to avoid traffic congestion, as messages about the current condition of road are delivered on social media for those who are planning to depart somewhere. So far it reduces the congestion and number of trips on certain road, on the other hand it might create congestion or heavy volume on other parallel roads.

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2.2. Impact of Information and Communication Technologies (ICT) on Travel Pattern

It is one of the known fact that the information and communication technologies has an impact on the movement and travel pattern of individuals along with four components of accessibility i.e. land use components, transportation components, temporal components and individual components (Geurs & Van Wee, 2004). Transport planner and decision makers often expected that at one stage ICT may become substitute for travel. At the same time, it is worth to mention here that ICT can also lead to generation of trips and activities. Its effect on generation side should be considered as more important than substitute for travel (Van Wee et al., 2013). It was concluded by (P. L. Mokhtarian & Meenakshisundaram, 1999) that it is unlikely to say that ICT will decrease the travel significantly.

The concept of fragmentation was introduced by (Couclelis, 2000). The concept was discussed by (Lenz & Nobis, 2007) and they concluded that demand of transport increases with fragmentation of activities. They provided the difference between the spatial fragmentation, temporal fragmentation and fragmentation manners in which activities are performed. Spatial fragmentation means the disintegration of different task at different locations. The fragmentation of activities over different timings is known as the temporal fragmentation. The best example of fragmentation in manner can be online shopping and physical movement to market. ICT has also effect on selection of mode, departure time choice and route network. Mobile or in-vehicle device connected to internet may have impact on selection of route network because of updated information available, as it reduces the search time for route information (Van Wee, Geurs, & Chorus, 2013).

2.2.1. Connection between ICT and Travel behavior

The problem of link between communication and travel behavior of individual is not new of nature (P. Mokhtarian, 2009a). The issue was first raised after the arrival of telephone i.e. land line (Claisse & Rowe, 1993) and recently after engagement of internet and online shopping trend (Golob & Regan, 2001). The question arises do ICTs generate or reduce the travel demand? The multiple researches on this topic still unable to give clear answer about this statement. (P. Mokhtarian, 2009a). The technology of mobile phone has provided the teenagers and youngsters with the freedom of movement and also facilitates to negotiate with parents about their physical movement(Williams & Williams, 2005). It can be said without doubt that communication at distance is done to avoid the number of trips or travelling (Aguiléra, Guillot, & Rallet, 2012). The ICT's have reduced some number of trips but still some remain unreduced for example shopping and going to office or work. The internet can slightly play a complementary role towards shopping(Rallet, 2005). At the same time it has been observed by (Farag, Schwanen, Dijst, & Faber, 2007) that number of trips by online shoppers are more as compared to those who do not prefer to shop online.

It has been revealed by (Lee-Gosselin & Miranda-Moreno, 2009) that there is positive link between mobile phone and trip generation and the access to internet at home lead to negative link between internet and trip generation. One must consider that there is two-way link between travel demand and ICTs as the travel demand increase with use of ICTs (Nobis & Lenz, 2009). The links of communication with physical mobility are extremely important but not explored yet in detail. Because the information gained by the travel survey is not sufficient to demonstrate the fragmentation (Line, Jain, & Lyons, 2011). Individuals using mobile phone and internet while travelling from one place to

another place enables them to plan or deviate from the original destination (i.e. going back to home or going to office) to other activities (recreational activity) (Aguiléra et al., 2012).

The members of the network having both type of communication physically i.e. face to face and by sending text messages to each other have higher intimacy than those who do not use text messages (Igarashi, Takai, & Yoshida, 2005). (Carey, 1989) claims that telegraph was one of the communication method that gave the conclusive and collective break of the distinctiveness of communication and transportation. The most dominant and reliable conclusion is that individuals show preference for individuals those are similar to themselves in social interaction. This phenomenon is also known as homophile (Byrne, 1971). The members of social group are considered as important attribute, because they belong to same group (organization, family and sport team) such belonginess among members develops a feeling of closeness for each other that is considered as important for fulfilling the social needs such as empathy (Bidart & Degenne, 2005)

2.3. ICT Reduces Travel

The idea about how ICT reduces the travel demand is based on robust spatiotemporal illustration that surrounds the changing situation of ICTs. According to this Illustration, telecommunications converted the physical distance to online distances, and make it possible to accomplish things from far distance which previously were done physically. The telecommunication has provided a substitute of virtual relationships instead of physical relationships. This illustrations also provided support to naïve views regarding the role of telecommunications in relations and faced much criticism (Musso, 2008).

One part of ICTs depicts that individuals are encouraged by using communication to accomplish few activities on computer at home which were previously done at distance from house at fixed location. One concept is that ICT may reduce few traveling distances as individuals may perform their duties in telecentres close to their home. The evolution of online shopping took place at start of twentieth century, the concept was based on the same shopping or purchasing different things by ordering online from home. It has reduced the number of trips on road. With increase in online market the scope of online marketing is also extended to other professions like health, online administrations, teaching and least but not last leisure activities. (P. L. Mokhtarian, Salomon, & Handy, 2006b)

Information and communication technologies can decrease the requirement of face-to-face gatherings in personal and professional domain by refining the quality of associations that held at far distance. Collectively, the wide variety of ICTs permits high quality communication and online meetings at longer distance via emails, instant messaging, social forums, skype and snapchat and videoconferencing. ICT has enabled individuals to be available and reachable all the time regardless of regional, national and international boundaries, therefore it has reduced burden on road and air traffic and has reduced the travelling by providing the facility of online face-to-face meetings using ICTs (Aguiléra et al., 2012).

There is no doubt that communication at far distance made it possible to evade few travels. However, the literature about the link between ICT and travel states that there is more generation of trips because of technologies (Aguiléra et al., 2012).

2.4.   ICT not Ample Substitute of Travelling

ICT cannot be substitute of travelling there are certain things that need to be done physically. These activities can only be done when individuals are present physically. Why ICT is not substitute for travelling? There are twelve answer, first five answers explain why ICT cannot substitute for travelling and rest of the answers describe the mechanism by which ICT increases travelling (P. Mokhtarian, 2009b)

2.4.1. Activities that cannot be done with ICT, Requires Travelling (5 Reasons)

The first reason is that all the activities do not have ICT counterpart. i.e. the location and movement of human beings is necessary for the medical treatment. Although the surgical instrument for surgery can be operated remotely (Morris, 2005) there is still need of some surgeon to be there at location to perform surgery. Another thing we need human worker to perform gardening, house cleaning and repairing of houses. Sometimes it is not required to send digital files to complete the tasks we need clothes, material and amenities so it cannot be done digitally. It can only be achieved by physical movement and transport. It is of worth to say that one can reduce the travelling demand but ICT always cannot be considered as the alternative for all activities (P. Mokhtarian, 2009b).

The second reason is sometimes ICT as a theoretical alternative is available for some tasks but still it lacks behind the in its practical feasibility. For example, the professional meetings, conferences and online grocery shopping is not possible through ICT. The practical feasibility of ICT can also be judged from the example that the use of mobile phone is prohibited while driving a car or when someone is theater. The feasibility constraints are because of lack of knowledge and economic means to have the ICT services within range (Schwanen & Kwan, 2008).

The third reason is about when ICT is practically feasible, but still cannot be considered as desirable option. Many researcher have given comment on the point that however ICT plays an important role in fostering the collaboration among distance learners and colleagues, but still compliments the importance of face-to-face meetings (Torre, 2008)

One of the five reasons of why ICT is not substitute of traveling is that travel carries a positive utility (P. Mokhtarian, 2009b). Desired travelling fulfills dual role, the first one is that it takes individual to the desired locations and the second role is that is fulfills the need of travelling for one's own sake. This observation is not only considered for short-term travel choices. But it is also acceptable for medium-term and long-term choices for example shifting residence and job locations (Handy, Weston, & Mokhtarian, 2005).

The fifth reason, ICT enhances the set of activities performed to fulfill task, but in any way, it does not directly replace any activity from the list. At some circumstances, ICT is supposed to be a "second-best" technique of contributing in the particular activity. When the physical appearance of person itself is not possible to lead, or head some activity. For instance, distance learning education is a gradually increasing its demand and becoming the important segment of the educational institutes. However, it is now considered as an effective means of transforming and delivering knowledge (Bernard et al., 2004).

2.4.2. *Mechanisms by Which ICT Increases Travelling (Seven Active Reasons)*

The first reason describing the mechanism how ICT increases travelling is ICT saves times and/or money for other activities. ICT facilitates to perform activities in speed i.e. communicating small information to friends. These activities can be done by using communication network and require nothing to do physically. But at the same time ICT generates time for other activities. For example, teleconferencing for daily meetings saves the time and money for a business man and it also permits him/her to schedule other trips to enhance and boost-up his/her business by developing relationship with other partners. It also facilitates in scheduling of trips and journeys to interesting places which might have been delayed or cancelled because of overlapping of routine business travel (P. Mokhtarian, 2009b).It is clear from the above example that ICT has facilitated the online business, reduced trips for daily meeting but at the same time it has enhanced the scope of discovering more places and developing more relationships that definitely generates more trips. Similarly, money saved from online bargains allows to use it for more customer goods, it includes the transportation in manufacturing, delivery, and acquisition (P. L. Mokhtarian, 2004).

The second reason is that the trips are becoming cheaper due to ICT. It has provided the individuals to save money by comparing the prices, last minute purchases and prices alerts at different timing is the main cause of increasing the number of trips and travelling around the globe. ICT effects the travelling and travelling cost in three different ways as described. Firstly, it reduces the cost of travelling by comparing the prices of trips offers at different timings with different packages. The saved money by comparing the prices enhances individual's capacity to avail more trips based on same budget. Secondly, it can change the destination for longer distance as compare to the selected distance with same budget i.e. if one can now go to Brazil instead of Boston, why not to avail such opportunity? Lastly, new offers and tourist packages can lead to entirely new trips to be made, as these offers for trips falls inside the flexible expenses people (P. Mokhtarian, 2009b).

The third reason how the ICT has increased the efficiency of travelling and it has made the travelling more attractive. Economic theory indicates that the demand rises when the cost of something is lowered. Same with travelling because of ICT as the comparing the prices through ICT lowers the amount of traveling. On the freight side, similar mechanisms are at work (P. Mokhtarian, 2009b).The price and timings of goods movement has reduced via Electronic Data Interchange (EDI), Global Positioning System (GPS) and Radio Frequency Identification (RFID)(McFarlane & Sheffi, 2003).

The fourth active reason is the extensive use of personal ICT can increase the productivity and enjoyment of travelling. ICT has made it possible to conduct activities during travelling i.e. talking to friends use of mobile phone, if not driving sitting on other side of vehicle and reading books, listening songs and studying tracks and earth geometry using GPS. However, ICT has also increased the potential of such activities (DeSerpa, 1973).

One of the seven active reason how ICT has increased the travelling is that ICT directly stimulates the travelling. One of the most important mechanism that enables the increase in travelling is the direct role of ICT in stimulating the additional trips of individual. Such mechanism can work in three different ways the first way is message using telecommunication networks may lead to travelling, first stated telephone message from Alexander Graham Bell was that "Mr. Watson, come here; I want to see you" thereby it generated trip, even it was trip between hallway to next room but it was trip because of message using ICT. The second way is by increasing the connectivity to people, events, services and goods also increased the involvement of individual that includes the collateral travel. The

third way can be telemedicine which is used to provide diagnostic services to patients in remote areas. Diagnostic technique may discover such disease for which physical presence is required in same case it may generate travelling to remote area (P. Mokhtarian, 2009b).

The sixth active mechanism is the role of ICT acting as an engine of increasing the globalization of commerce. Du Boff, 1980 captures and explains the nature of telegraph's influence. He also noted that telegraph not only provided with lowered information but also given direct stimulation to business. These reductions develop

"resources released for alternative uses: the direct benefits of the telegraph were distributed to the rest of the economy through decreased costs of coordination and movement, higher real incomes, and widened areas of economic activity. For firms, everything pointed to the growing feasibility of higher sales volumes through penetration of hitherto distant markets. The size of any market ... is limited by the costs of obtaining information, negotiating exchanges, and moving goods. Historically, these cost constraints have been loosened by technology and especially by breakthroughs in communication and transportation."

The seventh and the last mechanism of increasing the travel due to ICT is its role in shifting more towards decentralization and lower density land-use pattern. ICT not only enhances decentralization at the same time it increases concentration into more energetic and travel-efficient land use (Pool, 1980). However, it is necessary to consider in mind that technology is neutral and can serve as both ways positive and negative. One must have personal and collective choice while selecting the technology (Gottmann, 1983).

2.5.   The Mobilities Paradigm and ICT

(Urry, 2007) explains the mobilities paradigm as a post disciplinary matrix of theories, procedures, queries and answers related to the project of establishing a movement-driven social science. It was claimed by him that previously mobility was like black box for the social sciences. But within the increase in world's population, multiple objects, technologies and conversations are on the move. (Urry, 2007) thinks and notices about mobility in different ways.

Urry's policy regarding movement-driven social science explains many reasons to think why it is necessary discover the link between communication and movement. First reason is that communication has direct concern in many types of mobility's. The list of these types is as under.

1. Physical travel of individual, the real movement of people by covering some displacement to perform some activities
2. Movement of objects, the transport of goods from one place to another place
3. Imaginative travel transportation of goods and objects to other places via images and narratives in print, audio and graphic representation using media
4. Virtual travel, it can be defined as the reducing the geographical distances and developing connection by using video-conference, telecommunication, and social networks
5. Communicative travelling, contact between individuals through letters, mobile phone, internet and Fax) (Urry, 2007).

It can be analyzed from the above list of types of mobilities that communication and travelling are closely related to each other. (Urry, 2007) also explains the fact that mostly communications are

related to travel and mobility. He considers both to be the substitute of each other somehow. One can find link of mobility and communication from the Urry's evocative comments about mobility and communication from discussion.

The time spent on traveling is not necessarily unproductive and wasted time or dead time that people always wish to minimize. Movement often involves an embodied experience of the material and sociable modes of dwelling-in-motion, places of personal activities, to climb a mountain, to do a good walk, to take a nice train journey. There are activities conducted at the destination; activities conducted while traveling including the anti-activity of relaxing, thinking, shifting gears; and the pleasures of traveling itself, including the sensation of speed, of movement through and exposure to the environment, the beauty of a route and so on. (Urry, 2007)

The concept of dwelling-in-motion mentioned by Urry, needs some unpacking. It is of worth that Urry's mobilities comprises a section on place and includes extensive discussion of Heidegger's concept of dwelling. Heidegger (Urry, 2007) excellently professed

"to say that mortals are is to say that in dwelling they persist through spaces".

It would not be wrong to say that dwelling develops relationships between inside and outside, reduces distances by developing distances between near and far, and then enhances the travelling experience.

In addition to determine the importance of dwelling in movement, it is concluded that the imagination of individuals towards dwelling put an important role in anticipating the movement from one place to another place and develops the ambience of another place (Urry, 2007). Such communication turns itself to artefacts such as 'pictures, cultures, imageries, mementos and other objects as memories (Urry, 2007).

2.6.   How Social Media is Related to Travelling

Social media can be defined as consumer-generated media which includes the variety of innovative sources and presentation of online information. These information's are later used by user/consumers to educate others about new products, pricing, brands, cheap travelling, services, famous personalities and hot issues around the world (Blackshaw & Nazzaro, 2004).

(Safko, 2010) defines social media more simply as actions, practices and activities among people who share information, available knowledge and their specific opinions about some point. They comment and criticize through conversational media. Social media is not only about the software it also includes tools, these tools can be useful or sometimes not useful. Further, it was defined by (Hoffman, Novak, & Stein, 2013) as

"The set of web-based and mobile tools and applications that allow people to create (consume) content that can be consumed (created) by others and which enables and facilitates connections"

2.6.1. Types of Social Media and Travelling Context

Social media can be categorized in to eight different types (Fotis, 2015)

Author: Muhammad Shaker

1.   Blogs
2.   Microblogs
3.   Social networking sites(SNS)
4.   Wikis
5.   Content community sites
6.   Consumer review sites
7.   Internet forums
8.   Location based social media

The detail information about the aforesaid types and the impact of such social networking sites is described separately.

1. Firstly, is was used as weblog 1997 by John Barger (Blood, 2000) and later in 1999 Peter Merholz changes the word weblog to only blog (Fotis, 2015). In 2012, it was predicted that there were approximately 81 million blogs around the world (Nielsen, 2012). The word blog can be defined as a personal website that comprises exchange of information or entries that are frequently updated. These entries can be in the form of text, images, videos and links to get access to other websites (Lin & Huang, 2006). Travel blogs are related to visitors experience to reach at some point and sharing knowledge about the trip, providing details about the transportation in visiting zone, delays, positive points and accommodations based on his experience (Pan, MacLaurin, & Crotts, 2007)

2. The second type of social media is Microblogs, these are internet-based applications somehow similar to blogs these allow users to exchange information only in terms of small elements. These small elements can be in the form of short sentences, small size images and links to videos. The example of microblog applications is twitter, jaiku, plurk, and weibo. Twitter is largest microblog as compare to other described and it is considered as the reason of growth of microblogs (Kaplan & Haenlein, 2011). In 2014, it was noted that twitter's members has arisen to 255 million monthly active users and they send around 500 million tweets average per day (Twitter, 2014). Microblogs serve as a tool for recognizing and regularizing the travelling and tourism related sentiment (Fotis, 2015).

3. Social network sites (SNS) is one of famous type of social media and its fame increasing continuously day by day (McCann, 2010). The best examples of Social network sites are Facebook, wayn, Google plus, LinkedIn, and Xing. One of the findings of (Ofcom, 2013) it was observed that in United Kingdom, it is the routine of adults that approximately more than half of all adults use SNS once a week. (Kaplan & Haenlein, 2010b) define social networking sites as certain applications that allows users to create a connection with each other by developing online profiles. The individuals send information's and invitation to friends and colleagues to have access their profiles by e-mails and exchanging conversations via instant messages. Travelers use Facebook and share their pictures and travelling details on SNS when they get back home after making long trip (Fotis, 2015). It was estimated in US the statistics related to female travelers using social media, 57% of the use of Facebook is just to share travel related phots and videos, 38% of the use of Facebook to post status and comments about travelling and 13% of the total use was for check in on destination, before departure and arrival to spot (eMarketer, 2010a).

4. Content community's sites are web-based applications allowing people to share content for example pictures, videos, presentations and music. The examples of Content communities are YouTube, Vimeo and Dailymotion for videos ; Flickr, SmugMug and Picassa for pictures; slide share for presentations; lastfm and ping for music (Fotis, 2015). (Liu, Norman, & Pennington-

Gray, 2013) employed Uses & Gratifications theory to investigate the Flickr members effect of food photography by using mixed-methods on their travel planning process. The finding states that Flickr members choose travelling destinations to experience new food. This kind of exploring generates extra trips to new places.

