

IMPACTS OF ROAD NETWORK CONNECTIVITY ON QUALITY OF IN  
ABUJA CITY

NUHU HONEY TINI

A thesis submitted in fulfilment of the  
requirements for the award of the degree of  
Doctor of Philosophy (Transportation Planning)

Faculty of Built Environment and Surveying  
Universiti Teknologi Malaysia

NOVEMBER 2018

## **DEDICATION**

This thesis is dedicated to God Almighty. To whom be all the power, majesty, glory, honour and adoration.

## ACKNOWLEDGEMENT

To God Almighty be the glory; who marvellously helped me and made this work a success.

Words cannot sufficiently express my appreciation for the persistent guidance and care of my Supervisor, Assoc. Prof. Dr. Muhammad Zaly Shah, all through this research work. The support and contribution in all facets from Dr. Zahid Sultan and Dr. Mehdi Moeinadinni is also exceedingly acknowledged.

My enormous thanks goes to Nigerian Government for TETFUND sponsorship, and to Adamawa State University, Mubi for study leave.

I appreciate the support of my colleagues who in spite of tight research schedule sacrificed their precious time to train me in software applications. I specifically express my indebtedness to Dr. Hassan Adulaziz, Surveyor Anthony Tumba, Dr. Iraj Karimi, and Dr. Solomon Oluyinka.

The affections, prayers, and patience of my wife, Rita and children, Jehu, Jemimah, Jabin and Julia will keep on lingering in my heart for ever. Thanks for understanding and forbearing the many nights I was away.

I thank the Deeper Life Group, UTM, for their kindness to me throughout this study. I passionately acknowledge their support, prayer and courage which was constantly at my disposal during this endeavour. To friends and well-wishers: I am restricted by space and time from listing out all of you. Admit my deep gratitude collectively.

## ABSTRACT

Development of well-connected road network to guarantee quality living in cities is a major concern in the current era. Efforts have been made to establish the underlying relation between road network and societal well-being. However, the causal relationship remains poorly understood due to inability to consider personal quality of life in the appraisal technique. This research introduces a novel model with multidimensional analytical approach for empirical exploration of road connectivity impact on quality of life (QOL) in Abuja City, Nigeria. Forty planning districts were used as spatial units for road network analysis. QOL survey data were generated from 367 respondents in the 15 sampled districts. Graph theory metrics comprising alpha, beta, cyclomatic number, eta, gamma and aggregate transportation score (ATS) indices were applied to determine the connectivity of road networks. Exploratory factor analysis (EFA) was used to examine the components of road connectivity and quality of life indicators for the model development. Structural equation modelling (SEM) was applied for confirmatory factor analysis (CFA) to determine the model fitness between the components of road connectivity and the latent indicators of quality of life. Weighted average score (WAS) and analysis of variance (ANOVA) were used to compare the quality of life among the districts with different levels of road connectivity. Finding revealed that most districts (60%) have low road connectivity (6.66 – 46.23 ATS). About 22.5% of the districts have moderate connectivity (51.04 – 91.00 ATS), while 17.5% districts have high road connectivity (100.98 – 146.13 ATS). Factor analysis affirmed that four connectivity components, six latent factors and 26 observable factors were fit for model development. The structural equation modelling showed high factor loading ( $R^2 = 0.66$ ), implying that road connectivity components explained 66% of QOL. Path coefficient was 0.81, indicating that every one unit increase in connectivity, contributes 0.81 unit increase in QOL. Analysis of variance showed a statistical significant difference in quality of life at  $< .05$  level between low and high connected districts. However, quality of life slightly varied between the moderate and low connected districts as well as between the moderate and high connected districts. Overall, the results of this research have contributed by revealing how road connectivity empirically affects QOL. Hence, the study suggests a multidimensional model that can be employed in future analyses. The model would be useful to researchers, planners and engineers for examining the impact of transportation network on societal quality of life.

## ABSTRAK

Pembangunan rangkaian jalan yang bersambung dengan baik untuk memastikan kualiti hidup di bandar merupakan kebimbangan utama dalam era masakini. Usaha telah dibuat untuk mewujudkan hubungan asas antara rangkaian jalan dan kesejahteraan masyarakat. Walau bagaimanapun, hubungan kasual masih kurang difahami kerana ketidakupayaan untuk mengambilkira aspek kualiti hidup peribadi dalam teknik penilaian. Kajian ini memperkenalkan model baru dengan pendekatan analitik multidimensi untuk meneroka secara empirikal impak kesinambungan rangkaian jalan raya terhadap kualiti hidup (QOL) di Abuja City, Nigeria. Empat puluh daerah perancangan digunakan sebagai unit spatial untuk analisis rangkaian jalan raya. Data tinjauan QOL dihasilkan daripada 367 responden di 15 sampel daerah. Metrik Teori Graf yang terdiri daripada indeks alpha, beta, nombor cyclomatik, eta, gamma dan indeks skor agregat (ATS) digunakan untuk menentukan tahap kesinambungan rangkaian jalan. Analisis Faktor Eksplorasi (EFA) digunakan untuk mengkaji komponen kesinambungan jalan raya dan indikator kualiti hidup bagi pembangunan model. Model Persamaan Struktur (SEM) telah digunakan untuk Analisis Faktor Pengesahan (CFA) bagi menentukan kesesuaian model antara komponen kesinambungan jalan dan penunjuk kualiti hidup terpendam. Nilai purata berwajaran (WAS) dan analisis varians (ANOVA) digunakan untuk membandingkan kualiti hidup di antara daerah dengan tahap kesinambungan jalan yang berbeza. Dapatan menunjukkan bahawa kebanyakan daerah (60%) mempunyai tahap kesinambungan jalan yang rendah (6.66 – 46.23 ATS). Lebih kurang 22.5% daripada daerah mempunyai kesalinghubungan sederhana (51.04 - 91.00 ATS), sementara 17.5% mempunyai sambungan jalan raya yang tinggi (100.98 - 146.13 ATS). Analisis faktor mengesahkan empat komponen kesinambungan, enam faktor terpendam dan 26 faktor pemerhatian adalah sesuai untuk pembangunan model. Model persamaan struktur menunjukkan pemuatan faktor yang tinggi ( $R^2 = 0.66$ ) yang mencadangkan bahawa komponen kesinambungan jalan raya menerangkan 66% QOL. Pekali laluan ialah 0.81 menunjukkan bahawa setiap satu unit peningkatan kesinambungan menghasilkan 0.81-unit peningkatan QOL. Analisis varians menunjukkan perbezaan statistic yang signifikan dalam kualiti hidup pada tahap  $< .05$  antara daerah berkesinambungan tinggi dan rendah. Walau bagaimanapun kualiti hidup berbeza sedikit antara kesinambungan sederhana dan rendah serta antara daerah kesinambungan sederhana dan tinggi. Secara keseluruhannya, kajian ini menyumbang kepada pendedahan bagaimana kesinambungan jalan secara empirikal mempengaruhi kualiti hidup. Oleh itu, kajian ini menunjukkan bahawa model multidimensi boleh digunakan untuk analisis prestasi pengangkutan. Model ini berguna untuk penyelidik, perancang dan jurutera untuk mengkaji kesan rangkaian pengangkutan terhadap kualiti hidup masyarakat.

## TABLE OF CONTENTS

	TITLE	PAGE
	<b>DECLARATION</b>	<b>ii</b>
	<b>DEDICATION</b>	<b>iii</b>
	<b>ACKNOWLEDGEMENT</b>	<b>iv</b>
	<b>ABSTRACT</b>	<b>v</b>
	<b>ABSTRAK</b>	<b>vi</b>
	<b>TABLE OF CONTENTS</b>	<b>vii</b>
	<b>LIST OF TABLES</b>	<b>xv</b>
	<b>LIST OF FIGURES</b>	<b>xvii</b>
	<b>LIST OF ABBREVIATIONS</b>	<b>xx</b>
	<b>LIST OF SYMBOLS</b>	<b>xxii</b>
	<b>LIST OF APPENDICES</b>	<b>xxiii</b>
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	<b>1</b>
1.1	Research Background	1
1.2	Research Problem Statement	4
1.3	Research Aim	6
1.4	Research Objectives	6
1.5	Research Questions	6
1.6	Scope of the Study	7
1.7	Research Limitations	8
1.8	Significance of the Research	8
1.9	Structure of Thesis	9
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	<b>13</b>
2.1	Introduction	13
2.2	Transport Network and Societal Well-being Models	13
2.2.1	Socio-Economic Welfare Growth Model	13
2.2.2	Transport Investment Model	14

2.2.3	Economic Opportunity Model	14
2.2.4	Foundational Development Model	15
2.2.5	The Connection Model	15
2.3	Research Conceptual Framework	16
2.4	Research Gap	18
2.5	Urban Morphology and Form	22
2.5.1	Typology of Urban Form	23
2.5.2	Typology of Transportation Networks	25
2.6	Evolution of Road Network	27
2.6.1	Simple Theory of Networks	28
2.6.2	Economic Models of Networks	30
2.6.2.1	Random Models	30
2.6.2.2	Strategic Interaction Models	30
2.6.3	Science of Networks	31
2.7	Trends in Urban Road Transport Network Dynamics	33
2.8	Road Network Connectivity	36
2.8.1	Concept of Road Connectivity	36
2.8.2	Components of Road Network Connectivity	38
2.8.2.1	Route Options	39
2.8.2.2	Transport Efficiency	40
2.8.2.3	Network Reliability	42
2.8.2.4	Traffic Flow	43
2.9	Societal Benefit and Cost of Road Network Connectivity	44
2.10	Structural Measures of Road Network Connectivity	49
2.10.1	Network Density	52
2.10.2	Beta Index	53
2.10.3	Cyclomatic Number	53
2.10.4	Alpha Index	54
2.10.5	Gamma Index	54
2.10.6	Eta Index	55

2.10.7	Aggregate Transportation Score	55
2.10.8	Significance of Graph Theory in Transport Analysis	56
2.11	Quality of Life	57
2.11.1	Definition of Quality of Life	57
2.11.2	Quality of Life Concept	58
2.11.2.1	Preference Satisfaction	58
2.11.2.2	Flourishing Well-being	59
2.11.2.3	Objective Well-being	59
2.11.2.4	Subjective Well-being	60
2.11.3	Need for Assessment of Subjective Quality of Life	61
2.12	Transportation Network and Quality of Life	62
2.13	Existing Studies on Road Network Connectivity and Societal Quality of Life	63
2.14	Road Network Connectivity Quality of Life Indicators	68
2.14.1	Emotional Travel Safety	69
2.14.2	Social Interaction	70
2.14.3	Economic Well-Being	72
2.14.4	Travel Comfort	73
2.14.5	Personal Accessibility	74
2.14.5.1	Infrastructure-based Accessibility measure	74
2.14.5.2	Location-based Accessibility measure	75
2.14.5.3	Network Impedance Accessibility	75
2.14.5.4	Personal Mobility	76
2.15	Chapter Summary	77
<b>CHAPTER 3 EXISTING SITUATION, TRANSPORTATION NETWORK AND POLICY IN ABUJA CITY</b>		<b>79</b>
3.1	Introduction	79
3.2	Physical Setting	79
3.2.1	Location and Size	79



3.2.2	Topography	81
3.3	Population	81
3.4	Historical Background	82
3.5	Urban Form of Abuja City	82
3.6	Land Use Pattern	84
3.6.1	Residential Areas	85
3.6.1.1	Asokoro District	85
3.6.1.2	The City Centre	86
3.6.1.3	Garki District	88
3.6.1.4	Guzape District	88
3.6.1.5	Maitama District	89
3.6.1.6	Wuse District	90
3.6.1.7	Utako District	91
3.6.1.8	Jabi District	91
3.6.1.9	Gwarimpa District	92
3.6.1.10	Lokogoma District	93
3.6.1.11	Kafe District	94
3.6.2	Commercial Areas	94
3.6.3	Industrial Areas	97
3.6.4	Recreational Areas	97
3.7	Urban Development and Transport Policy in Abuja City	101
3.7.1	Accessibility	102
3.7.2	Transport System Integration	102
3.7.3	Traffic Management	102
3.7.4	Non-Motorized Transportation	103
3.7.5	Environmental Protection	103
3.8	Transportation Network	103
3.8.1	Air Transport	104
3.8.2	Rail Transport Network	104
3.8.3	Road Transportation System	105
3.8.3.1	Road Network Spatial Structure	106

	3.8.3.2	Urban Road Transportation	109
3.9		Chapter Summary	112
<b>CHAPTER 4</b>		<b>RESEARCH METHODOLOGY</b>	<b>113</b>
4.1		Introduction	113
4.2		Research Strategy	113
4.3		Method of Study	114
	4.3.1	Types and Sources of Data	115
	4.3.1.1	Types of Data	116
	4.3.1.2	Sources of Data	116
	4.3.2	Analytical Tools and Software	118
4.4		Population and Sampling Strategy	119
	4.4.1	Sampling Unit	120
	4.4.2	Population Sample Size	122
	4.4.3	Population Sampling Procedure	124
4.5		Data Analytical Techniques	127
	4.5.1	Road Network Spatial Analysis	127
	4.5.1.1	Representation of Road Network Configuration	127
	4.5.1.2	Analysis of Road Network Structural Topology	128
	4.5.2	Questionnaire Survey	130
	4.5.2.1	Questionnaire Development	130
	4.5.2.2	Questionnaire Scaling Technique	131
	4.5.2.3	Pilot Survey	132
	4.5.2.4	Questionnaire Administration	132
4.6		Questionnaire Analysis	133
4.7		Data Examination	134
	4.7.1	Missing Data	135
	4.7.2	Test of Normality	135
	4.7.3	Outliers	136
	4.7.4	Reliability Test	136

4.7.5	Sample Suitability Test	137
4.7.6	Exploratory Factor Analysis	137
4.8	Confirmatory Factor Analysis	138
4.8.1	Validity Test	140
4.8.1.1	Face Validity	140
4.8.1.2	Content Validity	141
4.8.1.3	Construct Validity	141
4.9	Statistical Test Analysis	144
4.9.1	Descriptive Statistics	144
4.9.2	Weighted Average Score (WAS)	145
4.9.3	One-way Analysis of Variance (ANOVA)	146
4.10	Chapter Summary	147
<b>CHAPTER 5</b>	<b>DATA ANALYSIS AND DISCUSSION</b>	<b>149</b>
5.1	Introduction	149
5.2	Demographic Profile of Respondents	150
5.2.1	Gender	150
5.2.2	Age Distribution	151
5.2.3	Educational Attainment	151
5.2.4	Employment Status	152
5.2.5	Monthly Income	153
5.2.6	Duration of Residence	154
5.2.7	Travel Mode	155
5.2.8	Vehicle Ownership	156
5.2.9	Daily Distance Travel	157
5.2.10	Daily Travel Expenses	158
5.3	Research Question 1: What is the spatial pattern of road network connectivity in Abuja city?	159
5.3.1	Road Network Spatial and Attribute Data	160
5.3.1.1	Curvilinear Grid Network Pattern	161
5.3.1.2	Irregular Grid Network Pattern	162