5. The fifth type of social media is consumer review websites (CRW) that enable users post reviews and rating about somethings. CRW range provides variety of output and assessments, i.e. comments and pictures, service rating, wish-lists, price comparisons, advanced search, price history charts, deals' rankings and other. The examples of CRW that help consumer in decision making are Amazon and eBay similarly for tourism (travelling and booking) context Expedia, Booking.com, Travelocity. TripAdvisor is one of the successful travel related or price comparing website as it hosts more than 150 million reviews for more than 4 million businesses (Fotis, 2015)

6. Wikis is defined as hypertext system with freely expandable collection of Web 'pages', these web-pages are interlinked and they have the capacity to store and modify information on these pages i.e. a database, the information can be easily edited on it by the web browser client. (Leuf & Cunningham, 2001) says that the most famous wiki that deals with travel and tourism related issues is Wikitravel the URL for this website is (www.wikitravel.org). This is free wiki and free travel guide to tourist all around the world. Wikipedia is considered as more valuable for tourists moving to Europe and USA as it delivers additional detailed information. This serve as source of information and contributes to the perceived credibility of the source, when tourists are completely unaware of their destination. (Fotis, 2015)

7. The seventh type of social media is internet forums (IF) are known as discussion forums, online communities, message boards, web forums, bulletin boards, discussion boards and social forums (Laughlin & MacDonald, 2010). IF were recognized as most influential source of information (Bickart & Schindler, 2001). The Japanese 2channel (www.2ch.net) is world's major internet forums with 2.7 million daily posts (Maslow, 2011). In travelling and tourism related, many internet forums (IF) are sometimes stand-alone websites, or may be fixed within travel websites. The Disney trip planning forum (http://www.disboards.com/) is the example of stand-alone website although this is unofficial forum for Disney travel. TripAdvisor's travel Forum is the examples of embedded forums (Fotis, 2015).

8. Location based social media (LBSM) 8th type of social media is web-based, or mobile based apps that permit operators to articulate a list of further operators and then they can share geographic position at certain point and certain time known as check-in that relates to a venue and place. The examples of LBSM are Foursquare, Facebook Places and Gowalla. In December 2013 Foursquare found that it has 45 million users and has 5 billion check-ins since its beginning which is such huge amount (Foursquare, 2013). It was found that check-ins those are related to travel were the fourth most famous type in generation of trips after success of food, work, and shopping related check-ins (Foursquare, 2011).

2.6.2. *Social Network and its Impact on Travel Behavior*

Social networks persuade, alter and even limits the travelling. The process of social network is not static it changes according to different times of age. One does not have the same social network for whole life. The individual goes through the change its circle of friends, colleagues, neighbors and even contacts keep on changing as the time passes and life moves a head (e.g. marriage happen, moving abroad, changing place of residence, school and office). For example, if somebody goes to college or university he/she might face entire different group of friends that is later added to his/her social network, after this if he/she get engaged in a relation, the social network of spouse of individual's also added to

the circle of person who get engaged, Similarly, if their children grows up they develop some social network with their friends and parents of their friends which is also added up to the circle of individuals and this process continues. (Sharmeen, Arentze, & Timmermans, 2010). The spatial pattern of individuals (place of residence and office) in contact with each other via social group generates and determines the communication and travel behavior of individual. (Ohnmacht, 2009).

The network clusters can be divided into three types. (Laurier & Philo, 1998) defines chain networks in which many nodes feast in less linear form of messages from individuals. The best examples of chain and linear networks are work-related network and networks among friends. Second type of networks is star or hub networks, in such networks the important relationships come from central hub. In this network, the person close to central hub is of highly values. For example, financial services industry having trading zone in London, Tokyo and New York contains 3 hubs that distributes the service messages and relationships. (Thrift, 2000) & (Bruegger & Knorr-Cetina, 2002). The third type of communication networks is known as the all-channel or distributed channel in this type of networks the communication is proceeded from all directions (Ronfeldt & Arquilla, 2001).

Axhausen developed the link between social network and travel with an argument that daily life of individual revolve around similar people meeting each day i.e. friends, colleagues, neighbors, school and family (K. W. Axhausen, 2002). The commitments to meet friends defines the available space of an individual within his/her daily routine. The size of this available space demonstrates the individual consumption of transport. There were 700 million arrivals of passenger to different parts of world every year till 2000 as compare to 25 million in year 1950. There are 4 million air passengers every day and any time. There are 3 lac passengers travelling in different flights above USA. 1.6 Billion air travelling occur each year, travelling and tourism is the world's largest industry with an average 11.7 per cent of total GDP of world. The demand for hotels for the accommodation of travelers reach up-to half million/year and this number is completed even (Urry, 2003).

2.7. Conclusion

Literature findings conclude that there is strong relationship between digital and physical communication, as the literature provide some important facts about the relationship statement. There is dual effect of both communication pattern of individual. Few of the physical movements of an individual are reduced by using communication technologies as the message is conveyed online. The conclusion based on research can be drawn as, the use of ICTs has drawn positive impact on physical movement of an individual. Digital movement of individual is increasing and communication networks also enhancing the share of digital movement to individual's social network. The various types of social media are helping people to plan their trips and journeys in an effective and economic way. The use of ICT has reduced the distances in terms of exploring other parts of world (the person planning to move from east to west). ICT also enabled individuals to communicate physically with all modes of transport, weather condition, security, road network and by providing price comparison of different modes of physical communication. The literature also helped in identifying the important characteristics of individuals that cause the physical and digital communication.

2.8. Way Forward

Based on the research and findings of the literature the study provides a step forward towards the development of real-world model that prescribes the relationship between communication pattern

and travelling of individuals. How much is the share of digital movement (ICTs) and how many time the physical movement is preferred by individual to develop relationship with social network. The model will also be helpful in analyzing the effect of communication behavior on travel behavior. The research has provided with fruitful attributes for further studies. Based on these attributes the questionnaire will be designed and questionnaire will help in answering the relevant research questions. The questionnaire will be distributed online to focus group and after getting data from the respondents, further analysis will be conducted. The brief explanation about how the research is carried out is explained step by step in the next section 3. research methodology. The further sections of thesis are according to this research approach.

CHAPTER NO. 03

3. RESEARCH METHODOLGY

In this chapter, brief explanation of research methodology adopted for accomplishment of thesis is discussed. Clifford Woody defines research as process of defining and redefining of problem, expressing hypothesis recommending solution; collection, organization and evaluation of data; drawing deductions and formulating conclusions; and finally, prudently verifying the formulated conclusions to determine whether these conclusions fit in hypothesis. Research methodology is a systematic approach used to solve the problem defined for research. One can say it as the science of way of studying research, the way research in which is carried out scientifically. There is difference between methods and methodology, methods/techniques are part of methodology and are used for conduction of research (Kothari, 2004). The very next step after the literature review is to define the list of parameters which are necessary to investigate the research question. The steps carried out to formulate the research are explained as under

3.1.   Research Topic

The selection of the topic should be given deep thought and it should not be contrary to the interest of researcher. The topic should be suitable and genuine for research and it should not be imposed by someone else (Rajasekar, Philominathan, & Chinnathambi, 2006). The topic was selected based on the researcher's personal interest and academic background. The area of interest is to find out the link between the communication pattern and travel. How often people communicate using digital means and how often they communicate using physical means. The use of social media is increasing and it is becoming important tool almost in every aspect of daily life. As there is limited research on this topic, so it was in the interest of researcher to give attention to new topic which may lead to extensive research in nearby future. To find out what is the impact is of information and communication technologies on travelling of individual. The topic was selected to understand what is the share of physical communication and digital in routine life of an individual.

3.2.   Defining Problem and Research Question

The next step after selecting the topic for research was defining the problem from literature research. The problem identified in this thesis was based on the literature and after discussion with supervisor. However, the problem is that the travel pattern of individual is changing because of social media and in contrast to general expectations the number of trips is increasing instead of decreasing. With the increasing growth of mobile apps and computer technologies the access to people is becoming more easy and convenient. But at the same time, it is observed that the traffic on road is also increasing and travel pattern of individual is also changing. The problem is to identify the characteristics that motivate individuals to communicate physically. After defining the problem, the research questions were developed by discussing the literature and problem statement with supervisor.

3.3.   Developing Theoretical Background

The literature review is critical discussion related to statistical literature it helps to understand how the proposed research is related to previous researches. Literature review was carried out to confirm what are the major communication types, how these types of communication effects the travelling of individual. The literature also provided some detail about the reasons behind the increase in travelling because of information and communication technologies. Literature review also suggested the best

methods and models to analyze the collected data, and to answer the research questions. i.e. Generalized linear model. From the literature review, the attributes of interests are finalized and later in this research attributes are included in the form of questions. To see the impact of these characteristics on communication behavior of an individual.

3.4. Data Collection

Data collection is the procedure of collecting and measuring information on targeted variables in a recognized orderly fashion, which then enables answer appropriate questions and estimate results (Wikipedia, 2017). For the data collection, the survey was carried out including revealed preferences. The data based on the real/actual choices of individual was collected and analyzed in the analysis part. The data was collected by asking simple questions from the respondents based on attributes. These questions were articulated to explore more about the variables. The detail steps to data collection procedure are explained in chapter 0.

3.5. Questionnaire Design

The list of attributes helped in preparing questions for the questionnaire, so that importance of attributes can be analyzed from respondents. While manipulating on a questionnaire, it requires a series of conclusions for each question. For example, would it be open-ended or closed ended? And for some closed-ended questions deciding what would be rating scales or ranking tasks? (Visser, Krosnick, & Lavrakas, 2000). Researcher's primary goal is to maximize the reliability and validity of the data collected through questionnaire. The questionnaire was prepared on Qualtrics (an online website for questionnaire preparation). The questionnaire was designed to access three major aspects, 1) the socio-demographics characteristics 2) share of individual to different communications and 3) questions based on attributes. The questionnaire was distributed among respondents from various countries.

3.6. Non-Probability Sampling

The respondents for this research were selected by non-probability sampling procedure. Non-probability sampling is process in which respondents are not randomly selected from the population. (Visser et al., 2000) . The distinguishing character of this technique (non-probability sampling) is that selection of population for getting response is under the control of researcher and he decides which unit of population to be included based on subjective judgements (Tansey, 2007). The research is related to communication and travel pattern of individuals so, it was decided to expand sample to different parts of world. Doing this may not cover the whole population of the world, however, it may provide with picture of communication trends in various countries. The sample selected for this research includes the individuals, those who use communication technologies (Email, Facebook, WhatsApp, Twitter etc.). As the response was to be collected online via these communication technologies.

3.7. Data Preparation and Model Interpretation

The next step after getting response from the focus group was to prepare data for analysis. Data preparation provides the researcher with understanding of the data and it provides direction to build right model for analysis (Pyle, 1999). After collecting data from the respondents, the data was cleaned

and only completed questionnaires were considered appropriate for analysis. The incomplete response was waived off from final data (see section 5.1.1,5.1.2,5.1.3, and 5.1.4). Data preparation is something more than just preparing the data for applying it to modeling tools (i.e. SAS); it is also necessary to gain insights into data to build the best possible models to solve the research question and problem, with the data at hand (Pyle, 1999). After preparing the data for analysis it helped in identifying the suitable model i.e. Generalized linear model with cumulative logit link function for multinomial response. The brief interpretation of this model was found necessary to explain. The interpretation of model is explained in section 5.2 After preparing data the coding was developed on SAS software and results were manipulated the detailed method of coding and defining model statement is discussed in section 6.4

3.8.   Data Analysis

Least but not the last, after arranging the data to be fitted into model. The next step is to analyze the results data analysis is the process of ordering, organizing structure and giving meaning to the mass of collected data. Sometimes the data analysis can be messy, ambiguous and time consuming, but it can also as be creative and captivating process. When the data collected is not in proper order and it is difficult to proceed in linear fashion, it is necessary to make sense of, interpreting and theorizing data that signifies a search (Poilblanc, Mambrini, & Schwandt, 2010). After making the sense of data for analysis the data was analyzed. The analysis of data was carried out in three step i.e. socio-demographic characteristics, behavior of individual and model based analysis to estimate the significance of various variables. The model used for data analysis is generalized linear model explanation of this model is given in subheading 3.8.1. The data analysis and model estimation is given in chapter 6.
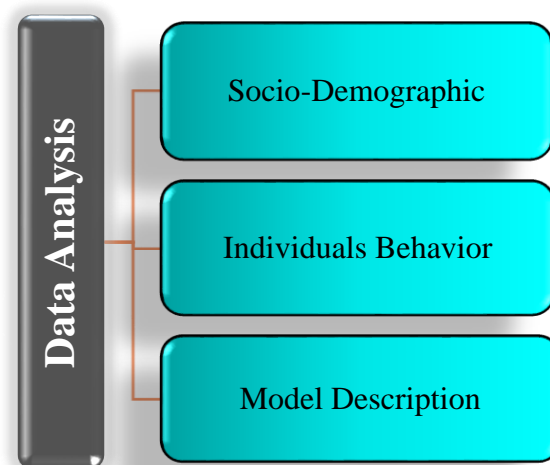
FIGURE 3-1 Description of data analysis parts

3.8.1.   Generalized Linear Model with Cumulative Logit Link

The data analysis would be carried out with the help of generalized linear model with cumulative logit link for multiple response variable. A traditional linear model is of the form

$$y_i = \mathbf{x}_i' \boldsymbol{\beta} + \varepsilon_i$$

where $\mathbf{Y}_i$ is the response variable for the ith observation. The quantity $\mathbf{X}_i$ is a column vector of covariates, or explanatory variables, for observation i that is known from the experimental setting and is considered to be fixed, or nonrandom. The vector of unknown coefficients β is estimated by a least square fit to the data $\mathbf{Y}$. The $\mathbf{\varepsilon}_i$ are assumed to be independent, normal random variables with zero mean and constant variance. The expected value of $\mathbf{Y}_i$, denoted by μ_i, is

$$\mu_i = \mathbf{x}_i' \boldsymbol{\beta}$$

While traditional linear models are used extensively in statistical data analysis. Generalized linear models (GLMs) is a used in statistical methods, these models generalizes the classical linear models in two different ways (Turner, 2008). GLMs work class of distributions of data, that includes a number of discrete and continuous data variables, in particular the normal, Poisson and gamma distributions. Various standard software for fitting GLMs are available, that can easily be used for a data analysis, among the list of these software's few are mentioned here SPSS, SAS, R or GenStat software packages and GLIM.

3.9. Conclusion and Recommendations

The last step of the research approach was to draw a conclusion based on the findings of the analysis of data. The conclusions are made by concluding the results of variables that are significant for an individual to choose either physical communication or digital. How this trend changes with family, friends and colleagues is also compared. The conclusion part was also divided into two sections. The first section is about general conclusion based on researcher's observation from the remarks obtained from questionnaire. The second part of conclusion is deduced from data analysis i.e. significance of various variables, that effect the behavior of an individual, estimated from generalized model results. The recommendations are made for future studies and research that can be carried out to gain more insight into this research question.

3.10. Motivation for Research Methodology

The methodology of the research is based on the literature from different studies. The methodology adopted by different researches motivated to conduct the research, by using revealed preference survey and generalized linear model for estimation of different variables.

The generalized linear method was used in Vrije university Brussels for predicting frequency of claims, claims severity and pure premium for insurance policy. The aim of the research was to check the significance of different pricing for third party insurance company (Brisard, en Begeleider, & Van den Acker, 2014). The generalized linear method was also used by Keren Pollak et al in one their research about predicting the vulnerability of highway network segments. In this research the method was used to predict the parameters that effect the road accidents (Pollak, Peled, & Hakkert, 2014). Another study was carried out in university college London by Abdul Qadeer Memon to model the risk of accidents per unit of distance. The significance of various variables like weekdays, seasons, months, time, holidays and road type was investigated using generalized linear model. In this research the data was collected by using structured questionnaire from respondents (Memon, 2012).

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The motivation for adoption of research methodology was adopted from the above studies as this study is also related to individual's preference to communicate either digitally or physically. Which is similar to prediction of pricing and pure premium for car insurance. In this study communication preference (either physically or digitally) is to be modeled based on various variables like, distance, time, cost, relationship and mode of communication. The data collection method used in this research is also questionnaire based as used in research by Memon, one of the motivational research mentioned above. The analysis of collected data is also carried out using generalized linear model on SAS software with coding on it, for different parameters.

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CHAPTER NO. 04

4. DATA COLLECTION AND QUESTIONNAIRE DESIGN

4.1. Data Collection

4.1.1. Revealed Preference

For the data collection revealed preference survey was conducted. Revealed-preference data is related to actual choices of individuals in real-world situations. As the people reveal their tastes, choices and preferences which they normally use in real world situations.

The advantage of such data is that, it reflects actual choices and there are no hypothetical situations in data. The revealed preference data is based on historically existing choices and nothing to do with future scenarios. Most of the time, the research is about the individual's choices to prefer/choose new and different product. This kind of research has nothing to do revealed preference data. In revealed preference data, there can also be limitation of fact about whatever researcher think that exists, but in reality, it may not exist. For example, assume that the researcher wants to estimate the parameters that affect the household's choice of energy supplier in California. While residential customers can always choose among dealers for several years, and practically there is no difference in price quoted by suppliers' offers. In this scenario, the customers' response to price variable cannot be estimated on data that contain little or no price variation. If it would be used as stated preference data. If all the dealers offer same price to their customers, knowing that their customers are highly price responsive it would create equilibrium situation (Rajasekar et al., 2006). If this data from market is used in choice model the result would be that price is insignificant and have no effect to costumers. In revealed preferences methods, the researcher can use observations to measure preferences based on actual choices made by individuals. The primary advantage of the revealed preference data is the confidence on actual choices, and avoiding the possible problems related to hypothetical responses (Hicks & others, 2002).

The data used in this research is also revealed preference, as it is desired to know the preference of individuals to communicate using physical or digital means. The hypothetical data was not necessary in this research, as every respondent has different satisfaction level with communication pattern. It would have to lead to insignificant results for various variables that account a lot for communication pattern of an individual. The choices defined for different variables in revealed preference data are discrete.

4.1.2. Selection of Attributes

Variables are things that vary or change as it is clear from the name variable. Variables can also be interpreted as measurable factors that can convert difficult concept to easier understandings. After going through literature and gaining positive ideas from the literature the next step towards research is to define the necessary attributes for analysis of data. For the research eight variables are considered as important based on literature except socio-demographic characteristics i.e. age, gender, education and country of residence. The brief explanation of these variables is given below

4.1.2.1. Attributes and Levels

The research is carried out based comprises of eight attributes, these attributes are extracted from literature review. The list of attributes is given below.