5.3.1.3	Rectilinear Grid Network Pattern	163
5.3.1.4	Hybrid Grid Network Pattern	164
5.3.1.5	Broken Gridiron Network Pattern	165
5.3.2	Road Network Connectivity	171
5.3.2.1	Proportion of Edges per Vertex	171
5.3.2.2	Network Circuitry	172
5.3.2.3	Network Cyclomatic Number	173
5.3.2.4	Proportion of Routes	175
5.3.2.5	Network Routes Length	176
5.3.2.6	Aggregate Transportation Score (ATS)	178
5.4	Research Question 2: What are the Components of Road Connectivity and Quality of Life Indicators?	181
5.4.1	Preliminary Analysis of Road Connectivity Components and Quality of Life Indicators	182
5.4.1.1	Reliability Test	183
5.4.1.2	Sample Suitability	185
5.4.2	Exploratory Factor Analysis	185
5.5	Research Question 3: To what extent does road network connectivity components influence quality of life in Abuja city?	189
5.5.1	Estimate of Measurement Model of QOL Variables	189
5.5.2	Pooled Confirmatory Factor Analysis (PCFA) of Quality of Life Perception	192
5.5.3	Model Modification	193
5.5.4	Model Fit Enhancement	195
5.5.5	Second Order Structural Model CFA for Quality of Life Perception	201
5.5.6	Structural CFA Model for Road Connectivity Components and Quality of Life Perception	205
5.6	Research Question 4: Is there any similarity in quality of life between districts with different levels of road network connectivity?	210

5.7	Discussion	215
<b>CHAPTER 6</b>	<b>CONCLUSION AND RECOMMENDATIONS</b>	<b>219</b>
6.1	Introduction	219
6.2	Research Summary	219
6.2.1	Research Question 1: What is the spatial pattern of road network connectivity in Abuja city?	220
6.2.2	Research Question 2: What are the components of road connectivity and quality of life indicators?	220
6.2.3	Research Question 3: To what extent does the components of road connectivity components influence quality of life?	221
6.2.4	Is there any similarity in quality of life between districts with different levels of road connectivity?	221
6.3	Summary of Findings	222
6.4	Theoretical and Policy Implications	223
6.5	Practical Implications	225
6.6	Contribution of Road Connectivity Quality of Life Model	226
6.7	Limitations and Suggestions for Further Research	228
6.8	Recommendations	229

**REFERENCES**

**231**

## **LIST OF TABLES**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
<b>2.1</b>	Research Gaps on Road Network Connectivity and Quality of Life	21
<b>2.2</b>	Road Connectivity Quality of Life Indicators	69
<b>3.1</b>	Trip Distance to District Locations in Abuja City	108
<b>3.2</b>	Road Transport Modal Split in Abuja City	109
<b>3.3</b>	Daily traffic Volume and VKT on Major Roads in Abuja City	110
<b>4.1</b>	Study Population per Sampled District	126
<b>4.2</b>	Road Network Connectivity Measures	129
<b>4.3</b>	Questionnaire Analysis Procedure	134
<b>4.4</b>	Types of Model Fit and Acceptance Level	143
<b>5.1</b>	Types of Road Network Pattern in Abuja City	161
<b>5.2</b>	District-wise Road Network Attribute Data	168
<b>5.3</b>	Computed Value of Road Connectivity Indices	169
<b>5.4</b>	Summary of Beta Index	172
<b>5.5</b>	Summary of Alpha Index	173
<b>5.6</b>	Summary of Cyclomatic Number	174
<b>5.7</b>	Summary of Gamma Index	175
<b>5.8</b>	Summary of Eta Index	177
<b>5.9</b>	Summary of Aggregate Transportation Score	179
<b>5.10</b>	Test of Reliability	184

<b>5.11</b>	KMO and Bartlett's Test	185
<b>5.12</b>	Exploratory Factor Analysis	187
<b>5.13</b>	Summary Connectivity Components & QOL Indicators	188
<b>5.14</b>	Modification Indices of Correlated Pair of Items	193
<b>5.15</b>	Statistics of Enhanced Model CFA for Quality of Life Perception	198
<b>5.16</b>	Discriminant Validity of Quality of Life Perception	200
<b>5.17</b>	Statistics of Second Order CFA for Quality of Life Perception	203
<b>5.18</b>	Statistics of CFA Model for Road Connectivity and QOL Perception	207
<b>5.19</b>	Discriminant Validity of Road Connectivity and Quality of Life Perception	209
<b>5.20</b>	District-wise Quality of Life Perception (Weighted Average Score)	207
<b>5.21</b>	Variable Descriptive Statistics	213
<b>5.22</b>	Result of Analysis of Variance (ANOVA)	214
<b>5.23</b>	Result of Post Hoc Tests	214
<b>6.1</b>	Summary of Findings	223

## LIST OF FIGURES

<b>FIGURE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
1.1	Research Design	11
2.1	Road Connectivity Quality of Life Conceptual Framework	18
2.2	Summary of Studies, Gap and Analysis Domains	22
2.3	Morphological Urban Forms	24
2.4	Fundamental Transportation Network	25
2.5	Road Network Nodes and Links (Nykamp, 2017)	28
2.6	Stages of Road Network Development	29
2.7	Scale-Free Road Network (Fonseca et al., 2007)	32
2.8	Ribbon Housing Development (Istock, 2017)	36
2.9	Spatial Patten of Road Connectivity (AAustin, 2015)	38
3.1	Location of Abuja FCT in Nigeria	80
3.2	Location of Abuja City in the FCT	80
3.3	Demarcation of the 40 Districts within Abuja Municipality	80
3.4	Urban Form of Abuja City. Source: <a href="https://imgcop.com">https://imgcop.com</a>	84
3.5	Land Use Map of Abuja Municipality	85
3.6	Housing Layout in Asokoro District with Walkway Street	86
3.7	National Christian Church Abuja. Source	87
3.8	National Mosque Abuja	87
3.9	Central Bank of Nigeria Sited in Garki District, Abuja	88
3.10	AICL Mall Guzape, Abuja	89



<b>3.11</b>	Maitama Residential District with Street Parkway	90
<b>3.12</b>	Wuse Residential Zone Sky View	91
<b>3.13</b>	Jabi Lake Estate	92
<b>3.14</b>	Classic House in Gwarimpa District, Abuja	93
<b>3.15</b>	Wuse Central market, Abuja	95
<b>3.16</b>	Garki International Mark, Abuja	96
<b>3.17</b>	Millenium Park Maitama, Abuja	98
<b>3.18</b>	Villa Park and Garden, Abuja	99
<b>3.19</b>	Art and Craft Village, Abuja	100
<b>3.20</b>	Nigerian Traditional Mask and Necklace	100
<b>3.21</b>	Abuja Metro Light Rail	105
<b>3.22</b>	Abuja City Road Network Sky View	106
<b>3.23</b>	Road Network Pattern in Abuja City	107
<b>4.1</b>	Flowchart of Data Collection and Analysis Procedure	115
<b>4.2</b>	Base Maps Used Extraction of Road Network	118
<b>4.3</b>	Case Study Districts for Questionnaire Administration	122
<b>5.1</b>	Data Analysis Flowchart	149
<b>5.2</b>	Respondents' Gender	150
<b>5.3</b>	Respondents' Age Distribution	151
<b>5.4</b>	Respondents' Educational Attainment	152
<b>5.5</b>	Respondent's Employment Status	153
<b>5.6</b>	Respondents' Monthly Income	154
<b>5.7</b>	Respondents' Duration of Residence in District	154

<b>5.8</b>	Respondents' Travel Mode	155
<b>5.9</b>	Respondents' Vehicle Ownership	157
<b>5.10</b>	Daily Distance Travelled by Respondents	158
<b>5.11</b>	Respondents' Daily Travel Expenses	159
<b>5.12</b>	Road Network Structure in Abuja City	160
<b>5.13</b>	Curvilinear Grid Pattern in Bonkoro District	162
<b>5.14</b>	Irregular Grid Pattern in Maitama District	163
<b>5.15</b>	Rectilinear Grid Pattern in Institution and Research Area	164
<b>5.16</b>	Hybrid Grid Pattern in Industrial Area 2	165
<b>5.17</b>	Broken Gridiron Pattern in Central Business District	166
<b>5.18</b>	Distribution of Road Network Pattern in Abuja City	167
<b>5.19</b>	Spatial Distribution of Road Connectivity in Abuja City	180
<b>5.20</b>	Normal Distribution of Response Cases	182
<b>5.21</b>	Estimate of QOL Pooled CFA Measurement Model	190
<b>5.22</b>	Initial Result of QOL Pooled Confirmatory Factor Analysis	192
<b>5.23</b>	Re-Specified QOL Model Fit Indexes after Correlating Items	194
<b>5.24</b>	Final Enhanced QOL Model CFA Fit Indices After Deleting Item e17 (SAFE5)	196
<b>5.25</b>	Second Order Structural Model CFA of Quality of Life	202
<b>5.26</b>	Structural CFA Model for Road Connectivity Components and Quality of Life Perception	206
<b>6.1</b>	Road Connectivity Quality of Life Model	228

## LIST OF ABBREVIATIONS

ACEA	-	Association des Constructeurs Europeen
AEPB	-	Abuja Environmental Protection Board
AGIS	-	Abuja Geographic Information Studies
AMOS	-	Analysis of Moments Structure
ArcGIS	-	Aeronautical Reconnaissance Coverage Geographic Information System
BRT	-	Bus Rapid Transit
CBD	-	Central Business District
CFA	-	Confirmatory Factor Analysis
CFI	-	Comparative Fit Index
CMIN	-	Chi Square
EFA	-	Exploratory Factor Analysis
EU	-	European Union
EUR	-	Euro
FCDA	-	Federal Capital Development Authority
FCT	-	Federal Capital Territory
FHA	-	Federal Housing Authority
FRF	-	French Franc
GDP	-	Gross Domestic Product
GIS	-	Geographic Information System
GOT	-	Goodness of Fit
GT	-	Guarantee Trust Bank
KM	-	Kilo Meter
KMO	-	Kaiser Meyer Olkin
ND	-	Network Density
NGO	-	Non-Governmental Organization
NFI	-	Normed Fit Index
NO	-	Nitric Oxide
NOX	-	Nitrogen Oxide

PDR	-	People's Democratic Republic
QOL	-	Quality of Life
R <sup>2</sup>	-	Squared Multiple Correlation
RMSEA	-	Root Mean Square of Approximation
SEM	-	Structural Equation Modelling
SINTEF	-	The Foundation for Industrial and Scientific Research
SPSS	-	Statistical Package for Social Science
TDM	-	Transportation Demand Management
TLI	-	Tusker-Lewis Index
TOD	-	Transit-oriented Development
UBA	-	United Bank of Africa
USA	-	United States of America
VEPI	-	Voter Education and Publicity Inec
VMT	-	Vehicle Miles Travelled
WHO	-	World Health Organization

## LIST OF SYMBOLS

$\alpha$	-	Alpha Index
$\beta$	-	Beta Index
$\eta$	-	Eta Index
$\infty$	-	Infinity
$\mu$	-	Cyclomatic Number
$\gamma$	-	Gamma Index

## LIST OF APPENDICES

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGE</b>
<b>Appendix A</b>	List of Publications	271
<b>Appendix B</b>	Research Questionnaire	272
<b>Appendix C</b>	Normality Test	279
<b>Appendix D</b>	Quality of Life Weighted Average Score	280
<b>Appendix E</b>	Summary of Literature on Road Network Connectivity and Quality of Life	283



# CHAPTER 1

## INTRODUCTION

### 1.1 Research Background

Transportation is a process that satisfies human mobility demand by providing access to diverse activities in the society. The social and economic activities of human kind centre on transportation (Harriet et al., 2013 and Coffin, 2009). This is a means by which people physically access social capital, either in form of associations and community groups or simply to maintain linkages with extended family members. Activities such as social, cultural or economic interaction involve diverse functions comprising ‘production, consumption and distribution’ occur at locations served by various modes of transportation (Rodrigue et al., 2013).

Road as a mode of transportation serves as a conduit linking places, regions, and economy together; facilitating movement of people, goods and services (Venter et al., 2016, and Niazi, 2017). Road plays a central role in economic development and enhancement of social transaction. Thus contributes to productivity in other economic sectors, foster prosperity and support the foundation upon which economic strength of a place, region or nation rest (Patarasuk and Binford, 2012, and Papoutsis, 2013). This in turn has tremendous influence on societal well-being.

Network is a group of path nodes joined together by sets of linkages (Newman, 2010). It is also known as a framework of functional relations shaping the pattern of a territory (Borruso, 2003). Hence road network has a fundamental structure defined by layout, arrangement and connectivity of individual network elements and their intersections (Parthasarathi, 2011).

Road network connectivity can be considered as the systematic linkage of points, lines, and areas in relation to degree of properties such as size, distance, travel



time and optimal path' (Jayasinghe and Munasinghe, 2013). Connectivity in order words refers to linking many places so as to create interconnections which yields web-like network (Levinson, 2012). Bashir et al. (2012) aver that connectivity expresses the degree to which network permits direct movement between its various vertices or nodes. Thus road connectivity is critical for the success of other urban sectors. The advantages of road network connectivity are far ahead of accessibility and mobility in the city. But encompasses safer roads, reduced traffic congestion, and cost saving (Lehigh-Valley-Planning-Commission, 2011).

Road network connectivity influence pattern of urban growth and location of socio-economic activities, environmental aesthetics, employment and residential areas in the city. It as well affects commuters' choice of destination and accessibility (Huang and Levinson, 2012, Waddell, 2011, and Bogale, 2012). Also, Rodrigue et al. (2013) posits that connectivity does not only favour economic development but also determine the spatial organization in terms of locations, relations and accessibility. In a city setting where roads are the predominant means of mobility; land-use and roads are intertwined. Consequently, road networks are solely relied upon to access different activities such as businesses, educational institutions, employment opportunities, cultural and recreational centres. Shahi (2014) rightly observes that 'road network is the basic foundation of other development initiatives which ensures overall social, cultural and economic empowerment of communities'.

It could be inferred from the foregoing statements that a well-connected road network is an indispensable prerequisite for attainment of quality living condition. Deluka-Tibljaš et al. (2013) affirm that quality of life in cities greatly rely on the nature of transport services and as well on traffic infrastructure which, alongside with efficient transport system, make urban areas more accessible, and in turn raises their value. Road network therefore needs to be accessible and link up most places so as to create a promotional impact of land use activity and socio-economic well-being of people within the city-region. As Handy et al. (2010) proclaim that adequate road connectivity ensures social equity by providing travel options, accessibility and reduce travel cost to those who lack means of transportation in the city.

Road transport network is paramount to advancement of social and economic development in urban areas. In due course, investigations are directed towards understanding the link between transportation and economy, environment, social relationships and the people, and in turn their causal effect on societal well-being. Nevertheless, the social impact of transportation network has not been sufficiently explored particularly in developing country cities (Tiwari and Arora, 2012). It is equally acknowledged that the influence of transport network on urban lifestyle is scarcely investigated (Mohamed et al., 2013).

Existing investigations on road transport network impact on societal living quality mostly dwell on objective attributes while subjective quality of life is scarcely examined. For instance, preceding studies (Oluseyi, 2006, Özbil et al., 2008, Rifaat et al., 2012, Bornasal, 2012, Schneider, 2013, Parida, 2014) tried to describe the link between road network and societal well-being. However, their analysis and emphasis concentrate on selective individual indicators of objective (external attributes like air quality, noise, local economy, crime, traffic crash, social interactions) of well-being. Such individual objective variables neither indicate thorough and adequate measures nor provide sufficient information on societal quality of life.

The statistical framework employed is another major defect in analytical process. Most of the preceding studies presented only descriptive statistics or used simple bivariate tests of correlation, while some proposed theoretic models without empirical assessment. Thus results of such investigation cannot adequately relate the causal effect of road network on living quality. This makes judgements difficult, which result to indefinite and disputed conclusions about the causality between transport network and societal well-being (Reardon and Abdallah, 2013).