- Frequency
- Distance
- Location
- Time
- Mode
- Relationship
- Cost
- Communication network
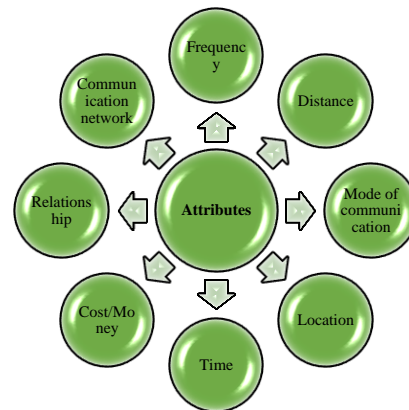
These attributes are included in questionnaire to analyze the individual's behavior for communicating with other people. The detailed description of all these variables along with their utility level can be found below.

a) Frequency

The attribute of frequency is the number of occurrences of a repeating event per unit time (Wikipedia, 2017). In this research, the attribute of frequency is divided in unit time of daily, once a week, once a month, Couple of times a year and never. The variable of frequency will illustrate how important are both types of communication with family, friends and colleagues of an individual. It can also be analyzed from this variable that how frequent an individual communicates digitally and physically with friends, colleagues and family (P. Mokhtarian, 2009 b)

b) Distance

It is assumed that, with the increase in distance the physical communication of individual decreases. However, an individual prefers physical movement for shorter distance rather than digital movement. To estimate the effect of this attribute on communication pattern of an individual, this attribute is added in questionnaire (Fotis, 2015).

c) Mode of Communication

The individual's behavior can be judged based on the availability of mode of transport and mode of digital communication. It was assumed that it would be easier for an individual, to plan physical movement, having personal conveyance, rather than the individual who has to travel using public transport to communicate other people. The response from individuals about this attribute will help in analyzing how important is the mode of communication for an individual. The mode of communication is asked in questionnaire about both physical and digital movement (P. Mokhtarian, 2009 b).

d) Location

Location is an important element for an individual while planning physical route. The motivational aspects can be pleasant environment at some locations, beautiful nature and mountains

etc. This variable is important as it may cause in increasing the physical movement of an individual, rather than making conversation using digital means (Morris, 2005).

e) Time

This attribute refers to the available time for physical communication, including the travelling time. Somebody with more available time may prefer physical communication and an individual with less available time may prefer digital communication (Van Wee, Geurs, & Chorus, 2013).

f) Cost/Money

This attribute is an important as it is assumed that the digital communication saves money, while the physical movement increases the travel time and cost as well. The question about this attribute is also be included in the questionnaire to see its significant on communication pattern of an individual (Fotis, 2015) & (P. Mokhtarian, 2009 b).

g) Relationship

The closeness to any relation also affects both type of physical and digital communication. But in the questionnaire the attribute of relationship is estimated by asking respondents, that how important is physical communication to develop strong relationship (Bidart & Degenne, 2005).

h) Communication Network

Least but not last, with the increase in ICT, the individual's behavior has changed to digital communication, as it is considered to be the most convenient way of communication. The reason behind the change is the preferences of an individual to opt for digital movement is variety of communication networks, which enables the individuals with easy way to send or receive information, greetings and all sort of communication. Because of aforementioned worth of this attribute it is found necessary to know about communication network's influence on individual's preference to digital movement (Fotis, 2015).

All above mentioned are the attributes retrieved from the literature, based on the personal experience of researcher and after discussion with supervisor, and are considered necessary to carry out the research. These attributes are part of questionnaire, so that the research questions can be analyzed in proper way.

4.1.3. Survey

The survey for research question is divided into three parts the first part is general questions about their experience and awareness to communication technologies. In this part the respondents were given choices i.e. do they have access to internet? Do they use smartphone either with internet or without internet?

In the second part of survey the core part of the survey is asked based on various attributes. The main part of survey is of three main questions with 13 small question. The same questions are asked for family, friends and colleagues. The behavior of an individual changes for all three categories. The questions were designed based on the attribute up to five levels of utility and were included in questionnaire. The list of variables with levels is given below in TABLE 4-1

TABLE 4-1 List of attributes and levels

Attributes	Levels				
Frequency	Daily	Once a week	Once a month	Couple of times a year	Never
Distance	Less than 1 KM	2-20 Kilometer	21-50 Kilometer	51-100 Kilometer	More than 100 KM
Digital Mode	Mobile phone	Smart Phone	Laptop	Desktop	None of these
Physical Mode	Cycle	Car	Bus/Train/Metro/Tram	Airplane	None of these
Location	Beautiful Nature	Mountains	Scenic views	Proximity to Rivers	Doesn't Matter
Time restriction to physical communication	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Cost saving by digital Means	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Strengthening of Relationship by physical communication	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

And in the third part the socio-demographic statistics of an individuals are asked i.e. age, gender, education and country of residence.

The next step after extracting variables and defining levels was designing the questionnaire for survey. The questionnaire was prepared online using Qualtrics. The detailed explanation of various parts of questionnaire is given below.

4.2. Questionnaire Design

The questionnaire was designed to gain insight into organization of individuals' physical and digital communication. The questionnaire was designed in Qualtrics, a web link for the development, distribution, and collection of data of respondents. The secondary data was collected and used for research analysis, as the desired data for the research is not available on OVG.

The questionnaire is divided into four different parts: The complete questionnaire is included in Annex 1: Questionnaire

1. General questions;
2. Experience part (share of different sources);
3. Communication part;
4. Socio-demographic part.

4.2.1. General Questions

The questionnaire needs to design in a simple way, so that the respondent may feel comfortable to response the questions with ease. While designing a questionnaire, the respondent's comfortability was the priority of the researcher. The first part of the questionnaire comprises the introduction of the

survey and four general questions. It was found necessary to inform the respondents about the research question. The brief description about research was included and the confidentiality of response was guaranteed. Little knowledge about the research will help respondents to response in precise way. The general questions included in the questionnaire are like awareness about the smart phone, availability of smart phone, access to internet and question about the available mode of transport used for physical movement. In the **FIGURE *4-1* Order of questionnaire FIGURE *4-1***, the sequence of questionnaire is explained

General questions
- This part includes general questions like availability of smart phone, internet access, and mode of transport

Experience part
- Questions related to share of individual to both type of communications i.e. Physical and digital

Communication part
- This is the main part to achieve the goal of the research that how the communication of individuals are organized in terms of physical and digital
- Questions related to respondents communication with friends, family and colleagues

Socio-demographic part
- This part is about the socio-demographic statistics i.e. age, education, sex, country etc.

FIGURE 4-1 Order of questionnaire

4.2.2. Experience Part

Questions in the experience part contains queries about sources of communication people use to communicate with friends, family, and colleagues. The communication sources are divided into three categories: first one is the mobile phone using only subscriber information module (SIM), the second source is the internet (using smart phone, laptop, desktop and tablet etc.), and the third category is face to face communication which may be referred as the 'physical' communication. It can be viewed in the **FIGURE *4-2*** how the question about communication source was asked from the respondents. The percentage of use of these three sources of communication was asked from respondents. The other question, is about the frequency of communication with different members i.e. friends, family, colleagues and others. The frequency was divided into five levels (1=Daily, 2= Once a week, 3=Once a month, 4=couple of time a year, 5=Never).

FIGURE 4-2 The screenshot of question asked in experience part

To understand what sources of communication individual use to communicate within their social zone such questions are made part of questionnaire. This part would also provide information regarding the frequency and the number of times people communicate with other members/people out of their busy schedule.

4.2.3. Organization of Individual's Communication Behavior

The motivation for questionnaire was taken from study by Fu (2005) and similar questions were asked in questionnaire with similar categories for each question. Fu (2005) demonstrates one approach to collect data about daily communications. The approach consists of a following question:

On an average, about how many people do you have contact with in a typical day, including all those who you say hello, chat, talk or discuss matters with, whether you do it face-to-face, by telephone, by mail, or on the internet and whether you personally know the person or not? Please give your estimate and select one from the following categories that best matches your estimate: (1) 0-4 persons; (2) 5-9 persons; (3) 10-19 persons; (4) 20-49 persons; (5) 50-99 persons; (6) over 100 persons (Fu, 2005)

This part of the questionnaire is the core of the survey. This part includes three major questions of almost similar type for different group of people (family, friends, and colleagues). The question about the physical or digital contact of an individual within family members is included to know about how much people communicate with family members and with what sources. This part also includes questions about the communication of individual with friends, family and colleagues. The individuals get involved in different kinds of communications with their friends for social gatherings, recreational purposes, parties, and for study purpose as well. However, people also communicate with colleagues in their offices, business partners for business deals and entrepreneurship, and politicians. The individuals choose one member with whom they communicate most out of their total communication. Then they are asked how they communicate with specific person from family, friends and colleagues separately. What is the percentage of their communication with this specific person to their total communication.

This part of the questionnaire was based on different attributes that affect the behavior of an individual to choose the method of communication with their interlocutors. The attributes are retrieved from the research as mentioned in literature review. In this questionnaire, the people are given choice of the frequency of physical movement and digital movement for communication. Distance related questions are part of this section of questionnaire, as it will help in elaboration of the fact, that how the

individual's behavior changes for physical movement when the distances are long. And how the distance variable effects the communication. One of the question was about the mode available for physical movement and digital movement. The choices offered for physical mode was (1=bicycle, 2=car, 3=bus/train/metro/tram, 4=airplane, 5= none of above). This attribute will help in comparing it with frequency parameter. The same mode type question also included for digital mode with levels (1=mobile phone, 2=smart phone, 3=laptop, 4=desktop, 5= none of above). Other attribute related questions like locational aspects with multi-level i.e. beautiful nature, mountains, scenic views, and rivers are also part of this main content of questionnaire. This attribute is used to measure the change in behavior of individual from digital to physical movement, depending upon this attribute. For the estimation of the individual's preferences about three attributes

1) availability of time for physical movement,
2) saving money by digital communication,
3) and strength of relationship

Likert scale (1=strongly agree, 2=agree, 3= neutral, 4=disagree, 5= strongly disagree) is used. In **FIGURE 4-3** few of the examples of questions asked in main part of questionnaire are shown.

The individuals were asked to response the aforementioned same questions separately for family, friends and colleagues. The individual's communication is divided into three categories i.e. friends, family and colleagues. It is assumed that all possible relationship of an individual come under these three categories with whom an individual communicates in his/her daily life. These categories are mandatory in understanding the organization of communication pattern of an individual.

FIGURE 4-3 Few examples of questions included in questionnaire

4.2.4. *Socio-Demographic Part*

The questionnaire's last part is about the socio-demographic characteristics of respondents, this part is compulsory, as it helped in understanding the behavior of individual in the context of age, education level, gender, and country of residence. This section of questionnaire includes only four questions i.e. the respondents age is questioned by dividing the age into four categories (1=less than 18 years, 2= 18-26 years, 3=27-45 years, and 4=more than 45 years). The age is categorized into four categories as it is assumed that the individuals with age less than 18 years old use less smart phone and social media. The age category two is of young people those who are more likely to use communication technologies. The third category is of professionals using communication technology and have more experience in these technologies. And last category is about those who are not much familiar with these technologies.

The next question is about the gender of respondent, either male or female. One very important socio-demographic statistic is about the education level of individuals. However, everyone is becoming aware of ICT now days, but still there are people, who are not much familiar with such facilities. The reason can be individuals who are not well educated know/use less ICT. The education level is categorized into five levels (1=undergraduate, 2=graduate, 3=masters, 4=doctorate, 5=post doctorate), the education level of individual will help in understanding the preferences for physical movement and digital movement by comparing it with their education level.

Respondents are asked about their current state of residence, as sometimes people having dual nationality may get confused in providing response. Individuals residing in developed countries use more of these technologies rather than in their home countries. The country wise variation can be helpful in estimating the probabilities of physical and digital communication.

4.3. Collecting Data

The most important part of any research concerns the data collection method. After preparing a questionnaire, the next step was to gather as much as possible responses from individuals. For this purpose, a strategy was planned by the researcher. First, it was thought necessary to approach respondents from Belgium only. Later, it was decided to extend the vision of study and case study should be extended to other countries. As the researcher, himself belongs to Pakistan, so it was found necessary to get response from Asian countries as well. There were three types of methods used for the distribution of online link for gathering response from different individuals of various countries.

- Email
- Facebook
- WhatsApp

FIGURE 4-4 Data collection sources

4.3.1. Email Based Data Collection

One of the focal person of the University of Hasselt was contacted for the distribution of anonymous link of the online questionnaire. The electronic mail was forwarded to students, staff members, and other employees. The email was forwarded on 21st of March 2017, this email comprised of brief introduction about research topic and Qualtrics based online link for filling of the questionnaire. The email also includes the deadline for filling in the questionnaire (i.e. 30th of March 2017). As per statistics of focus person of the university, the email was sent to around 6000 individuals. The respondents were again forwarded an email on 27th of March 2017, for filling the questionnaire.

4.3.2. Facebook Pages

The second source used for the data collection was social media, as the study is also related to the use of social media. It was found necessary to manipulate such exercise on such social forums so that individual's opinion may be calculated. The same version of email for getting response was shared in various Facebook groups of Belgium, Germany, Netherland, Slovenia, India, Vietnam, Pakistan, Denmark, United Kingdom, and Australia. This source of gathering information was used for getting response from Pakistan and other Asian countries, as far as the trend is concerned in Asian countries people mostly do not respond to email. However, the response in terms of filling of questionnaire on Facebook was also observed good in Asian countries. As few respondents also gave feedback by posting comments on the posts of questionnaire.

4.3.3. WhatsApp Groups

WhatsApp is also considered to be most successful source for communication with other people. The link of the questionnaire was also distributed to various WhatsApp groups in Pakistan and Belgium. The whole purpose of these kind of exercises was to gather maximum response from as many as individuals, so that better picture of the world can be analyzed.

Once the questionnaire was distributed and deadline for collecting response was over. The response collection through Qualtrics was stopped and response was extracted from Qualtrics in csv. file format. The next step was to clean and manage the data for analysis part. The data management process, selection and interpretation of suitable model is explained in chapter 0.

CHAPTER NO.05

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5. DATA PREPARATION AND MODEL INTERPRETATION

In this chapter, the data preparation process for analysis and model estimation are described. This chapter also includes the brief understanding of generalized linear model with cumulative logit link.

5.1. Data Preparation

Preparation of data is not a process that can be carried out blindly. There is no automatic tool that can be pointed at a data set and told to just "fix" the data. Because there is art involved in data preparation does not mean that powerful techniques are not available or useful (Pyle, 1999). In this research, the data preparation was an important task. The data preparation involves following tasks.

1. Cleaning of data
2. Exporting CSV file from Qualtrics
3. Importing data files on SAS
4. Data Management

The all four steps involved in data preparation are discussed in detail below.

5.1.1. Cleaning of Data

The very first step of data preparation is cleaning of data which includes removal of errors and missing values from response. The term error represents the missing values, duplication of data and unimportant information. In cleaning process the incomplete response was removed from the data to formulate the complete data for analysis. If the data was used with missing values, it may have affected the output generated by SAS. The Qualtrics data showed that 523 respondents participated in the research questionnaire, and 117 respondents did not complete the response. So, these respondents were waived off from the data and remaining respondents with complete response were considered as necessary to analyze in SAS. The incomplete response from the respondents was deleted on Qualtrics so that a complete version of data may be formulated to use in SAS. This step was done very carefully after viewing those respondents who left the response incomplete and were deleted one by one.

5.1.2. Exporting CSV File From Qualtrics

The next step after initial cleaning of incomplete response was exporting the file to use the data collected through Qualtrics. The data cleaning was also required in csv file exported by Qualtrics. The data cleaning in this file included the additional/unnecessary information like IP address of respondents, response id, response set, anonymous name, eternal id, blank column of email ID, Status, start date/end date, finished value, location longitude and latitude, location accuracy and remarks (which were in verbal statement). To enable SAS to use the data file in an effective way it was found necessary to remove all the unnecessary columns from the data file. This all information was deleted from the relevant csv file and this file was finalized for exporting it in SAS.

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5.1.3. Importing Data Files on SAS

The next step of data preparation was the import of csv file on SAS. So that, it can be used to generate results required for analysis by using SAS software. After successful import of csv file in SAS software it was set ready for programing and coding. Proc Import Out command was used to successfully import the data file to SAS. After this step, the file imported on SAS can be used for analysis. Before going to analysis, the coding of variables is required, so that the model statement can be applied easily on data file. The coding of the data will work only if the data is managed properly. The data management is time taking task and lot of effort is required. The data management process is discussed below.

5.1.4. Data Management

Management of parameters is time taking but once it is done, it is easier to analyze the variables. For assigning codes and labeling parameters the SAS software is used. The labeling/formatting is basically replacement of long statements (questions and statements used in questionnaire) by short codes that the researcher memorizes. And later, these codes can easily use these codes in model statement and in generation of report. For the data management task, few steps were used which helped in modeling the various variables. The first step was replacement of question number (assigned by Qualtrics) from questionnaire with variable title. For example, the question (Q15_3) how often do you communicate using physical means was replaced by "Freq. of physical means". (see **TABLE 5-1**) Similar, in the CSV file, the response was in the form of 1,2,3,4, and 5 for levels in ascending order. This response for all levels was replaced with original meaning of levels. For instance, for frequency of physical means the Qualtrics response was converted into original levels. This step was necessary for the interpretation of results.

This step was performed for all the variables and levels. The **TABLE 5-1** elaborates briefly about the command used in SAS software for management of data sets. After using these commands, the output file always replaces the original values and question numbers with assigned labels.