Thus far, no substantive predictive model has been developed for determining transport network connectivity impact on urban quality of life (Schneider, 2013). There is also no any previous study that has excursively investigated the impact of road connectivity on quality of life by examining multidimensional variables of well-being using self-reported (internal judgement) approach (Estlander, 2015; Lee and Sener, 2016).

Such limited capture of quality of life attributes in analysis, inadequate statistical approach, and undefined predictive model pose some difficulties to professionals and the society at large. Specifically, it constrains transport planners and engineers from gaining adequate insight to how their activities (policy and plan) influence the lifestyle of urban dwellers. It as well restricts policy-makers from comprehending the success of road investment in achieving the desired transport demand. It also makes the performance of urban road network in ensuring cultural, economic, social and overall urban development to remain unclearly defined.

The desire for more empirical approaches required in order to facilitate better insight to the rapport between societal well-being and transportation network stimulated interest in this present research. The motive is to introduce a firm and multi-dimensional (multiple interactive factor) model for empirical evaluation of road connectivity causal impact on quality of life. The model would help planners, engineers and decision-makers to better understand how road transportation system affect the well-being of urban dwellers. Thus the outcome of this research could facilitate future road planning, design, decision and implementation, without which sustainable transportation system and overall growth cannot be achieved in the city.

## **1.2 Research Problem Statement**

The spatial growth of urban centres is an emerging phenomenon in developing countries. Cities are experiencing spectacular expansion which tremendously attracts the attention of urban planners (Tini and Peter, 2013). In this vein, Abuja city has experienced enormous attention and intensive resource infusion towards road infrastructure and transport facilities since its inception as federal capital of Nigeria in 1991. This resulted to significant changes in road network pattern. However, some disparities in connectivity across the city regions generate inequity in inhabitants' quality of life. Such phenomenon prompted the pertinence and desire for this investigation.

Generally, improvement of living quality has become a spectacular issue in cities. Thus, because it is one of the most essential dimensions for sustaining urban development (El-Din, et al., 2013). In realizing this objective, Jiménez-Espada and Gonzalez-Escobar (2016) have established that optimization of road transport network is one of the main ways to attain urban quality of life. Unfortunately, the causal impact of transportation system on societal well-being is not yet well established (Schneider, 2013 and Venables, 2014). Such predicament is prompted by limited capture of quality of life attributes in analysis, inadequate statistical analytical approach, and undefined predictive model for assessment (Carse, 2010, and Schneider, 2013).

These challenges and the rising need for better approach arouse interest in the present research to develop a more suitable and reliable technique for assessment of road network connectivity causal impact on societal quality of life in the context of Abuja city. The intention is to introduce a model with multidimensional analytical approach and diverse variables of transport related quality of life. Such involves modelling spatial connectivity of road network, ascertaining the components of road connectivity and quality of life indicators, and determining the implication of road connectivity on societal quality of life. Then lastly compare the quality of life between the districts with different road connectivity levels.

Four components, including route options, network reliability, transport efficiency and traffic flow have been identified from literature as the most relevant and essential social constituents of road network performance. Hence, they were adopted as connectivity social predictors of personal quality of life. Similarly, it is established from literature that personal accessibility, personal mobility, economic well-being, emotional travel safety, travel comfort and social interaction have scarcely been combined together as main constructs of transport related quality of life indicators and thus considered as endogenous factors in this analysis. Such constituents are vital for attainment of the intended goal in this empirical investigation as well as in developing a multidimensional model for assessing road connectivity causal impact on quality of life.

### **1.3 Research Aim**

The main aim of this research is to extend the understanding of road network effect on societal quality living using multidimensional quantitative analytical approach. This will be achieved by investigating road network connectivity, and by determining the theoretical effect of connectivity components on quality of life via structural equation modelling. Such a dynamic approach can facilitate future planning and designing of roads, which in turn could offer sustainable transportation system, better quality of life and overall growth in the city.

### **1.4 Research Objectives**

The specific objectives to be achieved in this study are to:

- (a) Analyze the spatial pattern of road network connectivity in Abuja city.
- (b) Examine the connectivity components and quality of life indicators suitable for assessing impact of road network,
- (c) Determine the influence of road connectivity components on quality of life,
- (d) Compare quality of life between the districts with different levels of road network connectivity.

### **1.5 Research Questions**

The following are questions to enable the research achieve its objectives:

- (a) What is the spatial pattern of road network connectivity in Abuja city?
- (b) What are the connectivity components and quality of life indicators suitable for assessing impact of road network?
- (c) To what extent do road connectivity components influence quality of life?

- (d) Is there any similarity in quality of life between the districts with different levels of road connectivity?

## **1.6 Scope of the Study**

This research is mainly a cross sectional analysis of road connectivity influence on quality of life in Abuja municipality. The aspects looked into were spatial structure of road connectivity, components of road connectivity and quality of life indicators. Forty planning districts were designated as unit of road network analysis. The structural analysis is confined to road network connection pattern in the study area. Alpha index, beta index, gamma index, cyclomatic number, eta index, and aggregate transportation score were used to determine the road connection pattern. The analysis did not involve complex network analysis such as betweenness, heterogeneity, and homogeneity. All categories of road comprising expressway, arterial, sub-arterial, secondary and local roads within the metropolitan area were unanimously represented as primal graph for analysis.

Social implication of road network in this research is restricted to the performance of road connectivity components and quality of life indicators. Four social components of road network connectivity were examined. These comprised route options, traffic flow, network reliability and transport efficiency. Six transport-related quality of life indicators were surveyed. These encompassed personal accessibility, personal mobility, economic well-being, travel comfort, travel safety, social interaction. The selection of few social components and quality of life indicators is for convenience, easy variable management, interpretation and result implementation.

Fifteen out of the forty districts were sampled as case study area to obtain survey data on quality of life and road connectivity performance. The data were collected from road users residing within Abuja metropolis, including males and females who were at the age of twenty years and above. The survey was conducted from the month of April to August 2016.

## **1.7 Research Limitations**

This research will delineate connectivity of road network so as to know the pattern and properties of roads within Abuja municipality. Thereby provides adequate information to planners, engineers, administrators and the general public on the physical configuration and efficiency of road network in the city. This is vital for future decision on planning and development of roads. This investigation does not involve complex network analysis such as betweenness, heterogeneity, and homogeneity.

The study also ascertains the performance of road connectivity components and as well determines road users' life satisfaction with the road connectivity. This outcome will reveal to planners and engineers the impact of their activities on the lifestyle of city dwellers. The finding will also enable administrators to ascertain the ability of road investment in achieving the desired goal of improving standard of living of the urbanites.

Furthermore, the study shall verify and compare quality of life between the districts with different levels of road connectivity. Such understanding is essential for planning decision which could ensure cultural, economic, social equity and environmental sustainability at regional and the entire city levels.

## **1.8 Significance of the Research**

The rationale for this study was to develop a multidimensional analytical model which shall serve as a guide for transport planners and policy makers in assessing the impact of road connectivity on societal living quality. Thus the important and beneficial achievements of the research include the following:

This study will uncover the physical configuration of road network in Abuja city. Hence the outcome is beneficial since it will serve as a guide to planning authority in deciding for future need, plan and development of roads in the city. The research will analyse levels of road connectivity; therefore, the result will be helpful for the

inhabitants in choosing favourable location to reside either in the low, the moderate or the highly road connected districts.

Result of this research shall aid planning authority in detecting and finding solution to the problems associated with physical road network in Abuja city.

Findings of this study will also assist planning authority and administrators to know the performance of road connectivity in promoting societal liveability and quality of life.

In view of the rising requirement for approaches to assess transport impact on societal well-being. The active model introduced in this research will be useful for transport planners and researchers as a significant and flexible technique for evaluating the influence of road network on societal living quality. The study shall as well serve a future reference for researchers on urban transportation and human society.

Finally, the outcome of this work will provide planners and policy- makers with adequate information on the factors to be noted in designing an integral approach for planning quality and aesthetic urban environment with sustainable road network that would enhance cultural, social and economic well-being of the urbanites.

## **1.9 Structure of Thesis**

This research is organized in six sections systematically outlined as follows: **Chapter 1** captures background of the study, research problem, research questions, aim and objectives, scope and limitation of the study, and research significance. Generally, it describes the concept and content of this research work.

**Chapter 2** comprises detail literature review on transport network and societal well-being models, evolution of road network, trends of urban road network, concept of road network connectivity, its measures and societal impact. It also highlights



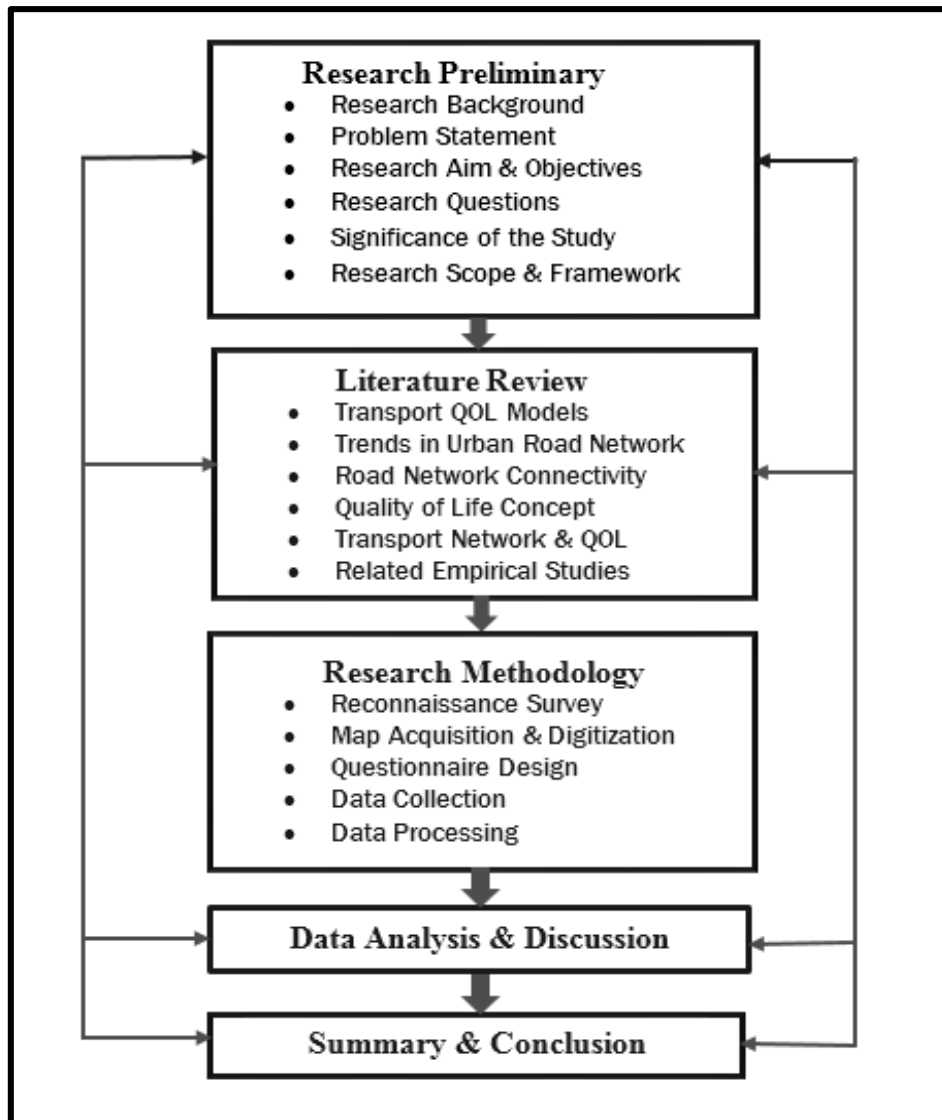
quality of life concept, its relationship with transportation network, quality of life indicators, and the related existing studies.

**Chapter 3** describes the physical and social characteristics of the study area. Additionally, it gives hint about urban form and land use pattern of the city. The existing transportation policy and transport network of Abuja city are other issues captured in this section.

**Chapter 4** presents the materials and methods used in achieving objectives of the study. It explains the types of data collected, data acquisition and processing methods. It further covers road network analysis, population sampling strategy, questionnaire administration, statistical test and structural equation modelling procedures.

**Chapter 5** consists of the data analysis and results discussion. The collected data were analysed and interpreted based on the research objectives as follows: analysis of spatial pattern of road network connectivity, components of road connectivity and quality of life indicators, impact of road connectivity on quality of life, and comparison of quality of life between different road connectivity districts.

**Chapter 6** concludes the entire research work. This constitutes the overall summary of the thesis, discussion of findings based on the research questions, conclusion and suggested future research areas in the field of study are highlighted. Graphical description of the thesis details is presented in research design (Figure 1.1).



**Figure 1.1:** Research Design

## REFERENCES

- AAM, (2012, August 30). Road Transportation – A History and How We Use it Today. *American Auto Move News Paper*. Retrieved on April 12, 2015 from <http://www.americanautomove.com>.
- Austin, (2015, September 16). *AARP: Livable Communities Solutions Forum*. *ULI Minnesota News*. Retrieved on June 15th, 2017 from <https://minnesota.uli.org>.
- Abdel-Aty, M., Pande, A., Das, A. & Knibbe, W. (2008). Assessing Safety on Dutch Freeways with Data from Infrastructure-based Intelligent Transportation Systems. *Transportation Research Record: Journal of the Transportation Research Board*, 153-161.
- Abreha (2007). Analysing Public Transport Performance Using Efficiency Measures and Spatial Analysis; The Case of Adis Ababa, Ethiopia. [https://webapps.itc.utwente.nl/librarywww/papers\\_2007/msc/upla/abreha.pdf](https://webapps.itc.utwente.nl/librarywww/papers_2007/msc/upla/abreha.pdf).
- Abubakar, I. R. (2014). Abuja City Profile. *Cities*, 41, 81-91.
- Abuja, (2012). *Abuja Word Document*. Retrieved from <https://wwejohncenaonlinebooks.files.wordpress.com/2012/02/abuja-word.docx>.
- Abujacity.com (2017, April 10). *Abuja City and Beyond*. Retrieved on May 20, 2017 from Abuja City Communication. <http://abujacity.com>.
- ACEA, (2005). *Tax Guide*. European Automobile Manufacturers' Association (ACEA). Retrieved on January 18th, 2015 from <http://www.acea.be/>.
- Adams, M. A., Ryan, S., Kerr, J., Sallis, J. F., Patrick, K., Frank, L. D. & Norman, G. J. (2009). Validation of the Neighborhood Environment Walkability Scale (NEWS) Items Using Geographic Information Systems. *Journal of Physical Activity and Health*, 6, S113-S123.
- Adeniyi, A. (2014). Graph Measurement of Road Network Connectivity & Accessibility on Farming Activities in Akoko South-West Local Government Area of Ondo State, Nigeria. *International Journal of Innovation and Applied Studies*, 9, 1258.