TABLE 5-1 Commands used in SAS software to manage the data for understanding

Command for labeling variables	Assigning formats to levels
```data analysis; set GLM.model; label Q15_3 = "Frequency of digital means" Q23 = "Age" Q25 = "Gender" Q27 = "Education?" Q29 = "Country"; run;```	```proc format; value communicat 1 = "Daily" 2 = "Once a week" 3 = "Once a month" 4 = "Couple Times a year" 5 = "Never"; run; proc print data = analysis; format Q15_3 communica.; run;```

5.2. Model Interpretation

5.2.1. Generalized Linear Model

Nelder and Wedderburn (1972) introduced the theory of generalized linear models. In this model, the response variable is taken to be distributed according to a member of the exponential family of probability distributions. The statistics of model are based on a linear predictor. The linear predictor

is a quantity that is calculated as a weighted linear combination of independent variables. One of the findings is that by restructuring the relationship between linear predictor and fitted values nonlinear relationship can be modeled. These models are known as generalized linear models (GLMs) (Memon, 2012). This model will be used in the analysis part to estimate the significant effect of explanatory variables on response variable.

In the generalized linear model the dependent variable *Yi, i=1,....n* is modelled by linear function of independent variables Xj, j= 1, …..,p plus error term as shown in equation 1 below.

$$y_i = \beta_0 + \beta_1 x_{1i} + \dots + \beta_p x_{pi} + \epsilon_i$$

In this model, the word general is referred to dependency of Y on more than one covariates, vs. the simple linear model (Turner, 2008). In this model, the term ε is assumed as independent and distributed identically as below

$$E[\epsilon_i] = 0$$
$$\text{and } \text{var}[\epsilon_i] = \sigma^2$$

There are few problems for which traditional linear model cannot be considered as appropriate for example. It could not be effective to assume that data are normally distributed. Let's consider, the normal distribution (continuous) may not be sufficient for modeling counts and proportions that are considered to be discrete. Secondly, If the restriction is applied to mean of the data to a range of values, this traditional linear model might not work appropriately, as the linear predictor may take on any value. Let's suppose the mean measured proportion is between 0 and 1, but the linear predictor identified by traditional linear model based on mean is not restricted to this range. Thirdly, it is not realistic to assume that the variance of the data is constant for all observations. For example, it is usual to observe data, where the variance increases with the mean value of the data.

A generalized linear model is an extension of the traditional linear model, and it can be applied to a wide range of data analysis problems. A generalized linear model contains succeeding components:

The linear component of generalized linear model is as same as it is for traditional linear models:

$$\eta_i = \mathbf{x}_i' \boldsymbol{\beta}$$

A monotonic differentiable link function g defines how the predictable value of Yi is associated to the linear predictor ηi :

$$g(\mu_i) = \mathbf{x}_i' \boldsymbol{\beta}$$

The response variables Y_i are independent for i = 1, 2,…and have a probability distribution from an exponential family. This implies that the variance of the response depends on the mean μ through a variance function V:

$$Var(y_i) = \frac{\phi V(\mu_i)}{w_i}$$

In the above equation, the ϕ is constant and w_i is weight calculated for each observation. The *dispersion parameter ϕ* may be known (for example, for the binomial or Poisson distribution, $\phi=1$) or must be estimated.

5.2.2. Cumulative Logit Link

Cumulative link model is model for ordinal response variable. In this model the $\mathbf{Y}_i$ can be up to j = 1,………, J categories. In this case the $\mathbf{Y}_i$ is based on multinomial distribution with parameter π where π_{ij} represents the probability that ith observation falls in response category. The cumulative probability can be defined as

$$\gamma_{ij} = P(Y_i \leq j) = \pi_{i1} + \ldots + \pi_{ij} \,.$$

The first step to proceed to cumulative logit link is to define logit link, the logit link is defined as logit $(\pi) = \log[\pi/(1-\pi)]$. Based on this equation the cumulative logit can be defined as

$$\text{logit}(P(Y_i \leq j)) = \log \frac{P(Y_i \leq j)}{1 - P(Y_i \leq j)} \quad j = 1, \ldots, J - 1$$

The cumulative logit are defined for all categories of response variable except last category as for j=J, the denominator in the case of last category would be $1-P(Y_i \leq J) = 1-1 = 0$ and the result would fraction could not be defined.

The generalized linear model is used in the analysis part of this research with multinomial response and cumulative logit link by using GENMOD process of SAS software. The analysis based on this process for different variables is explained in section 6.4, 6.5, and 6.7 in chapter 6.

CHAPTER NO. 06

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6. DATA ANALYSIS AND DISCUSSION

6.1. Analysis of Data Collected through Responses

This chapter is about the analysis of response collected through questionnaire. The analysis part is divided into three parts. The first part is about the description of respondents, their socio-demographics i.e. age, gender, education, and residence. The second part is about the preferences of individuals for communication. Either they prefer physical communication or digital communication with their friends, family, and colleagues. The third part is about the model estimation. The model part is about the probabilities of individuals in terms of physical or digital movement based on explanatory variables. The pictorial description of data analysis parts is shown in **FIGURE 6-1**. The analysis part is carried out based on the results obtained through Qualtrics for 406 respondents. The model is developed using GENMOD process on SAS software.
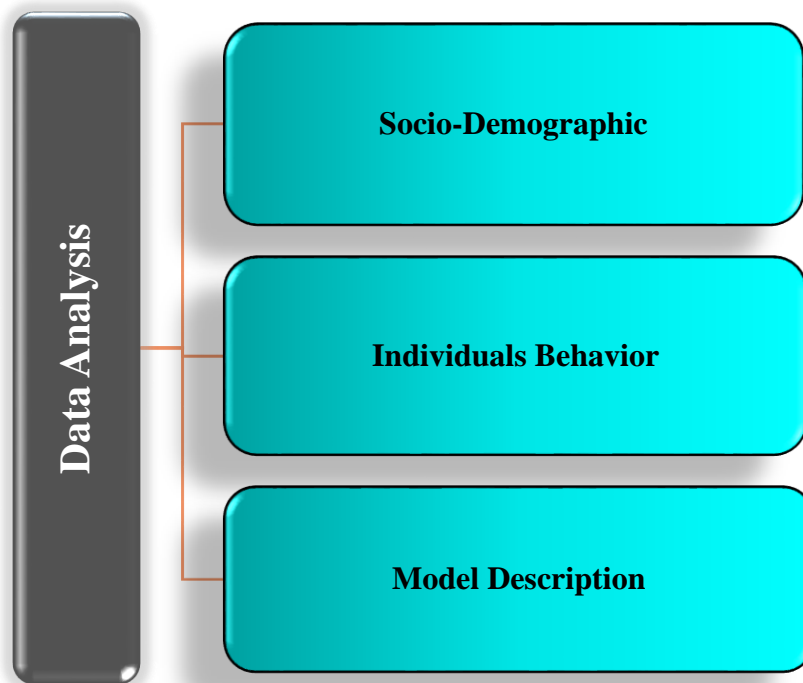
FIGURE 6-1 Description of data analysis parts

The anonymous link of questionnaire was forwarded for getting response from various countries for getting online response about questions asked in questionnaire. The data collection process was carried out for two weeks starting from 21st March 2017 to 4th of April 2017. Around 523 respondents took part in online filling of questionnaire, but only 406 respondents completed the questionnaire. The rest did not complete the questionnaire. The response rate was 78 percent only. The others were given three to four time reminders in two week's durations for filling the questionnaire. At end of time for data collection the incomplete surveys were excluded from the data and analysis is done only on complete response from 406 respondents. The step wise analysis as shown in **FIGURE 6-1** is explained below in detail.

6.2. Socio-Demographic Statistics

The socio-demographic statistics include the age, gender, the country of residence, and their education level. The analysis of individual's digital mode and physical mode of communication is also presented.

6.2.1. Country of Residence

The research was carried out to know the individual's response concerning the communication pattern of individuals; either physical or digital. Respondents from different countries of world were invited to participate in this unique research. Out of 198 countries of world, the response was received from 38 countries. The country wise list of respondents is attached in (Annex 4: Number of Respondents from Different Countries) It is difficult to include all 38 countries separately in analysis part. For the data analysis, it was decided to categorize the list of countries into three parts, based on most number of responses received from any country.

1. Belgium
2. Pakistan
3. Other countries

Out of 406 respondents, 214 responses are from Belgium, 81 responses from Pakistan, and 111 responses were from other countries. These results give the overall picture of respondents from almost all continents. The results are shown in **FIGURE 6-2**
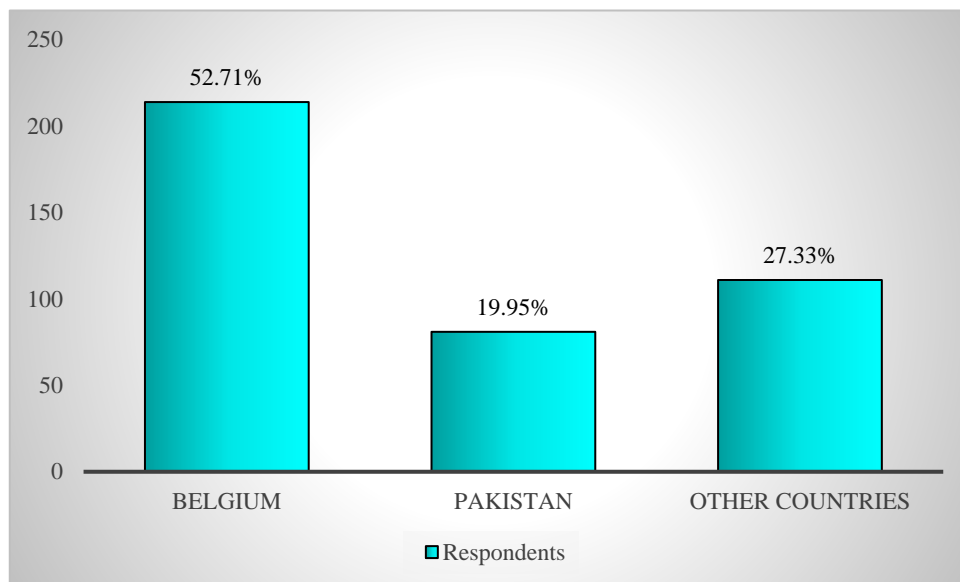
FIGURE 6-2 Country wise distribution of respondents

6.2.2. Gender

The questionnaire was designed for both sex and it was distributed to both male and female without any discrimination. The statistics of this gender wise comparison are necessary, as it would be easier to understand/estimate either males are more willing to digital communication than females. Out of total 406 respondents, 187 respondents are female and 219 respondents are male. The response

gathered further analyzes that, out of two hundred and fourteen respondents from Belgium 48 percent are male and 52 percent are female. So, it can be assumed that the ratio of individuals i.e. male and female taking part in surveys is almost equal to one. The same was observed in the list of other countries. However, this trend was different in the case of Pakistan as 68 percent respondents are male and rest are female. As far as the population of Pakistan is concerned females are in greater number. The gender related stats are shown in **FIGURE 6-3**.
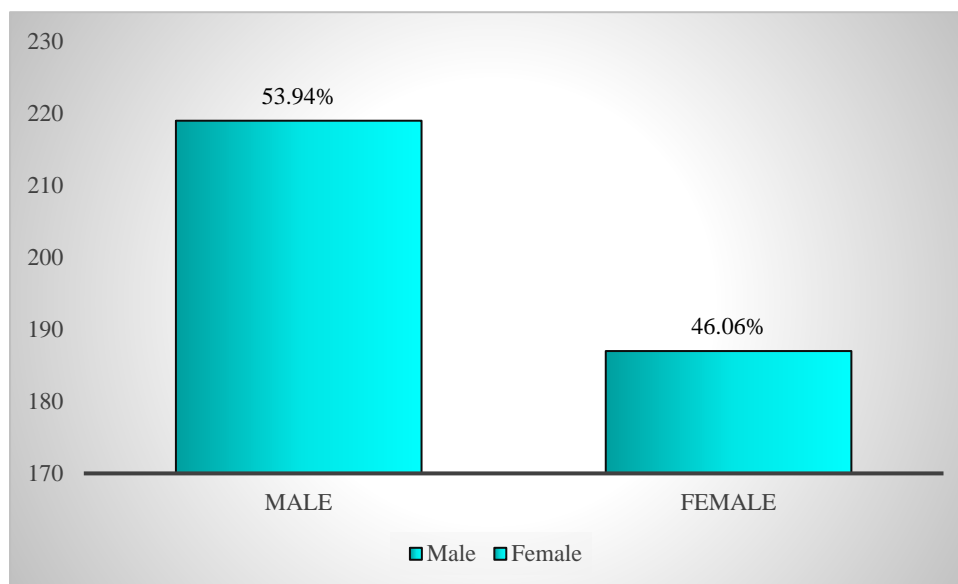
FIGURE 6-3 Gender based calculation of respondents

6.2.3. Age Categories

The age of an individual is an important element to predict the interests of individuals related to their education, profession, family terms, and communication patterns. As the age factor increases the interests, communication pattern, social network and travelling of an individual change with the passage of time. In this questionnaire, the respondents were asked about their age, so that it can be determined which age category prefer physical communication and which age category prefer digital communication. The very first age category is less than 18 years and only one respondent has an age of less than 18 years. The second category is 18 to 26 years and it is observed that most of the respondents belong to this category of age approx. 65 percent of total respondents). The third category covers 27-45 years and it comprises to be the second largest number of respondents which is equal to 34 percent of total respondents. Approximate 2 percent responses are received from the third age category of more than 45 years.

From the aforementioned results obtained through online distribution of questionnaire it is clear that individuals between the age 18 to 45 years mostly use the communication technologies, and it can also be assumed that individuals belonging to this age category also take more part in research related activities as compare to other age categories. It could also be analyzed from these stats that this topic was bit more interested in second and third age category of individuals. The graphical presentation of age related categories is shown in **FIGURE 6-4**
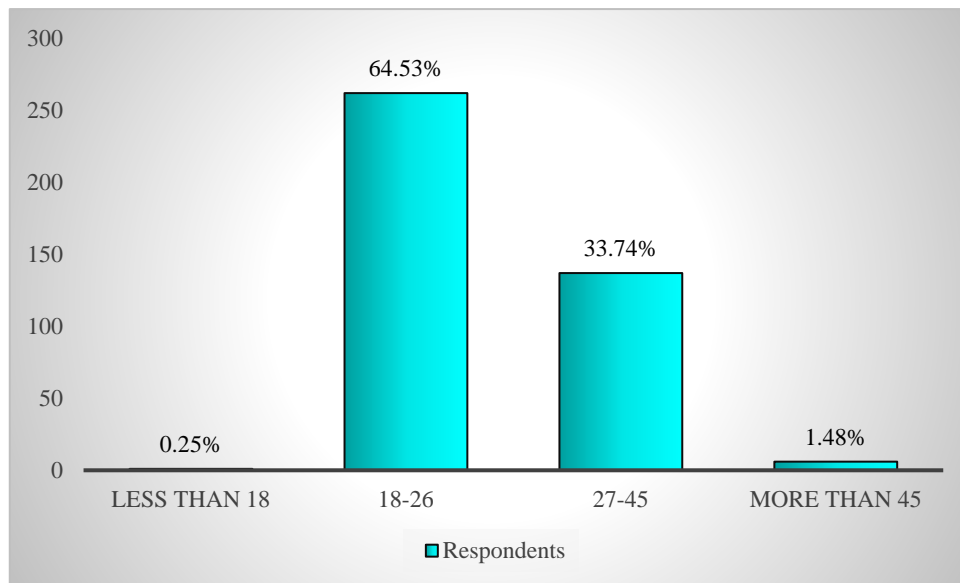
FIGURE 6-4 Division of respondents according to their age

6.2.4. *Education Level*

The education level of respondents is also inquired in the questionnaire. The education level of an individual was categorized into five level namely undergraduate, graduate, masters, doctorate, post doctorate. The results of the survey show that 22 % respondents do not have the graduation, 23 % of respondents are graduate, 41 % are masters, 11 % respondents are doctorate and only 2 % of the respondents have degree of post doctorate among those who participated in research.

Education level is an important element for judgment of behavior of human beings. However, it can be assumed that educated people prefer to use communication technologies more as compare to uneducated. As the response from master's degree holders is maximum. The bar chart explaining the percentage of different education level of respondents is shown in **FIGURE 6-5**.
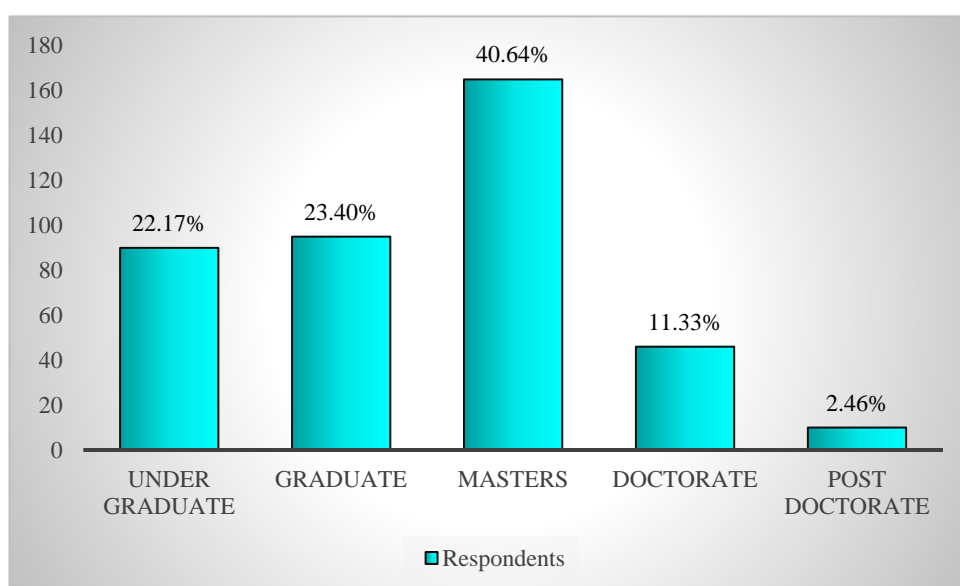
FIGURE 6-5 Education level of respondents

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6.3. Individuals' Behavior

6.3.1. Communication Sources

The respondents were asked to choose what is the approximate percentage of their communication with different sources of communication (mobile phone, Internet, and face to face communication) the question included in questionnaire is shown in **FIGURE 4-2**. The stats of the results describe the individual's behavior towards different communication sources. The statistics of the question explains that 49 respondents stated that their approximate 0% communication is through mobile phone, 227 respondents stated that their approximate 25% communication is with mobile phone, 76 respondents stated that their approximate 50% of communication is with mobile phone, 40 respondents said that their 75% communication is with mobile phone and only 14 respondents have their approximate 100% communication with mobile phone. Similarly, for internet source, 6 respondents stated they have approximate 0% communication through internet, 147 respondents have approximate 50% communication through internet, 135 respondents have approximate 75% communication, 93 respondents have approximate 75% communication through internet and only 25 respondents stated that their approximate 100% communication is through internet. (see **FIGURE 6-6**).
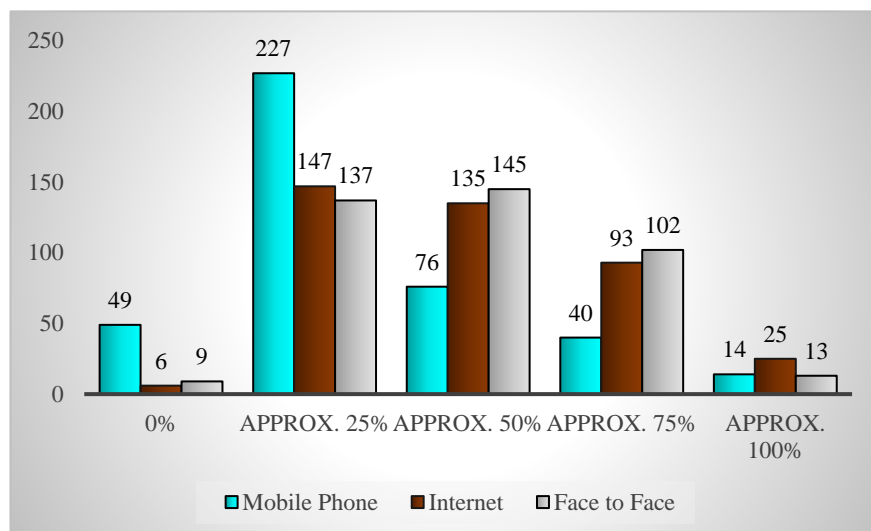
FIGURE 6-6 Different sources of communication and response of respondents.

6.3.2. Communication with Family Members

The respondents were asked to provide answers about the members with whom they communicate most within their family members and what is the approximate percentage of their communication with selected member of family. Remember these family members do not reside with individuals at their living place. The results state that, 58 percent of the respondents have their most communication with their parents within family members, 23 percent respondents communicate with siblings and only 4 percent with uncles. **FIGURE 6-7** explains the rest of individual's behavior or with whom they communicate most in their families.

The results show that 148 respondents stated that their approximate 50 % communication out of total communication with family is with selected member of family. And 119 respondents stated that their approximate 25 % communication is with this selected family member. Similarly, 110 respondents stated that their approximate 75 % communication is with selected family. Only 21 respondents have approximate 100 % communication with one of the selected family member. (see **FIGURE 6-8**.)

Author: Muhammad Shaker
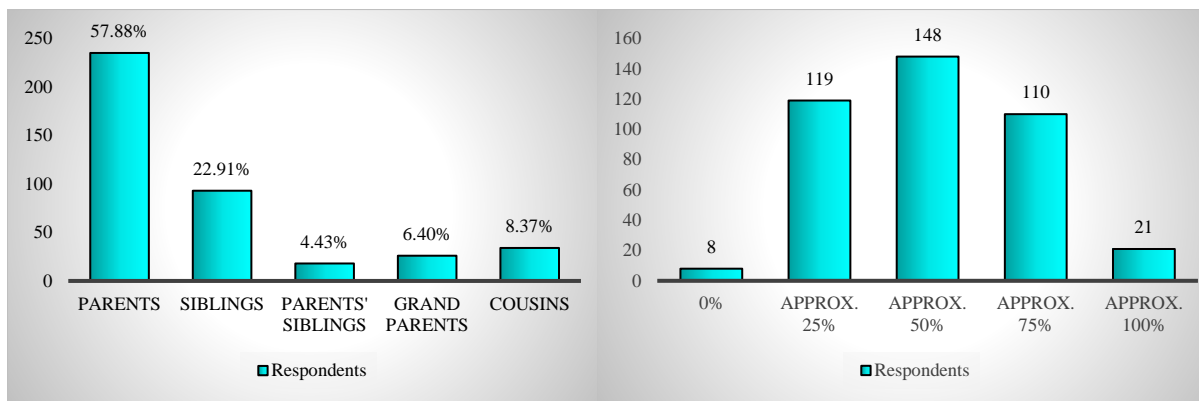
FIGURE 6-7 Individuals communicate most of time with these members

FIGURE 6-8 Share of communication with family members

6.3.3. *Communication with Friends*

The same questions as mentioned in section 6.3.2 were asked to individuals about their communication with friends and colleagues. The respondents were asked to respond about those colleagues who are not living with them at their residence. The response calculated through online questionnaire about friends is shown in **FIGURE 6-9**. As far the communication of individuals with their friends is concerned around 63 percent of respondents communicate most with their best friends, 25 percent with their school friends, 5 percent with friends in neighbors, and 6 percent with old friends. These statistics show that more individuals spend time with their best friends. Individuals treat differently while communicating with friends as compare to family members.

The respondents were also asked to choose between five options, indicating their share of communication with specific friends (i.e. best friend) they communicate mostly. The results show that 142 respondents said that their approximate 25 % of communication is with this selected friend out of total communication with friends, 122 respondents stated that their approximate 50 % communication is with this specific friend, 111 respondents stated that their approximate 75% communication is with selected friend. Only 21 respondents said that their approx. 100 percent of the communication is with this selected friend. The **FIGURE 6-10** show that while communicating with friends the preference of people is best friends and their half of communication is with best friends.
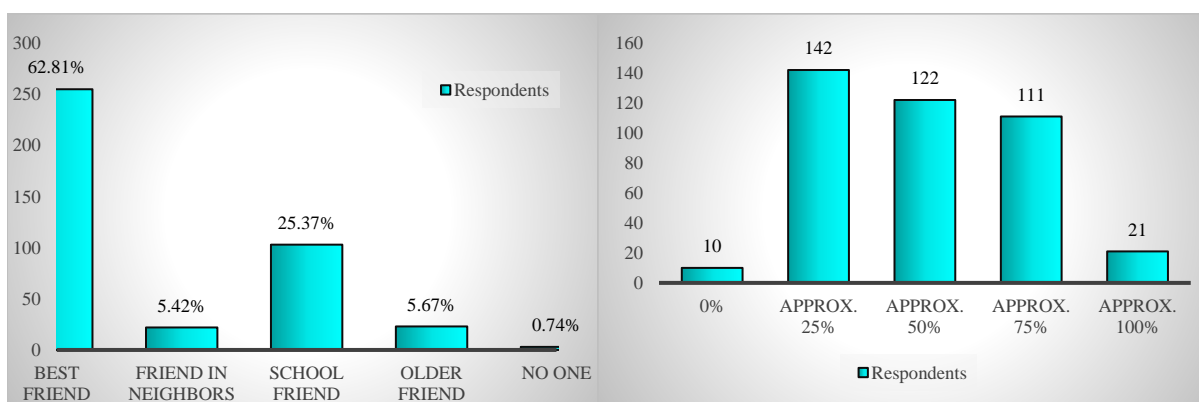
FIGURE 6-9 Communication with friends

FIGURE 6-10 Share of communication with friends

6.3.4. *Communication with Colleagues*

The results of communication with colleagues are different as 44 percent of respondents stated that they communicate with business man which is quite unexpected. These results also state that individual's communication with colleagues is related to business activities. Another major conclusion based on result is that the most communication of individuals is with politicians out of their total communication with colleagues, as 30 percent of the respondents said that they communicate with politicians and only 21 percent of the respondents communicate with their office fellows. Approximately 2 percent of respondents stated that they do not communicate with colleagues. FIGURE 6-11 shows the aforementioned statements.

In the **FIGURE 6-12** percentage of communication with selected colleague out of total communication with colleagues is shown. The results of the survey shows that, 93 respondents stated that they have approximate 0 % communication with colleagues, 143 respondents stated that they have approximate 25% communication with selected colleagues, 128 respondents have approximate 50% communication with selected colleagues, 32 respondents have approximate 75% communication and only 10 respondents have approximate 100% communication with selected colleague. It can be assumed from the statistics that while communicating with colleagues' individuals normally do not communicate most with one specific colleague.
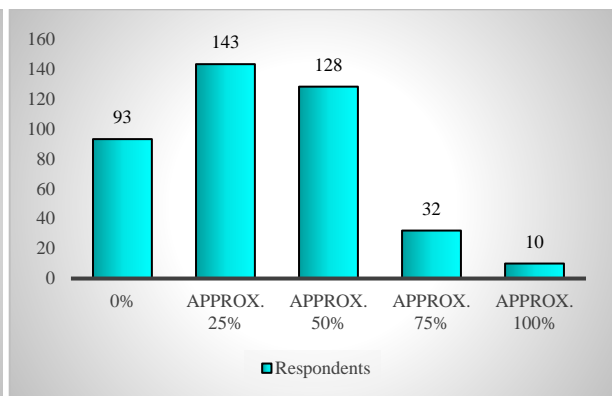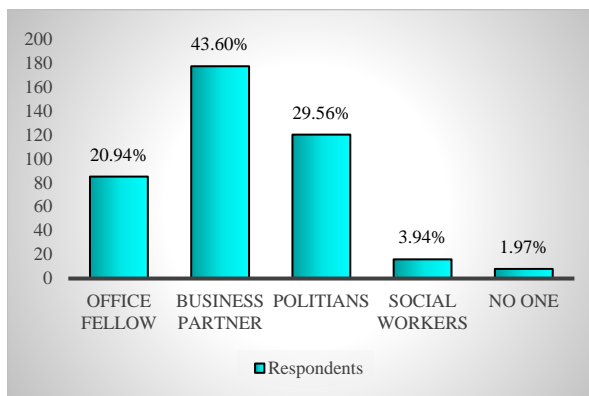
FIGURE 6-11 Communication with colleagues

FIGURE 6-12 Share of communication with colleagues

6.4. GENMOD Process

The third part of analysis is the estimation of probabilities of different categories of dependent variables are modeled and significant and insignificant variables are identified. The process used to estimate the probability and significant effect of explanatory variables is GENMOD. The GENMOD procedure is used to fit a generalized linear model to the data by estimating maximum likelihood of the parameter vector β. In general, there is no solution for estimation of maximum likelihood vector parameters. The GENMOD procedure estimates the parameters of the model numerically through an iterative fitting process. The dispersion parameter is also estimated by maximum likelihood or, optionally, by the residual deviance or by Pearson's chi-square divided by the degrees of freedom. Covariances, standard errors, and p-values are calculated for the estimated parameters based on the asymptotic normality of maximum likelihood estimators ("SAS® Help Center: The GENMOD Procedure," n.d.).

The GENMOD procedure was used in SAS by applying class statement as the data is not continuous, but it is categorical. The distribution (dist) of data is used as multinomial as the response is

up to 5 levels/categories. In the model statement distribution (dist) is multinomial and link function used in cumulative logit. If we talk about the type of analysis the type3 analysis is carried out. Least square means (lsmeans) for explanatory variables is calculated with inverse link (ilink). The syntax used for modeling the probabilities is as follows (see **TABLE 6-1**)

TABLE 6-1 GENMOD syntax for cumulative logit model

```
proc genmod data = analysis;
class Distance Physicalmode;
model Freq of physical means = Distance Physicalmode;/type3
dist=multinomial link=clogit;
lsmeans Distance/ilink diff;
lsmeans Physicalmode /ilink diff;
run;
```

The above syntax statement was used in SAS software to estimate the probabilities of frequency of physical means with explanatory variables distance and physical mode of communication. In the proc statement the SAS is given the command to use genmod procedure to estimate probabilities. The analysis in proc statement represents the SAS data set.

In the second step the class statement is used which uses the classification of levels and the levels are displayed in the same sorted order used to generate columns in the design matrix. For example, for distance variables the design matrix would be like this. This dummy coding for all levels of explanatory variables is considered automatically by use of class statement and there is no need to define dummy coding separately for each variable in SAS. The dummy coding considered for analysis of distance variable is shown in **TABLE 6-2**. As the data is categorical so the class statement is used for all explanatory variables.

TABLE 6-2 Classification of distance variables

Distance	X_1	X_2	X_3	X_4
< 1 Kilometer	1	0	0	0
2-20 Kilometer	0	1	0	0
21-50 Kilometer	0	0	1	0
51-100 Kilometer	0	0	0	1
> 100 Kilometer	0	0	0	0

The third statement in the syntax is the model statement on left side of the equation the frequency of physical means is the dependent variable and on the right side of model equation independent variables are placed as defined in section 5.1.4. In the model statement the type3 analysis is carried out with multinomial response and cumulative logit link function. The multinomial response considers the response variable in original frequency. The model statement will estimate variables either significant or insignificant.

The third statement is for the estimation of least square means with inverse link (ilink), the inverse link in the statement would provide the estimated probabilities of dependent variables associated with explanatory variable. In lsmeans statement diff command is also used, this command generates the significant difference between different levels of explanatory variables.

The results generated based on above mentioned syntax **TABLE 6-1** are explained in are explained in below section 6.5.1 The complete SAS code for all the modals is included in Annex 2 : SAS Code. The same GENMOD process is used for all dependent variable with appropriate independent variables and results are generated and analysis is done as below.

6.5. Cumulative Logit Model for Frequency of Physical Communication

6.5.1. *Frequency of Physical Communication with Family*

In this model probabilities of frequency of physical communication of an individual are modeled. The **TABLE 6-3** shows that there is a significant effect of explanatory variables i.e. distance and digital mode of communication, as ($\chi^2 = 191.73$ (4 df); P-value < 0.0001) and ($\chi^2 = 54.00$ (4 df); P-value < 0.0001) respectively for both variables. It can be assumed that with the increase in distance the physical communication effected. The mode of physical communication also effects the communication pattern, more the access to physical mode more the physical communication. It is also tested that there is no significant effect of other variables like locational aspects, cost, time and relationship strength to the frequency of physical communication of an individual with selected family member.

TABLE 6-3 Significant variables for physical communication with family

Source	DF	Chi-Square	Pr > ChiSq
Distance	4	191.73	<.0001
Physical Mode	4	54.00	<.0001

The probabilities of frequency of physical communication is estimated with two explanatory variables separately. In the first column of TABLE 6-4 there are levels of physical communication and the middle column is the first explanatory variable distance. The contribution of distance variable to probabilities that the individuals will communicate physically are also mentioned in this middle column. Similarly, the estimated probabilities in the third column explains that how the probability of physical communication of an individual change according to the available physical mode.

For example, in the TABLE 6-4 it is estimated that the distance less than one kilometer has a high contribution to the probability of daily communication which is 0.79. As the distance increase from 2-20 Kilometer the graph of contribution to the probability to daily physical communication comes down as the probability is 0.16. And for the third level of distance i.e. 21-50 Kilometer has a low contribution to the probability of daily physical communication equal to 0.10. There is also decrease in the contribution to the probabilities of daily physical communication for fourth and fifth level of distance i.e. 51-100 Kilometer and more than 100 Kilometer. The **FIGURE 6-13** explains how the contribution to the probabilities of daily physical communication of an individual goes down as the distance parameter increases.
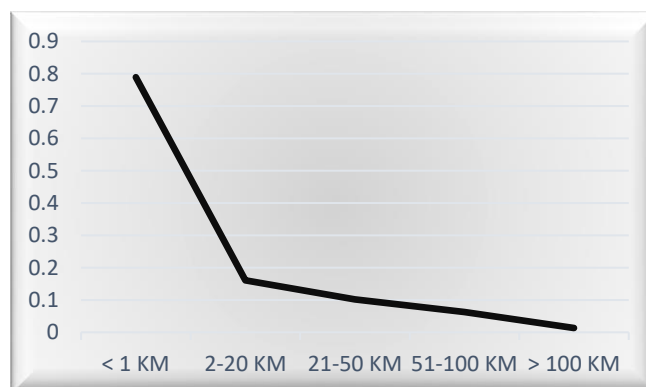
FIGURE 6-13 Contribution of distance variable to probability of physical communication with family

In the table below TABLE 6-4 the value of contribution to the probabilities for each level is cumulated with the previous level i.e. the contribution to the probability of once a week is cumulated with probability of daily, once a month is cumulated with once a week and couple times a year is cumulated with once a month.

TABLE 6-4 Estimated probabilities of frequency of physical communication with family

Dependent Variable	Explanatory Variables			
Family Physical Comm	Distance	Estimated probabilities	Physical Mode	Estimated probabilities
Daily	< 1 KM	0.7892	Cycle	0.1147
Daily	2-20 KM	0.1609	Car	0.1837
Daily	21-50 KM	0.1018	Public Transport	0.2220
Daily	51-100 KM	0.06282	Airplane	0.02735
Daily	> 100 KM	0.01326	None of Above	0.2384
Once a week	< 1 KM	0.9739	Cycle	0.5634
Once a week	2-20 KM	0.6564	Car	0.6915
Once a week	21-50 KM	0.5303	Public Transport	0.7398
Once a week	51-100 KM	0.4005	Airplane	0.2189
Once a week	> 100 KM	0.1181	None of Above	0.7573
Once a month	< 1 KM	0.9959	Cycle	0.8932
Once a month	2-20 KM	0.9253	Car	0.9356
Once a month	21-50 KM	0.8797	Public Transport	0.9485
Once a month	51-100 KM	0.8123	Airplane	0.6449
Once a month	> 100 KM	0.4646	None of Above	0.9529
Couple Times a year	< 1 KM	0.9999	Cycle	0.9980
Couple Times a year	2-20 KM	0.9986	Car	0.9988
Couple Times a year	21-50 KM	0.9977	Public Transport	0.9991
Couple Times a year	51-100 KM	0.9961	Airplane	0.9907

TABLE 6-4 Estimated probabilities of frequency of physical communication with family

Dependent Variable	Explanatory Variables			
Family Physical Comm	Distance	Estimated probabilities	Physical Mode	Estimated probabilities
Couple Times a year	> 100 KM	0.9808	None of Above	0.9992

The second variable is about the mode of physical communication in TABLE 6-4, the contribution to the probability of daily physical communication is 0.11 for cycle as physical mode of transport. The contribution to the probability of daily communication increases to 0.18 as the physical mode changes to car. The access to public transport has a high contribution to probability of daily physical communication equal to 0.22. There are only 2 percent chances that individual will communicate physically if he/she has access to airplane mode. The parameter none of above (individual may use another mode not mentioned in choices) has a high contribution to the probability of daily physical communication with family.
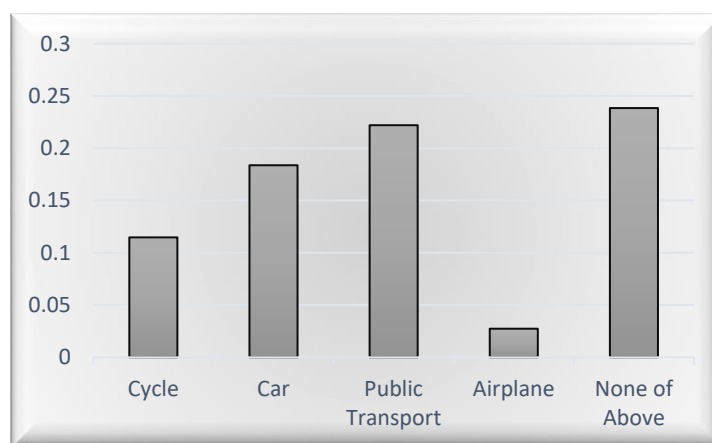
FIGURE 6-14 Contribution of physical mode to probability of physical communication with family

In order to further investigate the significant effect of distance, the four levels of distance are compared two by two. To control the overall type I-error α of 0.05, these comparisons are done at a significance level of $\alpha/10 = 0.005$ each (Bonferroni correction for multiple comparisons). So, it can be concluded the there is a significant difference between level of distance less 1 Kilometer and all other four levels. The rest of significance difference between various distance levels is explained below in **TABLE 6-5**

TABLE 6-5 Differences of distance (least squares means)

Distance	_Distance	Pr > |z|
< 1 KM	2-20 KM	<.0001
< 1 KM	21-50 KM	<.0001
< 1 KM	51-100 KM	<.0001
< 1 KM	> 100 KM	<.0001
2-20 KM	> 100 KM	<.0001

TABLE 6-5 Differences of distance (least squares means)

Distance	_Distance	Pr > |z|
21-50 KM	> 100 KM	<.0001
51-100 KM	> 100 KM	0.0002

As the physical mode is also a significant variable the effect of different physical modes is also tested and it is described in **TABLE 6-6** that there is significant difference between car and airplane, public transport and airplane, and air plane and none of the given physical mode for physical communication. The complete results generated by using model statement in for this model only is included in (Annex 3: Complete results of Model Statement of Physical communication with Family).

TABLE 6-6 Differences of physical mode (least squares means)

Physical Mode	_Physical Mode	Pr > |z|
Car	Airplane	<.0001
Public Transport	Airplane	<.0001
Airplane	None of Above	<.0001

6.5.2. *Frequency of Physical Communication with Friends*

The dependence of communication of an individual with friends using physical means is also estimated with various variables. In this model, it is estimated that distance and relationship variable are more significant as compare to physical mode and locational aspects. The TABLE 6-7 shows that there is a significant effect of explanatory variables i.e. distance, physical mode, locational aspects and strength of relationship among friends. The statistics of model are as distance (χ^2 = 141.11 (4 df); P < 0.0001), physical mode (χ^2 = 9.56 (4 df); P = 0.0485), locational aspects (χ^2 = 10.01 (4 df); P = 0.0403), and relationship (χ^2 = 17.27 (4 df); P =0.0017) respectively.

TABLE 6-7 Significant variables for physical communication with friends

Source	DF	Chi-Square	Pr > ChiSq
Distance	4	141.11	<.0001
Physical Mode	4	9.56	0.0485
Loc. Aspects	4	10.01	0.0403
Relationship	4	17.27	0.0017

In the **TABLE 6-8** the dependence of physical communication is estimated with variables like distance and physical mode. The results of dependence of physical communication on distance are as same as these are in the case of family members. Distance less than 1 km has a high contribution to the probability of daily physical communication with friends. And distance more than 100 kilometer has a low contribution to the probability of daily communication with friends. The estimated probability of daily communication with different physical modes is different for friends as compare to family members. The contribution to the probability of daily physical communication with cycle mode is 0.12,

car 0.09, public transport 0.13, airplane 0.04 and 0.13 for other modes. The situation here is different as in case of family members the contribution to the probability with car was more here it is less.

TABLE 6-8 Estimated probabilities of frequency of physical communication with Friends

Dependent Variable	Explanatory Variables			
Friends Physical Comm	Distance	Estimated probabilities	Physical Mode	Estimated probabilities
Daily	< 1 KM	0.4869	Cycle	0.1206
Daily	2-20 KM	0.1865	Car	0.09735
Daily	21-50 KM	0.1460	Public Transport	0.1274
Daily	51-100 KM	0.04603	Airplane	0.04348
Daily	> 100 KM	0.007995	None of Above	0.1285
Once a week	< 1 KM	0.8344	Cycle	0.4214
Once a week	2-20 KM	0.5490	Car	0.3641
Once a week	21-50 KM	0.4759	Public Transport	0.4367
Once a week	51-100 KM	0.2040	Airplane	0.1944
Once a week	> 100 KM	0.04104	None of Above	0.4390
Once a month	< 1 KM	0.9563	Cycle	0.7598
Once a month	2-20 KM	0.8409	Car	0.7132
Once a month	21-50 KM	0.7977	Public Transport	0.7710
Once a month	51-100 KM	0.5266	Airplane	0.5117
Once a month	> 100 KM	0.1567	None of Above	0.7726
Couple Times a year	< 1 KM	0.9984	Cycle	0.9893
Couple Times a year	2-20 KM	0.9936	Car	0.9865
Couple Times a year	21-50 KM	0.9914	Public Transport	0.9900
Couple Times a year	51-100 KM	0.9703	Airplane	0.9685
Couple Times a year	> 100 KM	0.8450	None of Above	0.9901

The second comparison of the dependence of physical communication is estimated with variables like locational aspects and relationship. The **FIGURE 6-15** illustrate that the rivers have a high contribution to the probability of daily physical communication with friends equal to 0.54. The contribution to the probability is less for mountains, scenes, nature and others and (see TABLE 6-9). It means rivers has a high contribution to the probability of daily physical communication with friends and scenes has a low contribution to the probability of daily physical communication with friends.
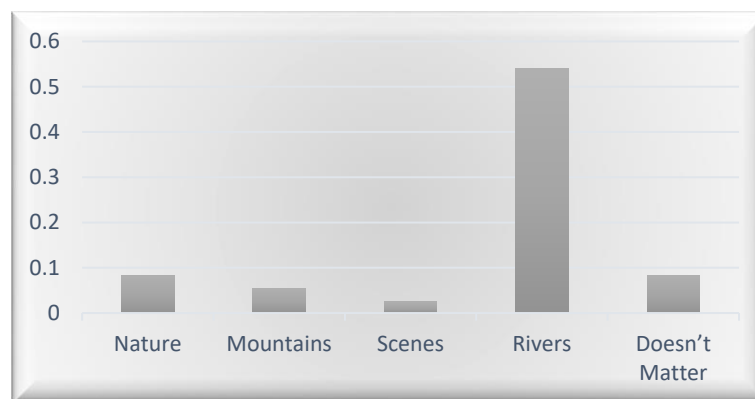
FIGURE 6-15 Contribution of locational aspects to probability of physical communication with friends

TABLE 6-9 Estimated probabilities of frequency of physical communication with Friends

Dependent Variable	Explanatory Variables			
Friends Physical Comm	Locational Aspects	Estimated probabilities	Relationship	Estimated probabilities
Daily	Nature	0.08197	Strongly Agree	0.2814
Daily	Mountains	0.05460	Agree	0.2537
Daily	Scenes	0.02589	Neutral	0.1324
Daily	Rivers	0.5403	Disagree	0.2381
Daily	Doesn't Matter	0.08244	Strongly Disagree	0.002274
Once a week	Nature	0.3216	Strongly Agree	0.6753
Once a week	Mountains	0.2347	Agree	0.6435
Once a week	Scenes	0.1237	Neutral	0.4476
Once a week	Rivers	0.8619	Disagree	0.6240
Once a week	Doesn't Matter	0.3230	Strongly Disagree	0.01196
Once a month	Nature	0.6730	Strongly Agree	0.9003
Once a month	Mountains	0.5711	Agree	0.8868
Once a month	Scenes	0.3799	Neutral	0.7787
Once a month	Rivers	0.9644	Disagree	0.8781
Once a month	Doesn't Matter	0.6744	Strongly Disagree	0.04992
Couple Times a year	Nature	0.9837	Strongly Agree	0.9962
Couple Times a year	Mountains	0.9750	Agree	0.9957
Couple Times a year	Scenes	0.9473	Neutral	0.9904
Couple Times a year	Rivers	0.9987	Disagree	0.9953
Couple Times a year	Doesn't Matter	0.9838	Strongly Disagree	0.6065

In the TABLE 6-9 the second explanatory variable is the relationship; the individuals were asked to give their opinion whether it is necessary to communicate physically to make the relationship strong. There are 28 percent chances that the individuals who were strongly agreed with the statement communicate daily with friends using physical means. And who were strongly disagree with the statement has almost 0 contribution to the probability of daily physical communication with friends (See TABLE 6-9).

The further investigation of significant effect of different levels of distance, physical mode, locational aspects and relationship is also carried out. In case of physical communication of friends only significant difference was observed in distance variables, the difference in levels of rest of the variables found insignificant. (see TABLE 6-10).

TABLE 6-10 Differences of distance (least squares means)

Distance	_Distance	Pr > |z|
< 1 KM	2-20 KM	0.0003
< 1 KM	21-50 KM	<.0001
< 1 KM	51-100 KM	<.0001
< 1 KM	> 100 KM	<.0001
2-20 KM	51-100 KM	0.0004
2-20 KM	> 100 KM	<.0001
21-50 KM	> 100 KM	<.0001
51-100 KM	> 100 KM	0.0003

6.5.3. *Frequency of Physical Communication with Colleagues*

The significance of various characters associated to an individual with regard to physical communication with colleagues is calculated using cumulative logit model. For physical communication with colleagues the model estimated four parameters as significant i.e. distance, physical mode, locational aspects and less availability of time. The less availability of time is an explanatory variable meaning that less availability of time restricts the physical communication to colleagues. However, this variable was insignificant for friends and family, it can be assumed that people communicate with colleagues physically depending upon available time variable as well but this time variable does not matter with family and friends (see **TABLE 6-11**).

TABLE 6-11 Significant variables for physical communication with colleagues

Source	DF	Chi-Square	Pr > ChiSq
Distance	4	39.22	<.0001
Physical Mode	4	21.71	0.0002
Do Loc. Aspects	4	49.71	<.0001
Less Time	4	23.64	<.0001

The estimated probabilities of physical communication of an individual with colleagues are calculated with other variables i.e. distance, physical mode and less available time. The distance

parameter is not different from family and friends. it can be visualized in **FIGURE 6-16** as the distance increases the probability to communicate physically goes down. For the distance parameter, less than 1 kilometer has the high contribution to the probability of daily physical communication with colleagues. However, for more than 100 kilometer has a low contribution to the probability of daily physical communication with colleagues.
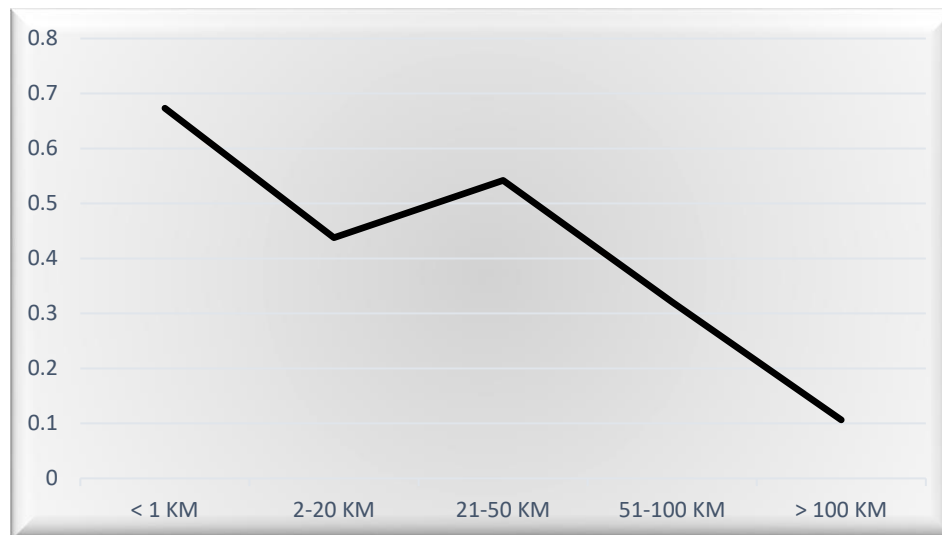
FIGURE 6-16 Contribution of distance to probability of physical communication

The second variable is quite interesting it can be viewed from the statistics that Airplane mode' has a high contribution to the probability physical communication with colleagues which is equal to 0.52 and a low contribution to the probability by car it is 0.39. As it is also observed in statistics that while communicating with colleagues' people communicate most with businessman and politicians, It can be concluded that business meeting is the reason that contribution to the probability for communicating with airplane mode is higher than other modes.

The third parameter is about the less availability of time, there are 36 percent chances that those strongly agree with this statement communicate physically daily, this percentage increase to 44 who just agree with statement. The results are quite interesting for those who disagree with this statement as the contribution to the probability of daily physical communication with colleagues is 0.59. It can be concluded that less availability of time does not restrict the physical communication among colleagues.

TABLE 6-12 Contribution to probabilities of frequency of physical communication with colleagues

Dependent Variable	Explanatory Variables					
Colleagues Physical Comm	Distance	Estimated Probabilities	Physical Mode	Estimated probabilities	Less available Time	Estimated Probabilities
Daily	< 1 KM	0.6733	Cycle	0.4415	Strongly Agree	0.3647
Daily	2-20 KM	0.4379	Car	0.3923	Agree	0.4356
Daily	21-50 KM	0.5419	Public Transport	0.4509	Neutral	0.2425
Daily	51-100 KM	0.3208	Airplane	0.5263	Disagree	0.5959
Daily	> 100 KM	0.1064	None of Above	0.1866	Strongly Disagree	0.3380

TABLE 6-12 Contribution to probabilities of frequency of physical communication with colleagues

Dependent Variable	Explanatory Variables					
Colleagues Physical Comm	Distance	Estimated Probabilities	Physical Mode	Estimated probabilities	Less available Time	Estimated Probabilities
Once a week	< 1 KM	0.8665	Cycle	0.7134	Strongly Agree	0.6438
Once a week	2-20 KM	0.7104	Car	0.6703	Agree	0.7085
Once a week	21-50 KM	0.7883	Public Transport	0.7211	Neutral	0.5020
Once a week	51-100 KM	0.5979	Airplane	0.7777	Disagree	0.8228
Once a week	> 100 KM	0.2728	None of Above	0.4195	Strongly Disagree	0.6166
Once a month	< 1 KM	0.9123	Cycle	0.7996	Strongly Agree	0.7434
Once a month	2-20 KM	0.7972	Car	0.7652	Agree	0.7957
Once a month	21-50 KM	0.8565	Public Transport	0.8056	Neutral	0.6177
Once a month	51-100 KM	0.7044	Airplane	0.8486	Disagree	0.8816
Once a month	> 100 KM	0.3754	None of Above	0.5366	Strongly Disagree	0.7204
Couple Times a year	< 1 KM	0.9432	Cycle	0.8644	Strongly Agree	0.8223
Couple Times a year	2-20 KM	0.8627	Car	0.8389	Agree	0.8616
Couple Times a year	21-50 KM	0.9051	Public Transport	0.8688	Neutral	0.7208