- Adolphe, L. (2001). A Simplified Model of Urban Morphology: Application of An Analysis of the Environmental Performance of Cities. *Environment and Planning B 2001 Journals*. sagepub.com
- Affenzeller, J. (2017). ERTRAC: The European Road Transport Research Advisory Council. In *Automated Driving 2017* (pp. 607-610). Springer, Cham.
- Alba, C. A., & Beimborn, E. (2005). Analysis of the Effects of Local Street Connectivity on Arterial Traffic. In *Transportation Research Board Annual Meeting*.
- Albemarle (Producer). (2015, November 5th, 2017). *Neighborhood Model Design Approach for Principle*. Retrieved from <https://www.albemarle.org>.
- Allen, M. (2017). *The SAGE Encyclopedia of Communication Research Methods* (Vol. 2, pp. 957-960) Thousand Oaks, California: Sage Publications.
- Andalucia, J. E. A. (2000). Socio-Economic Benefits of the A92 Motorway in Spain. In *IRF (2007) The Socio-Economic Benefits of Roads in Europe*. November 2007 IRF Research Report. <http://www.aecarretera.com>.
- Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D. & Cochran, J. J. (2014). *Statistics for Business & Economics*, Revised Edition (11th ed.) South Western Cengage, LearningTM.
- Anderson, W. P., Kanaroglou, P. S., & Miller, E. J. (1996). Urban Form, Energy and the Environment: A Review of Issues, Evidence and Policy. *Urban Studies*, 33(1), 7-35.
- Andrews, F. M. & Withey, S. B. (2012). *Social Indicators of Well-being: Americans' Perceptions of Life Quality*. Springer Science & Business Media, eBook, P82.
- Apparicio, P., Seguin, A.-M. & Naud, D. (2008). The Quality of the Urban Environment Around Public Housing Buildings in Montréal: An Objective Approach-based on GIS and Multivariate Statistical Analysis. *Social Indicators Research*, 86, 355-380.
- Arasu, A., Cherniack, M., Galvez, E., Maier, D., Maskey, A. S., Ryvkina, E., ... & Tibbetts, R. (2004, August). Linear Road: A Stream Data Management Benchmark. In *Proceedings of the Thirtieth International Conference on Very Large Data Bases*-Volume 30 (pp. 480-491). VLDB Endowment.
- Armitage, R. (2011). The Impact of Connectivity and Through-Movement within

- Residential Developments on Levels of Crime and Anti-social Behaviour*. University of Huddersfield, Huddersfield. (Unpublished) <http://eprints.hud.ac.uk/id/eprint/13592/1/Briefing>.
- Arnold Jr, C. L., & Gibbons, C. J. (1996). Impervious Surface Coverage: The Emergence of a Key Environmental Indicator. *Journal of the American Planning Association*, 62(2), 243-258.
- Arian, M., Campbell, M. J., Cooper, C. L., & Lancaster, G. A. (2010). What is a Pilot or Feasibility Study? A Review of Current Practice and Editorial Policy. *BMC Medical Research Methodology*, 10(1), 67.
- Artimy, M. M., Robertson, W. & Phillips, W. J. (2004). Connectivity in Inter-vehicle Ad-hoc Networks. *Electrical and Computer Engineering, 2004. Canadian Conference on*, 2004. IEEE, 293-298.
- Asher & Novosad, (2018). Rural Roads and Local Economic Development. *World Bank Policy Research Working Paper* 8466. <https://openknowledge.worldbank.org/bitstream/handle/10986/29895/WPS8466.pdf?sequence=1>.
- Attane, M., Jose, P. & Aniceto, Z. (2009). *ERF's Position on the Socio-economic Benefits of Roads to Society*. European Union Road Federation (ERF) Publications. Retrieved on January 18, 2015 from <http://www.irfnet.eu>
- Auge, M. (2008). *Non-Places: An Introduction to Supermodernity*, 1995 Trans. John Howe, London and New York: Verso.
- Auld, C. J. & Case, A. J. (1997). Social Exchange Processes in Leisure and Non-leisure Settings: A Review and Exploratory Investigation. *Journal of Leisure Research*, 29, 183.
- Ayachi, F., Dorey, J. & Guastavino, C. (2015). Identifying Factors of Bicycle Comfort: An Online Survey with Enthusiast Cyclists. *Applied Ergonomics*, 46, 124-136.
- Baileson, J. N., Shum, M. S. & Uttal, D. H. (1998). Road Climbing: Principles Governing Asymmetric Route Choices on Maps. *Journal of Environmental Psychology*, 18, 251-264.
- Banister, D. (2002). *Transport Policy and the Environment*. London: Routledge.
- Banister, D. (2008). The Sustainable Mobility Paradigm. *Transport Policy*, 15, 73-80.
- Bannister, D. & Berechman, Y. (2001). Transport Investment and the Promotion of Economic Growth. *Journal of Transport Geography*, 9, 209-218.

- Bannister, D. & Bowling, A. (2004). Quality of Life for the Elderly: The Transport Dimension. *Transport policy*, 11, 105-115.
- Barabasi, A.-L. (2002). *Linked: The New Science of Networks*. Cambridge: MA, Perseus Publication.
- Bashir, A., Yelwa, S. A. & Mariya, L. (2012). Spatio-Temporal Analysis of Roads Connectivity and Accessibility Pattern: A Case Study of North-Eastern Nigeria. *Pakistan Journal of Social Sciences* 9, 79-88.
- Bartlett, R (2013). GTA-303 Road Classification - Some Current Examples. Series 3-Discussion Papers. *Global Transport Atlas*. Retrieved on October 23rd, 2018 from <https://www.researchgate.net/publication/236522667>.
- Bawa-Cavia, A. (2010). Sensing the Urban. Using Location-based Social Network Data in Urban Analysis. *1st Workshop on Pervasive Urban Applications (PURBA)* San Francisco.
- Beatty, P. C. & Willis, G. B. (2007). Research Synthesis: The Practice of Cognitive Interviewing. *Public Opinion Quarterly*, 71, 287-311.
- Bedogni, L., Gramaglia, M., Vesco, A., Fiore, M., Harri, J. & Ferrero, F. (2015). The Bologna Ringway Dataset: Improving Road Network Conversion in SUMO and Validating Urban Mobility Via Navigation Services. *IEEE Transactions on Vehicular Technology*, 64, 5464-5476.
- Bell, M. G. & Iida, Y. (1997). *Transportation Network Analysis*. <https://books.google.com.my>.
- Bentler, P. M. (1990). Comparative Fit Indexes in Structural Models. *Psychological Bulletin*, 107, 238.
- Bentler, P. M. & Bonett, D. G. (1980). Significance Tests and Goodness of Fit in the Analysis of Covariance Structures. *Psychological Bulletin*, 88, 588.
- Berdica, K. (2002). An Introduction to Road Vulnerability: What Has Been Done, Is Done and Should be Done. *Transport Policy*, 9, 117-127.
- Bergstad, C. J., Gamble, A., Hagman, O., Polk, M., Garling, T., Ettema, D., Friman, M., Olsson, L.E., (2011a). Influences of Affect Associated with Routine Out-of-Home Activities on Subjective Well-Being. *Applied Research in Quality of Life*, 1-14.
- Bergstad, C. J., Gamble, A., Garling, T., Hagman, O., Polk, M., Ettema, D., Friman, M. & Olsson, L. E. (2011b). Subjective Wellbeing-related to Satisfaction with Daily Travel. *Transportation*, 38, 1-15.