Couple Times a year	51-100 KM	0.7920	Airplane	0.8996	Disagree	0.9224
Couple Times a year	> 100 KM	0.4899	None of Above	0.6492	Strongly Disagree	0.8046

Further investigation between different levels of distance, physical mode and time is investigated and the results state that, there is significant difference between less than one kilometer and 2-20 kilometer, less than one kilometer and more than 100 kilometers, 2-20 kilometer and more than 100 kilometers, and 21-50 kilometer and more than 100 Kilometer.

TABLE 6-13 Differences of distance least squares means

Distance	_Distance	Pr > |z|
< 1 KM	2-20 KM	0.0009
< 1 KM	> 100 KM	<.0001
2-20 KM	> 100 KM	0.0006
21-50 KM	> 100 KM	<.0001

TABLE 6-14 Differences of physical mode least squares means

Physical Mode	_Physical Mode	Pr > |z|
Cycle	None of Above	0.0012
Car	None of Above	0.0014
Public Transport	None of Above	<.0001
Airplane	None of Above	0.0275

6.6. Cumulative Logit Model for Frequency of Digital Communication

6.6.1. *Frequency of Digital Communication with Family*

In the second model probabilities of frequency of digital communication of an individual are modeled. The **TABLE 6-15** Significant variables for digital communication with family shows that there is a significant effect of explanatory variables i.e. distance and digital mode of communication, as ($\chi^2 = 13.56$ (4 df); P=0.0088) and ($\chi^2 = 23.51$ (4 df); P=0.0001) respectively for both variables. It can be assumed that with the increase in distance the digital communication increases. The mode of digital communication also effects the communication pattern, as more the availability of digital mode to an individual the more will be the use of digital communication. It is also tested that there is no significant effect of locational aspects, cost, time and relationship strength to the frequency of digital communication with family members.

TABLE 6-15 Significant variables for digital communication with family

Source	DF	Chi-Square	Pr > ChiSq
Distance	4	13.56	0.0088
Digital Mode	4	23.51	0.0001

The probabilities of frequency of digital communication is estimated with two explanatory variables separately. In the first left column, there are levels of digital communication and the middle column is the first explanatory variable distance and in last column second independent variable digital mode. In **TABLE 6-16** it can be viewed that with the increase in distance the contribution to the probability of digital communication increases. Similarly, the probabilities in third column of the table also shows that the mode of digital communication has also impact on the frequency of digital communication. It can be assumed that with the smart phone daily digital communication of an individual with family member moves up to 47 %.

TABLE 6-16 Estimated probabilities of frequency of digital communication with family

Dependent Variable	Explanatory Variables			
Family Digital Comm	Distance	Estimated probabilities	Digital Mode	Estimated probabilities
Daily	< 1 KM	0.1728	Mobile phone	0.3400
Daily	2-20 KM	0.1528	Smart phone	0.4735
Daily	21-50 KM	0.2305	Laptop	0.4278
Daily	51-100 KM	0.1939	Desktop	0.07100

TABLE 6-16 Estimated probabilities of frequency of digital communication with family

Dependent Variable	Explanatory Variables			
Family Digital Comm	Distance	Estimated probabilities	Digital Mode	Estimated probabilities
Daily	> 100 KM	0.2938	None of Above	0.04093
Once a week	< 1 KM	0.5838	Mobile phone	0.7757
Once a week	2-20 KM	0.5478	Smart phone	0.8580
Once a week	21-50 KM	0.6679	Laptop	0.8339
Once a week	51-100 KM	0.6177	Desktop	0.3392
Once a week	> 100 KM	0.7365	None of Above	0.2227
Once a month	< 1 KM	0.7754	Mobile phone	0.8949
Once a month	2-20 KM	0.7488	Smart phone	0.9370
Once a month	21-50 KM	0.8320	Laptop	0.9251
Once a month	51-100 KM	0.7991	Desktop	0.5581
Once a month	> 100 KM	0.8731	None of Above	0.4136
Couple Times a year	< 1 KM	0.8844	Mobile phone	0.9497
Couple Times a year	2-20 KM	0.8685	Smart phone	0.9705
Couple Times a year	21-50 KM	0.9165	Laptop	0.9648
Couple Times a year	51-100 KM	0.8981	Desktop	0.7368
Couple Times a year	> 100 KM	0.9384	None of Above	0.6098

In order to further investigate the significant effect of distance, the four levels of distance are compared two by two. To control the overall type I-error α of 0.05, these comparisons were done at a significance level of $\alpha/10 = 0.005$ each (Bonferroni correction for multiple comparisons). So, it can be concluded the there is a significant difference between length of distance less 1 Kilometer and length of distance two to twenty kilometers. There is no significant difference between all other levels of distance (see **TABLE 6-17**).

TABLE 6-17 Differences of distance least squares means

Distance	_Distance	Pr > |z|
< 1 KM	> 100 KM	0.0080
2-20 KM	> 100 KM	0.0012

The effect of digital mode of communication was also investigated and it can be concluded that there is significant difference between modes of digital communication (Mobile phone, smart phone, laptop) and no mode of digital communication (see **TABLE 6-18**).

TABLE 6-18 Differences of digital mode least squares means

Digital Mode	_Digital Mode	Pr > |z|
Mobile phone	None of Above	0.0016
Smart phone	None of Above	<.0001
Laptop	None of Above	0.0005

6.6.2. *Frequency of Digital Communication with Friends*

As the research is not only limited to family members the communication of an individual the statistics for friends and colleagues are also compared. In this model frequency of digital communication is taken as the dependent variable and results are compared using SAS. The TABLE 6-19 shows that there is a significant effect of explanatory variables i.e. distance and digital mode of communication on digital communication with friends, as ($\chi^2 = 31.52$ (4 df); P < 0.0001) and ($\chi^2 = 52.24$ (4 df); P <0.0001) respectively for both variables. There is no significant effect of other variables to the digital communication of an individual with friends.

TABLE 6-19 Significant variables for digital communication with friends

Source	DF	Chi-Square	Pr > ChiSq
Distance	4	31.52	<.0001
Digital Mode	4	52.24	<.0001

In the TABLE 6-20 the dependence of digital communication on explanatory variable like distance and mode of digital communication is estimated. The results in this model are different from the communication with family members. The estimated probabilities of communication using digital means daily decreases as the distance increases. Distance less than 1 kilometer has a high contribution to daily digital communication with friends. However, the distance more than 100 kilometer has a low contribution to the probability of daily communication with friends. The contribution to the probability of daily communication with different modes of digital communication is as same as for family members. It is estimated from the model that if an individual communicates daily by using mobile phone the contribution to probability of daily digital communication is 0.56 and for the smart phone it is 0.60. This contribution to the probability decreases with laptop mode and desktop. The contribution to the probability of individual, having none of above four modes, to communicate daily is very low equal to almost 0.

TABLE 6-20 Estimated probabilities of frequency of digital communication with friends

Dependent Variable	Explanatory Variables			
Friends Digital Comm	Distance	Estimated probabilities	Digital Mode	Estimated probabilities
Daily	< 1 KM	0.3118	Mobile phone	0.5617
Daily	2-20 KM	0.2086	Smart phone	0.6016
Daily	21-50 KM	0.2028	Laptop	0.4135

TABLE 6-20 Estimated probabilities of frequency of digital communication with friends

Dependent Variable	Explanatory Variables			
Friends Digital Comm	Distance	Estimated probabilities	Digital Mode	Estimated probabilities
Daily	51-100 KM	0.1215	Desktop	0.4499
Daily	> 100 KM	0.08216	None of Above	0.000337
Once a week	< 1 KM	0.7080	Mobile phone	0.8728
Once a week	2-20 KM	0.5853	Smart phone	0.8899
Once a week	21-50 KM	0.5766	Laptop	0.7905
Once a week	51-100 KM	0.4254	Desktop	0.8140
Once a week	> 100 KM	0.3239	None of Above	0.001802
Once a month	< 1 KM	0.9305	Mobile phone	0.9743
Once a month	2-20 KM	0.8863	Smart phone	0.9781
Once a month	21-50 KM	0.8827	Laptop	0.9542
Once a month	51-100 KM	0.8036	Desktop	0.9603
Once a month	> 100 KM	0.7258	None of Above	0.009877
Couple Times a year	< 1 KM	0.9946	Mobile phone	0.9981
Couple Times a year	2-20 KM	0.9907	Smart phone	0.9984
Couple Times a year	21-50 KM	0.9904	Laptop	0.9965
Couple Times a year	51-100 KM	0.9825	Desktop	0.9970
Couple Times a year	> 100 KM	0.9732	None of Above	0.1203

The further investigation of significant effect of different levels of distance and different modes of communication is also carried out. As far as the variable of distance is concerned it can be concluded that there is significant difference between less than one kilometer and more than 100 kilometers, 2-20 kilometer and more than 100 kilometers, and 21-50 kilometer and more than 100 kilometers. (see **TABLE 6-21**)

TABLE 6-21 Differences of distance least squares means

Distance	_Distance	Pr > |z|
< 1 KM	> 100 KM	<.0001
2-20 KM	> 100 KM	<.0001
21-50 KM	> 100 KM	0.0005

It is also concluded that there is also significant difference in various modes of digital communication (see **TABLE 6-22**)

TABLE 6-22 Differences of digital mode least squares means

Digital Mode	_Digital Mode	Pr > |z|
Mobile phone	Desktop	<.0001
Smart phone	Desktop	<.0001
Laptop	Desktop	<.0001
Desktop	Desktop	<.0001

6.6.3. Frequency of Digital Communication with Colleagues

The individual's behavior is different towards the colleagues and in some cases individuals may not communicate with colleague as friendly as with friends and family. The frequency of digital communication of individual with colleagues is modeled and estimates for different variables are as under. It is observed that there is significant effect of distance, digital mode, and time and money. The parameter of time and money is observed significant while communicating with colleagues, this parameter is not significant for friends and family. It is observed in the statistics that individuals communicate most with businessman and politician, so this way one can consider the time and money are important parameter. The results of the model are also according to assumption (see **TABLE 6-23**).

TABLE 6-23 Significant variables for digital communication with colleagues

Source	DF	Chi-Square	Pr > ChiSq
Distance	4	34.02	<.0001
Digital Mode	4	158.76	<.0001
Time & Money	4	17.00	0.0019

The trend of digital communication with colleagues is quit fluctuating, the distance less than 1 kilometer has a high contribution to the probability of daily communication with colleagues' equal to 0.29. The digital communication should increase as the distance increase, but here the values state that contribution to the probability of daily digital communication decreases when the distance is increasing. It can be concluded that individuals do not communicate most with their colleagues using digital means. The probabilities of digital mode have interesting estimates as the contribution to the probability of daily digital communication with mobile phone is 0.27, smart phone 0.34, laptop 0.34 and increases for desktop to 0.41 and decreases to zero with no mode (see TABLE 6-24). The desktop mode has a high contribution to the probability of digital communication with colleagues may be because individuals communicate with colleagues via email for official purpose.

TABLE 6-24 Contribution to probabilities of frequency of digital communication with colleagues

Dependent Variable	Explanatory Variables					
Colleagues Digital Comm	Distance	Estimated Probabilities	Digital Mode	Estimated probabilities	Time and Money	Estimated Probabilities
Daily	< 1 KM	0.2912	Mobile phone	0.2731	Strongly Agree	0.2110

TABLE 6-24 Contribution to probabilities of frequency of digital communication with colleagues

Dependent Variable	Explanatory Variables					
Colleagues Digital Comm	Distance	Estimated Probabilities	Digital Mode	Estimated probabilities	Time and Money	Estimated Probabilities
Daily	2-20 KM	0.2157	Smart phone	0.3299	Agree	0.2017
Daily	21-50 KM	0.1894	Laptop	0.3362	Neutral	0.1037
Daily	51-100 KM	0.2651	Desktop	0.4139	Disagree	0.06410
Daily	> 100 KM	0.03464	None of Above	0.005137	Strongly Disagree	0.3896
Once a week	< 1 KM	0.6710	Mobile phone	0.6510	Strongly Agree	0.5704
Once a week	2-20 KM	0.5772	Smart phone	0.7096	Agree	0.5564
Once a week	21-50 KM	0.5371	Laptop	0.7154	Neutral	0.3648
Once a week	51-100 KM	0.6416	Desktop	0.7781	Disagree	0.2537
Once a week	> 100 KM	0.1512	None of Above	0.02499	Strongly Disagree	0.7601
Once a month	< 1 KM	0.8315	Mobile phone	0.8186	Strongly Agree	0.7626
Once a month	2-20 KM	0.7676	Smart phone	0.8553	Agree	0.7521
Once a month	21-50 KM	0.7373	Laptop	0.8588	Neutral	0.5815
Once a month	51-100 KM	0.8124	Desktop	0.8945	Disagree	0.4513
Once a month	> 100 KM	0.3011	None of Above	0.05839	Strongly Disagree	0.8846
Couple Times a year	< 1 KM	0.9025	Mobile phone	0.8944	Strongly Agree	0.8577
Couple Times a year	2-20 KM	0.8610	Smart phone	0.9173	Agree	0.8506
Couple Times a year	21-50 KM	0.8404	Laptop	0.9194	Neutral	0.7227
Couple Times a year	51-100 KM	0.8904	Desktop	0.9409	Disagree	0.6068
Couple Times a year	> 100 KM	0.4470	None of Above	0.1042	Strongly Disagree	0.9350

In **TABLE 6-24** the statistics of the third variables i.e. Time and money stat that the individual who strongly disagree with the statement that digital communication saves time and money has a high contribution to the probability of digital communication with colleagues, equal to 0.39. And the contribution to the probability for those individuals who agree with the statement is 0.21. The significant difference between different levels of distance is also estimated and it is observed that there is significant difference between all the levels of distance less than 100 kilometers and more than 100 kilometers (see **TABLE 6-25**).

TABLE 6-25 Differences of distance least squares means

Distance	_Distance	Pr > |z|
< 1 KM	> 100 KM	<.0001
2-20 KM	> 100 KM	<.0001
21-50 KM	> 100 KM	<.0001
51-100 KM	> 100 KM	0.0006

The difference between different digital modes is also investigated for the communication of individuals with colleagues. It is observed that all the modes have significant difference with no mode (see **TABLE 6-26**)

TABLE 6-26 Differences of digital (mode least squares means)

Digital Mode	_Digital Mode	Pr > |z|
Mobile phone	None of Above	<.0001
Smart phone	None of Above	<.0001
Laptop	None of Above	<.0001
Desktop	None of Above	<.0001

6.7. Effect of Socio-Demographics on Physical and Digital Communication

The effect of socio-demographic status of individuals was also tested that how the socio-demographics characteristics of an individual effect the digital and physical communication of an individual. In the first part **TABLE 6-27** the frequency of communication of individual with family member using digital means is modeled and it is observed that age is more significant and gender is less significant, means age has more effect than gender while education is not significant in this case.

However, for physical communication with family members, the age and education are significant and gender is not significant (see

TABLE **6-28**).

The effect of socio-demographic characteristics is also tested on individual's communication with friends. The results for friend's physical communication is not different from family, as in this case also age and education

TABLE 6-27 Dependent variable: Freq. of digital communication with family

Source	DF	Chi-Square	Pr > ChiSq
Gender	1	5.19	0.0227
Age	3	17.36	0.0006

TABLE 6-28 Dependent variable: Freq. of physical communication with family

Source	DF	Chi-Square	Pr > ChiSq
Age	3	21.17	<.0001
Education	4	13.96	0.0074

TABLE 6-29 Dependent variable: Freq. of physical communication with friends

Source	DF	Chi-Square	Pr > ChiSq
Age	3	11.96	0.0075
Education	4	18.26	0.0011

is significant for physical communication with friends and gender is insignificant (see

TABLE **6-29**).

For digital communication with friend's results are different as in case of family gender is significant, however, gender is insignificant for digital communication with family, and age and education is significant. (see **TABLE 6-30**)

The effect of socio-demographic parameters is same for colleagues as it is for friends. For digital communication with colleagues age is less significant and education is more significant. See **TABLE 6-31**.

As far as the physical communication with colleagues is concerned, age is again less significant and education is more significant.see **TABLE 6-32**.

It can be concluded that socio-demographic characteristics also effect the communication pattern of an individual

TABLE 6-30 Dependent variable: Freq. of digital communication with friends

Source	DF	Chi-Square	Pr > ChiSq
Age	3	15.23	0.0016
Education	4	15.54	0.0037

TABLE 6-31 Dependent variable: Freq. of digital communication with colleagues

Source	DF	Chi-Square	Pr > ChiSq
Age	3	8.86	0.0312
Education	4	17.76	0.0014

TABLE 6-32 Dependent variable: Freq. of physical communication with colleagues

Source	DF	Chi-Square	Pr > ChiSq
Age	3	10.37	0.0156
Education	4	14.77	0.0052

CHAPTER NO.07

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusions

The research accentuated the understanding of the communication pattern of an individual in two ways i.e. physically and digitally. The increase in communication technologies has affected the communication behavior of individual. It was expected that; these communication technologies will help in reducing the physical movement. This research configured the communication pattern of individuals in terms of physical and digital movement. And also analyzed what characteristics of individual influence the organization of these two types of communication. The research on this particular topic was considered necessary to see the effect information and communication technologies (ICT) on road transport (physical movement). Individuals living at longer distance from each other mostly communicate digitally, as it saves time and money. The research emphasizes to know how different is the communication pattern of an individual with family and other members of social network (friends, colleagues).

The literature studied for communication pattern of individuals, provided very interesting facts. The telecommunication technologies has reduced the physical travelling by enabling the individuals with virtual relationships through digital movement (Musso, 2008). But it cannot be considered the same case always, as there are many activities for which an individual definitely need physical movement. For example, it is not possible for a patient to get surgical treatment using digital means. Individuals need physical movement to attend conferences, for plantation in gardens, painting a house, and to fulfill utmost desire of travelling to explore nature and different locations. However, it was also observed in literature that ICTs has the effect in increasing the physical movements of individual. For example, ICT provided individual with facilities to explore more about different offers of travelling, beautiful locations, hotels accommodation pricing and cheapest travel packages for travelling. With this facility the of ICT the user are travelling more as compare to previous era (P. L. Mokhtarian, 2004). To explore more about the organization of communication pattern (either physical movement or digital movement) of individuals, the further investigation in this regard was carried out.

The physical movement is face to face communication between two individuals and digital movement is through internet and mobile phone. The physical movement do not require any medium to communicate, the digital movement requires medium to transfer information and messages. If the individual is living far away from each other they have to travel a distance to communicate each other. However, the digital movement enables to disseminate information to others living at longer distance without travelling. Physical movement is time taking requires lot of resources like time, money and mode of transport. The digital movement saves time and money.

The scope of research was extended and behavior of individuals was estimated with the help of questionnaire based survey approach. The literature review provided with important characteristics of individuals. These important variables for investigation of communication pattern of individual are; frequency of communication, distance, mode of communication, locational aspects, time, money, relationship and communication network. These important variables were included in the questionnaire and revealed preference survey was carried out. The respondents selected the maximum utilization of variables associated with dependent variables. The data collected through Qualtrics questionnaire approach was used in analysis part after cleaning and making the data fit for modeling. The response was collected from various countries was analyzed and findings of the analysis are as under.

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The response rate was 78% as the 406 respondents from different countries completed the questionnaire. The analysis part was estimated based on generalized linear model with cumulative logit link and multinomial response. The variables of frequency of communication, distance, mode of communication, locational aspects, time, money, relationship and communication network were tested separately for family, friends and colleagues from the respondents. The purpose of testing separately was to identify, how the communication pattern of individual changes with family members, friends and colleagues.

The communication with family is different from friends and colleagues. As the communication with family includes the communication to close relationships like parents, siblings, cousins, uncle and grandparents. These are important members for any individual and they communicate mostly with family members. The family communications are mostly family re-unions, weekly get to gather and different events for family. The friends are different from family members, there can be some good family friends in some cases, but in most of the cases friends are considered different from family members. The communications with friends are related to study, parties, adventures, playing, recreational activities and long journeys. The communication with colleagues is related to office tasks, assignment, business deals and for political matters. That was the reason the three-different analysis were carried out to find the difference between communications with family, friends and colleagues.

It was estimated in the communication of individual within family members with whom they communicate most, that the frequency of physical and digital movement is affected because of two variables. These two variables are distance and mode of communication (Physical mode and digital mode). It means that when the individual communicates with his/her family members, only distance and mode of communication are the important characteristics that can affect their communication. It was also observed in the statistics of this data, that as the distance increases the physical movement decreases and the digital movement increases. The physical movement also changes with the available mode of transport, it increases from low to high for cycle to car and public transport. The digital movement with family increases as the mode of digital communication changes from desktop to smartphone. The rest variables locational aspects, time, money, relationship strength and communication network were not significant. The communication of an individual with family is not affected because of these variables.

The second model was estimated to know what are the characteristics of individual that effect the communication pattern of an individual with friends. The friend could not be considered as family members, so different analysis was carried out based on data collected through questionnaire. It was observed that the frequency of physical movement of individuals is affected, because of distance, physical mode, locational aspects and relationship. It is clear from the results that the communication behavior of individual is different with friends as compare to family members, as there is addition of two more significant variables. The beautiful location and strength of friendship matters a lot while communicating physically with friends. However, the digital movement of individuals with friends is as same as it was with family. Because digital movement with friends is only affected by distance and available mode of digital movement.

The communication pattern of individuals is also analyzed with colleagues. It was the target of research to analyze the overall behavior of individuals. Family, friends and colleagues are important relations with whom an individual communicate in his/her routine life. The significant variables for frequency of digital movement with colleagues were found interesting, as compared to significant variables for family and friends. The significant variables for digital movement with colleagues are

distance, digital mode and time and money. It is important to note here that the digital movement with colleagues is also affected because of time and money. As far as the physical movement with colleagues is concerned the variables like distance, physical mode, locational aspects and availability of less time are significant.

There is difference between both type of communication with family, friends and colleagues. The physical movement with family is affected because of two variables, distance and available physical mode. There is addition of two more significant variables for physical movement with friends, as relationship between friends and locational aspects also effect the physical movement. However, the physical movement with colleagues is effected by distance, mode, location aspects and time variables. Which is again different from physical movement with family and colleagues. There is also slight difference in digital movement with family, friends and colleagues. The digital movement with family and friends is affected because of two variables; distance and digital mode. However, for digital movement with colleagues is concerned the time and money is also an important variable in addition to distance and digital mode.

The frequency of communication of individuals was estimated with socio-demographic characteristics like age, gender, education. The frequency of digital movement with family members is influenced because of age and gender variable. The characteristics of education do not have significant effect on digital communication with family members. However, two socio-demographic characteristics (age and education) of individuals has significant effect on physical movement with family members. The physical and digital movement with both friends and colleagues is influenced by age and education of individuals. The gender variable is not significant for both type of communication with friends and colleagues.

There can be many factors that affect the communication pattern of individuals. This research estimates that the communication of individual is different with family, friends and colleagues. Both type of communication is dependent on distance, mode of communication, availability of time, money locational aspects and relationships, but the dependence on these variables vary for friends, family and colleagues. However, the communication network does not have any significant effect on communication of individual with anyone.

7.2. Recommendations

The individuals are concerned with both type of communications. It is recommended that individual should prefer digital movement so that physical movement can be minimized. The target of maximizing digital movement can be achieved if the individuals are provided with awareness about digital movement and are given access to communication technologies. To reduce the physical movement initiatives are required to be taken by individuals, companies, universities, social groups and organizations by performing activities digitally. i.e. work from home, distance learning education, online workshops and awareness programs. It would help individuals to avoid physical movement as much as they can. They need to understand that communication is also possible on internet and through other communication technologies. The individuals must understand that physical movement is causing pollution, congestion and distress for many users on road, so they should prefer digital movement. The transport agencies should test and invent various devices, that can create awareness and encouragement among individuals to use digital movement rather than physical movement.

The recommendations made on above study for future research as mentioned below.

1. The research would provide some valuable results if the analysis is carried out on interaction effect of variable i.e. distance, mode, locational aspects, time and relationship strength. The data collected in this research can be used to analyze the interaction effect of these variables on frequency of both type of communications.

2. It would be better to analyze how the communication pattern of an individual changes with entry of new member in routine life. The new member can be life partner, new friend, stranger.

3. This research was analyzed for the communication of an individual with whom he/she communicate most out of his/her total communication. It would also be better to analyze the communication of individual with whom he/she communicate less.

4. It is recommended that the future study may be carried out for those individuals who are living abroad. The communication network of an individual is not strong as it would have been in parental country. Living abroad decreases the physical movement of an individual and increases digital movement.

5. This research covers the communication behavior of individuals with discrete choice analysis, limited choices/levels for certain variables, with model estimation. The results generated through model estimation are static. As the human behavior is not static always, it changes with new friends, new locations and change in environment. It is recommended to further expand the scope of this research with agent based modeling. The agent based modeling will help in analyzing the changing behavior of individuals.

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ANNEX

Annex 1: Questionnaire

I, Muhammad Shaker, student of University of Hasselt Belgium developed this questionnaire for my master thesis. I would like to get your response to estimate behavior of individuals regarding their communication. For this purpose, this questionnaire is prepared to gain insight into the individual preferences regarding communication with other people. Your response is necessary and will be highly appreciated. The response will help me to extract a good understanding of individuals' preferences in this particular topic. The results will be analyzed anonymously by combining the results of all the respondents.

I assure you that the response gathered through this questionnaire will be used only for academic purposes. The responses will be kept confidential and will not be distributed to other researchers/companies. You can also get the research results, if you are interested by email. The survey will take approximately 10 minutes of your precious time. I hope you also will find it an interesting topic.

Words of interest:
Digital means: Using Internet(Email,Facebook,twitter,whats app,IMO) and Mobile Phone
Physical means: Face to Face, Traveling (road, rail and by air)

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Do you know what a smart phone is?
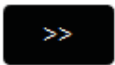
○ Yes

○ No

Do you have a smart phone?

○ Yes

○ No

Do you always have internet access on your smart phone?

○ Yes

○ No

Which mode of transport do you use for physical movement?

○ Car
○ Motor bike
○ Bicycle
○ Public transport (Bus, Train, Tram, Metro)
○ None of above

>>

Author: Muhammad Shaker

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What is the percentage of different communication sources in relation to your total amount of communication?

	Percentage				
	0%	Approx. 25%	Approx. 50%	Approx. 75%	Approx. 100%
Mobile Phone (Using only Sim Card)	○	○	○	○	○
Internet (Using smart phone, Laptop, Desktop, Tablet etc)	○	○	○	○	○
Face to Face	○	○	○	○	○

How often do you communicate with people?

You have to answer separately for four categories

1.Family members not people residing with you at your home/Living place

2.Friends (all of your friends but no colleagues)

3.Colleagues (Office fellows, business partners)

4.Others (Strangers, friends of friends, friends of family members)

	Share of meeting				
	Daily	Once a week	Once a month	Couple of times a year	Never
Family members	○	○	○	○	○
Friends	○	○	○	○	○
Colleagues	○	○	○	○	○
Others	○	○	○	○	○

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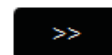
In this question you have to select an answer related to your communication particularly with regard to your family members. Remember you have to select an answer about those family members who are not living with you at your living place.

With whom do you communicate most?	Parents	Siblings	Parents' siblings	Grandparents	Cousins
	○	○	○	○	○
Percentage of your communication to whom you communicate most? (Out of your overall communication)	0%	Approx 25%	Approx 50%	Approx 75%	Approx 100%
	○	○	○	○	○
How often do you communicate with these members using digital means?	Daily	Once a week	Once a month	Couple of times a year	Never
	○	○	○	○	○
What is the approx. distance to these members you communicate most with?	Less than 1 KM	2-20 Kilometer	21-50 Kilometer	51-100 Kilometer	More than 100 KM
	○	○	○	○	○
Which mode do you use for physical communication with your family?	Cycle	Car	Bus/Train /Metro/Tram	Airplane	Non of above
	○	○	○	○	○
Which mode do you use for digital communication with your family?	Mobile phone	Smart Phone	Laptop	Desktop	Non of above
	○	○	○	○	○
Which communication network do you use with your family?	Facebook/Twitter	Skype	Whats app	Email	Non of above
	○	○	○	○	○

	Yes	No	May be	May be not	Don't Know
Do locational aspects influence your communication with family?	◯	◯	◯	◯	◯

	Beautiful Nature	Mountains	Scenic views	Proximity to Rivers	Doesn't Matter
What locational aspects influence your communication with your family?	◯	◯	◯	◯	◯

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Less availability of time restricts physical communication to your family	◯	◯	◯	◯	◯
Digital communication saves time and money by providing more access to family members	◯	◯	◯	◯	◯
Physical communication is necessary to family members as it develops a strong relationship	◯	◯	◯	◯	◯

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83

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This is same question as the previous one, but in this question you have to give answers related to your communication with your friends. Remember to answer about those friends who are not living with you at your living place.

	Best Friend	Friend in Neighbors	School Friend	Older Friend	No One
With whom do you communicate most?	○	○	○	○	○

	0%	Approx 25%	Approx 50%	Approx 75%	Approx 100%
Percentage of your communication to that friend you communicate most (Out of overall communication)	○	○	○	○	○

	Daily	Once a week	Once a Month	Couple times a year	Never
How often do you communicate with this friend using digital means?	○	○	○	○	○
How often do you communicate with this friend using physical means?	○	○	○	○	○

	Less than 1 KM	2-20 Kilometer	21-50 Kilometer	51-100 Kilometer	More than 100 KM
What is the approx. distance to that friend you communicate most with?	○	○	○	○	○

	Cycle	Car	Bus/Train /Metro/Tram	Airplane	Non of above
Which mode do you use for physical communication with your friends?	○	○	○	○	○

	Mobile phone	Smart Phone	Laptop	Desktop	Non of above
Which mode do you use for digital communication with your friends?	○	○	○	○	○

Which communication network you use with your friends?	Facebook/Twitter	Skype	Whats app	Email	Non of above
	○	○	○	○	○

Do locational aspects influence your communication with friends?	Yes	No	May be	May be not	Don't Know
	○	○	○	○	○

What locational aspects influence your communication with your friends?	Beautiful Nature	Mountains	Scenic views	Proximity to Rivers	Doesn't Matter
	○	○	○	○	○

Less availability of time restricts physical communication to your friends	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
	○	○	○	○	○

Digital communication saves time and money by providing more access to friends	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
	○	○	○	○	○

Physical communication is necessary to meet friends as it develops a strong relationship	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
	○	○	○	○	○

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Same question as the previous one, but in this question you have to give answers related to your communication with your Colleagues. Colleagues can be office fellows, business partners, project partners etc.

	Office Fellow	Business Partner	Politians	Social Workers	No One
With whom do you communicate most?	○	○	○	○	○

	0%	Approx 25%	Approx 50%	Approx 75%	Approx 100%
Percentage of your communication to that colleague you communicate most (Out of overall communication)	○	○	○	○	○

	Daily	Once a week	Once a month	Couple times a year	Never
How often do you communicate with this colleague using digital means?	○	○	○	○	○

	Daily	Once a week	Once a month	Couple times a year	Never
How often do you communicate with this colleague using physical means?	○	○	○	○	○

	Less than 1 KM	2-20 Kilometer	21-50 Kilometer	51-100 Kilometer	More than 100 KM
What is the approx. distance to that colleague you communicate most?	○	○	○	○	○

	Cycle	Car	Bus/Train /Metro/Tram	Airplane	Non of above
Which mode do you use for physical communication with your colleague?	○	○	○	○	○

	Mobile phone	Smart Phone	Laptop	Desktop	Non of above
Which mode do you use for digital communication with your colleague?	○	○	○	○	○

	Facebook Twitter	Skype	Whats app	Email	Non of above
Which communication network do you use with your colleague?	○	○	○	○	○

	Yes	No	May be	May be not	Don't Know
Do locational aspects influence your communication with colleagues?	○	○	○	○	○

	Beautiful Nature	Mountains	Scenic views	Proximity to Rivers	Doesn't Matter
What locational aspects matter your communication with your colleague?	○	○	○	○	○

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Less availability of time restricts physical communication to your colleagues	○	○	○	○	○

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Digital communication saves time and money by providing more access to colleagues	○	○	○	○	○

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Physical communication is necessary to meet colleagues as it develops a strong relationship	○	○	○	○	○

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KNOWLEDGE IN ACTION
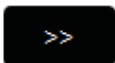
What is your age?

- ○ Less than 18
- ○ 18-26
- ○ 27-45
- ○ More than 45

What is your gender?

- ○ Male
- ○ Female

What is your level of education?

- ○ Undergraduate
- ○ Graduate
- ○ Masters
- ○ Doctorate
- ○ Post doctorate

What is your current country of residence?

[▾]

Other comments/suggestion and your point of view about how Mobile phone and Internet has changed the communication and traveling pattern of individuals?

[ ]

[<<]   [>>]

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Annex 2 : SAS Code

```
                              /*Importing Data File*/
SAS code for GENMOD Procedure
%LET PATH = "Path";

LIBNAME GLM "&PATH";
PROC IMPORT OUT= GLM.model
            DATAFILE= "Path\datafile.csv"
            DBMS=CSV REPLACE;
     GETNAMES=YES;
     DATAROW=2;
RUN;
PROC CONTENTS DATA = GLM.model VARNUM;
run;

                       /*Setting temporary Data File*/
Data analysis;
set GLM.model;

                    /*Formatting of levels in Data File*/
proc format;
            value gendfmt 1 = "Male"
                          2 = "Female";
       value agefmt     1 = "Less than 18"
                          2 = "18-26"
                          3 = "27-45"
                          4 = "More than 45";
       value educfmt 1 = "Undergraduate"
                          2 = "graduate"
                          3 = "Masters"
                          4 = "Doctorate"
                          5 = "Post Doctorate";
       value ynfmt 1 = "Yes"
                    2 = "No";
       value communica 1 = "Daily"
                          2 = "Once a week"
                          3 = "Once a month"
                          4 = "Couple Times a year"
                          5 = "Never";

run;

                         /*Model Development*/


ods rtf file=Path/complete file.rtf';
 /*Modeling probability of frequency of Digital communication with distance
                           and Mode variable*/
proc genmod data = analysis;
class DISTANCEDIGITAL MODE;
model FAM FREQUENCY OF DIGITAL COMMUNICATION= DISTANCE DIGITAL MODE /type3
dist=multinomial link=clogit;
lsmeans Distance/ilink diff;
lsmeans Digital Mode/ilink diff;
run;
```

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/*Modeling probability of frequency of Physical communication with distance and Mode variable*/

```
proc genmod data = analysis;
class DISTANCEPHYSICAL MODE;
model FAM FREQUENCY OF PHYSICAL COMMUNICATION= DISTANCE PHYSICAL MODE
/type3 dist=multinomial link=clogit;
lsmeans Distance/ilink diff;
lsmeans Physical Mode/ilink diff;
run;
```

/*Modeling probability of frequency of Digital communication with distance and Mode variable*/

```
proc genmod data = analysis;
class DISTANCEDIGITAL MODE ;
model FRIENDS FREQUENCY OF DIGITAL COMMUNICATION= DISTANCE DIGITAL MODE
/type3 dist=multinomial link=clogit;
lsmeans Distance/ilink diff;
lsmeans Digital Mode/ilink diff;
run;
```

/*Modeling probability of frequency of Physical communication with distance, locational aspects relationship and Mode variable*/

```
proc genmod data = analysis;
class DISTANCEPHYSICAL MODE LOCATIONAL ASPECTS RELATIONSHIP;
model FRIENDS FREQUENCY OF PHYSICAL COMMUNICATION= DISTANCE PHYSICAL MODE
LOCATIONAL ASPECTS RELATIONSHIP/type3 dist=multinomial link=clogit;
lsmeans Distance/ilink diff;
lsmeans Physical Mode/ilink diff;
lsmeans Locational Aspects/ilink diff;
lsmeans Relationship/ilink diff;
run;

ods rtf close;
```

Author: Muhammad Shaker

Annex 3: Complete results of Model Statement of Physical communication with Family

Model Information	
Data Set	WORK.ANALYSIS
Distribution	Multinomial
Link Function	Cumulative Logit
Dependent Variable	Frequency of Physical communication

Number of Observations Read	406
Number of Observations Used	406

Class Level Information		
Class	**Levels**	**Values**
Distance	5	< 1 KM 2-20 KM 21-50 KM 51-100 KM > 100 KM
Physical Mode	5	Cycle Car Public Transport Airplane None of Above

Response Profile		
Ordered Value	**Frequency of Physical communication**	**Total Frequency**
1	Daily	97
2	Once a week	98
3	Once a week	80
4	Once a month	120
5	Couple Times a year	11

PROC GENMOD is modeling the probabilities of levels of FREQUENCY having LOWER Ordered Values in the response profile table. One way to change this to model the probabilities of HIGHER Ordered Values is to specify the DESCENDING option in the PROC statement.

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Parameter Information			
Parameter	**Effect**	**DISTANCE**	**PHYSICAL MODE**
Prm1	DISTANCE	< 1 KM	
Prm2	DISTANCE	2-20 KM	
Prm3	DISTANCE	21-50 KM	
Prm4	DISTANCE	51-100 KM	
Prm5	DISTANCE	> 100 KM	
Prm6	PHYSICAL MODE		Cycle
Prm7	PHYSICAL MODE		Car
Prm8	PHYSICAL MODE		Public Transport
Prm9	PHYSICAL MODE		Airplane
Prm10	PHYSICAL MODE		None of Above

Criteria For Assessing Goodness Of Fit			
Criterion	**DF**	**Value**	**Value/DF**
Log Likelihood		-384.8390	
Full Log Likelihood		-384.8390	
AIC (smaller is better)		793.6781	
AICC (smaller is better)		794.4720	
BIC (smaller is better)		841.7543	

Algorithm converged.

Analysis Of Maximum Likelihood Parameter Estimates								
Parameter			**DF**	**Estimate**	**Standard Error**	**Wald 95% Confidence Limits**		**Wald Chi-Square**	**Pr > ChiSq**
Intercept1			1	-3.5666	0.5003	-4.5471	-2.5861	50.83	<.0001
Intercept2			1	-1.2675	0.4658	-2.1804	-0.3547	7.41	0.0065
Intercept3			1	0.6013	0.4518	-0.2843	1.4869	1.77	0.1833
Intercept4			1	4.6743	0.5771	3.5432	5.8054	65.60	<.0001

Analysis Of Maximum Likelihood Parameter Estimates								
Parameter		DF	Estimate	Standard Error	Wald 95% Confidence Limits		Wald Chi-Square	Pr > ChiSq
DISTANCE	< 1 KM	1	5.6298	0.4782	4.6926	6.5671	138.60	<.0001
DISTANCE	2-20 KM	1	2.6580	0.3606	1.9514	3.3647	54.35	<.0001
DISTANCE	21-50 KM	1	2.1319	0.4014	1.3451	2.9187	28.20	<.0001
DISTANCE	51-100 KM	1	1.6072	0.4383	0.7482	2.4662	13.45	0.0002
DISTANCE	> 100 KM	0	0.0000	0.0000	0.0000	0.0000	.	.
PHYSICAL MODE	Cycle	1	-0.8829	0.6155	-2.0892	0.3235	2.06	0.1515
PHYSICAL MODE	Car	1	-0.3306	0.4151	-1.1441	0.4830	0.63	0.4258
PHYSICAL MODE	Public Transport	1	-0.0927	0.4611	-0.9964	0.8110	0.04	0.8407
PHYSICAL MODE	Airplane	1	-2.4099	0.5172	-3.4236	-1.3963	21.71	<.0001
PHYSICAL MODE	None of Above	0	0.0000	0.0000	0.0000	0.0000	.	.
Scale		0	1.0000	0.0000	1.0000	1.0000		

Note: The scale parameter was held fixed.

LR Statistics For Type 3 Analysis			
Source	DF	Chi-Square	Pr > ChiSq
DISTANCE	4	191.73	<.0001
PHYSICAL MODE	4	54.00	<.0001

DISTANCE Least Squares Means							
FREQUENCY	DISTANCE	Estimate	Standard Error	z Value	Pr > |z|	Mean	Standard Error of Mean
Daily	< 1 KM	1.3200	0.3202	4.12	<.0001	0.7892	0.05328
Daily	2-20 KM	-1.6518	0.2735	-6.04	<.0001	0.1609	0.03692

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DISTANCE Least Squares Means							
FREQUENCY	DISTANCE	Estimate	Standard Error	z Value	Pr > |z|	Mean	Standard Error of Mean
Daily	21-50 KM	-2.1779	0.3730	-5.84	<.0001	0.1018	0.03409
Daily	51-100 KM	-2.7027	0.4470	-6.05	<.0001	0.06282	0.02631
Daily	> 100 KM	-4.3098	0.3376	-12.77	<.0001	0.01326	0.004417
Once a week	< 1 KM	3.6191	0.3824	9.46	<.0001	0.9739	0.009723
Once a week	2-20 KM	0.6473	0.2710	2.39	0.0169	0.6564	0.06112
Once a week	21-50 KM	0.1212	0.3471	0.35	0.7270	0.5303	0.08646
Once a week	51-100 KM	-0.4036	0.4117	-0.98	0.3269	0.4005	0.09884
Once a week	> 100 KM	-2.0108	0.2656	-7.57	<.0001	0.1181	0.02766
Once a month	< 1 KM	5.4879	0.4239	12.95	<.0001	0.9959	0.001739
Once a month	2-20 KM	2.5161	0.3243	7.76	<.0001	0.9253	0.02242
Once a month	21-50 KM	1.9900	0.3838	5.18	<.0001	0.8797	0.04060
Once a month	51-100 KM	1.4653	0.4387	3.34	0.0008	0.8123	0.06688
Once a month	> 100 KM	-0.1419	0.2264	-0.63	0.5308	0.4646	0.05633
Couple Times a year	< 1 KM	9.5609	0.5515	17.34	<.0001	0.9999	0.000039
Couple Times a year	2-20 KM	6.5891	0.4713	13.98	<.0001	0.9986	0.000646
Couple Times a year	21-50 KM	6.0630	0.5134	11.81	<.0001	0.9977	0.001189
Couple Times a year	51-100 KM	5.5383	0.5545	9.99	<.0001	0.9961	0.002164
Couple Times a year	> 100 KM	3.9311	0.4020	9.78	<.0001	0.9808	0.007588

PHYSICAL MODE Least Squares Means							
FREQUENCY	PHYSICAL MODE	Estimate	Standard Error	z Value	Pr > |z|	Mean	Standard Error of Mean
Daily	Cycle	-2.0441	0.5351	-3.82	0.0001	0.1147	0.05432

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PHYSICAL MODE Least Squares Means							
FREQUENCY	PHYSICAL MODE	Estimate	Standard Error	z Value	Pr > |z|	Mean	Standard Error of Mean
Daily	Car	-1.4918	0.2257	-6.61	<.0001	0.1837	0.03384
Daily	Public Transport	-1.2539	0.2677	-4.68	<.0001	0.2220	0.04624
Daily	Airplane	-3.5712	0.3726	-9.58	<.0001	0.02735	0.009913
Daily	None of Above	-1.1612	0.3988	-2.91	0.0036	0.2384	0.07243
Once a week	Cycle	0.2550	0.5158	0.49	0.6211	0.5634	0.1269
Once a week	Car	0.8073	0.1973	4.09	<.0001	0.6915	0.04209
Once a week	Public Transport	1.0452	0.2530	4.13	<.0001	0.7398	0.04869
Once a week	Airplane	-1.2721	0.3587	-3.55	0.0004	0.2189	0.06134
Once a week	None of Above	1.1379	0.3990	2.85	0.0043	0.7573	0.07333
Once a month	Cycle	2.1238	0.5352	3.97	<.0001	0.8932	0.05105
Once a month	Car	2.6761	0.2457	10.89	<.0001	0.9356	0.01481
Once a month	Public Transport	2.9140	0.3010	9.68	<.0001	0.9485	0.01470
Once a month	Airplane	0.5968	0.3611	1.65	0.0984	0.6449	0.08268
Once a month	None of Above	3.0067	0.4299	6.99	<.0001	0.9529	0.01930
Couple Times a year	Cycle	6.1968	0.6488	9.55	<.0001	0.9980	0.001316
Couple Times a year	Car	6.7491	0.4452	15.16	<.0001	0.9988	0.000521
Couple Times a year	Public Transport	6.9870	0.4815	14.51	<.0001	0.9991	0.000444
Couple Times a year	Airplane	4.6698	0.4057	11.51	<.0001	0.9907	0.003733
Couple Times a year	None of Above	7.0797	0.5657	12.52	<.0001	0.9992	0.000476

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Annex 4: Number of Respondents from Different Countries

#	Country	%	Count
1	Afghanistan	0.24%	1
2	Australia	0.97%	4
3	Belgium	52.43%	214
4	Belize	0.24%	1
5	Botswana	0.24%	1
6	Brazil	0.24%	1
7	Bulgaria	0.24%	1
8	Cameroon	0.24%	1
9	Canada	0.49%	2
10	Chile	0.24%	1
11	China	1.46%	5
12	Egypt	0.24%	1
13	France	0.24%	1
14	Germany	3.88%	15
15	Ghana	0.49%	2
16	Great Britain	0.73%	3
17	Hungary	0.24%	1
18	India	3.88%	16
19	Indonesia	0.24%	1
20	Iran	0.24%	1
21	Jordan	0.97%	4
22	Malaysia	0.24%	1
23	Morocco	0.24%	1
24	Netherlands	3.40%	14
25	Pakistan	19.90%	79
26	Russian Federation	0.24%	1
27	Saudi Arabia	0.49%	2

28	Slovenia	0.24%	1
29	Solomon Islands	0.24%	1
30	Korea, Republic of (South Korea)	0.24%	1
31	Suriname	0.24%	1
32	Sweden	0.73%	3
33	Switzerland	1.70%	7
34	Tanzania	0.24%	1
35	Thailand	0.49%	2
36	Turkey	0.49%	2
37	Ukraine	0.24%	1
38	United States of America (USA)	0.24%	1
39	Vietnam	1.94%	8
	Total	100%	406

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Jaar: **2017**

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Shaker, Muhammad

Datum: **2/06/2017**