- Berrigan, D., Pickle, L. W. & Dill, J. (2010). Associations Between Street Connectivity and Active Transportation. *International Journal of Health Geographics*, 9, 20.
- Beuran, M., Gachassin, M. G., Raballand, G. (2013). *Are There Myths on Road Impact and Transport in Sub-Saharan Africa?*. HAL Id: halshs-00830006. Retrieved on October 22nd, 2018 from <https://halshs.archives-ouvertes.fr/halshs/>.
- Bhat, C. R. (2000). Development of an Urban Accessibility Index: Literature Review, Center for Transportation Research. University of Texas at Austin.
- Bhattacharjee, A. (2012). Social Science Research: Principles, Methods, and Practices.
- Blaikie, N. (2003). Analyzing Quantitative Data: From Description to Explanation. Sage Publications.
- Blair, N., Hine, J., & Bukhari, S. M. A. (2013). Analysing the Impact of Network Change on Transport Disadvantage: a GIS-based Case Study of Belfast. *Journal of Transport Geography*, 31, 192-200.
- Bogale, Y. A. (2012). *Evaluating Transport Network Structure: A Case Study in Addis Ababa, Ethiopia*. Master Degree M.Sc Thesis, University of Twente, The Netherlands.
- Bollen, K. A. (1989). A New Incremental Fit Index for General Structural Equation Models. *Sociological Methods & Research*, 17, 303-316.
- Boonekamp, T. & Burghouwt, G. (2017). Measuring Connectivity in the Air Freight Industry. *Journal of Air Transport Management*, 61, 81-94.
- Bornasal, F. B. (2012). *Transportation Network Connectivity*. Facilities Encouraging Walkability, and Crime.
- Borruso, G. (2003). Network Density and the Delineation of Urban Areas. *Journal of Transaction in GIS* Vol. 7,, 177-199.
- Bovy, P. H. (2009). On Modelling Route Choice Sets in Transportation Networks: A Synthesis. *Transport Reviews*, 29, 43-68.
- Bovy, P. H. & Bradley, M. A. (1985). Route Choice Analyzed with Stated-Preference Approaches.
- Bowen, P., Rose, R. & Pilkington, A. (2017). Mixed Methods-Theory and Practice. Sequential, Explanatory Approach. *International Journal of Quantitative and Qualitative Research Methods*, 5, 10-27.
- Bozovic, T. (2017). Reducing Barriers to Walking in a Car-focused Environment: The Potential for Inclusion, and a Pragmatic Way Forward for Hamilton, New

- Zealand (Breakout Presentation). *Journal of Transport & Health*. 2017 Dec 31;7:S47-8.
- Brereton, F., Clinch, J. P. & Ferreira, S. (2008). Happiness, Geography and the Environment. *Ecological Economics*, 65, 386-396.
- Brown, O. (2015). Sharing Cars: The Future of Road Transport. *Solution Online Journal* 6, 25-29.
- Browne, M. W. & Cudeck, R. (1993). Alternative Ways of Assessing Model Fit. *Sage Focus Editions*, 154, 136-136.
- Bryceson, D., Davis, A., Ahmed, F. & Bradbury, T. (2004). Framework for the Inclusion of Social Benefits in Transport Planning: Final Report. *Transport Research Laboratory*, Crowthorne.
- Bullmore, E. & Sporns, O. (2009). Complex Brain Networks: Graph Theoretical Analysis of Structural and Functional Systems. *Nature Reviews. Neuroscience*, 10, 186.
- Burckhardt, L. & Ritter, M. (2006). Warum Ist Landschaft Schön. Die Spaziergangswissenschaft. Berlin.
- Caltrans (2006). Performance Measures for Rural Transportation Systems GUIDEBOOK.
- Campbell, A., Converse, P. E. & Rodgers, W. L. (1976). *The Quality of American Life: Perceptions, Evaluations, and Satisfaction*. Russell, Sage Foundation.
- Carruthers, R. E. A. E. (2009). *Improving Connectivity: Investing in Transport Infrastructure in Sub-Saharan Africa*. AICD (Africa Infrastructure Country Diagnostic). Washington DC: World Bank Publication.
- Carse, A. T. (2010). Development of an Alternative Transport Appraisal Technique: the Transport Quality of Life Model. Doctoral Dissertation, University of Glasgow.
- Carse, A. T. (2011). Assessment of Transport Quality of Life as an Alternative Transport Appraisal Technique. *Journal of Transport Geography*, 19, 1037-1045.
- Celik, V. & Yesilyurt, E. (2013). Attitudes to Technology, Perceived Computer Self-efficacy and Computer Anxiety as Predictors of Computer Supported Education. *Computers & Education*, 60, 148-158.



- Chandra, S. & Quadrifoglio, L. (2013). A New Street Connectivity Indicator to Predict Performance for Feeder Transit Services. *Transportation Research Part C: Emerging Technologies*, 30, 67-80.
- Chang, M. T. (2012). Final Project Network Analysis of Urban Street Patterns. In: 1.204 (ed.).
- Chen, A., Yang, H., Lo, H. K. & Tang, W. H. (1999). A Capacity-related Reliability for Transportation Networks. *Journal of Advanced Transportation*, 33, 183-200.
- Chen, A., Yang, H., Lo, H. K. & Tang, W. H. (2002). Capacity Reliability of a Road Network: An Assessment Methodology and Numerical Results. *Transportation Research Part B: Methodological*, 36, 225-252.
- Chen, Y. (2016). Investigating the Influences of Tree Coverage and Road Network Density on Property Crime: A Case Study in the City of Vancouver. British Columbia, Canada. University of Waterloo.
- Cheng, L. & Panichpapiboon, S. (2012). Effects of Intervehicle Spacing Distributions on Connectivity of VANET: A Case Study from Measured Highway Traffic. *IEEE Communications Magazine*, 50, 90-97.
- Choi, M. & Lee, H.-Y. (1995). Traffic Flow and 1/f Fluctuations. *Physical Review E*, 52, 5979.
- Chong, E. E., Nazim, A. & Ahmad, S. B. (2014). A Comparison Between Individual Confirmatory Factor Analysis and Pooled Confirmatory Factor Analysis: An Analysis of Library Service Quality: A Case Study at a Public University in Terengganu. *International Journal of Engineering Science and Innovative Technology*, 3, 110-116.
- Chou, J.-S. & Yang, J.-G. (2013). Evolutionary Optimization of Model Specification Searches Between Project Management Knowledge and Construction Engineering Performance. *Expert Systems with Applications*, 40, 4414-4426.
- Christian, H., et al., (2015). The Influence of the Neighborhood Physical Environment on Early Child Health and Development: A Review and Call for Research. *Health & Place*, 33, pp.25-36.
- Cirillo, M. Â. & Barroso, L. P. 2017. Effect of Outliers on the GFI Quality Adjustment Index in Structural Equation Model and Proposal of Alternative Indices. *Communications in Statistics-Simulation and Computation*, 46, 1895-1905.

- Clement, S., Vogiatzis, N., Daniel, M., Wilson, S. & Clegg, R. (2000). Road Networks of the Future: Can Data Networks Help? *28th Australasian Transport Research Forum*, 2000.
- Coffin, A. W. (2009). Road Network Development and Landscape Dynamics in the Santa Fe River Watershed, North-Central Florida, 1975 to 2005. Doctoral Dissertation, University of Florida.
- Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Hillsdale, NJ: Lawrence Earlbaum Associates, 20-26.
- Collins (2018). *English Dictionary*. Webster's New World College Dictionary, Online.
- Cooper, D. R., & Schindler, P. S. (2011). *Business Research Methods*. New York. McGraw-Hill Higher Education.
- Cornelia, Butler Flora., Jan, L. Flora., Stephen, P., & Gasteyer, Chartres Refresh 8 (1989, Spring). Road Transport and Economic Growth in the 18th Century. Printed by William Sessions Limited. York, England, The Ebor Press.
- Costanza, R., Fisher, B., Ali, S., Beer, C., Bond, L., Boumans, R., Danigelis, N. L., Dickson, J., Elliott, C. & Farley, J. (2007). Quality of life: An Approach Integrating Opportunities, Human Needs, and Subjective Well-being. *Ecological Economics*, 61, 267-276.
- Costanza, R., Fisher, B., Ali, S., Beer, C., Bond, L., Boumans, R., Danigelis, N. L., Dickson, J., Elliott, C. & Farley, J. (2008). *An Integrative Approach to Quality of Life Measurement, Research, and Policy*. SAPI EN. S. Surveys and Perspectives Integrating Environment and Society.
- Coubergs, C., Struyven, K., Vanthournout, G. & Engels, N. (2017). Measuring Teachers' Perceptions about Differentiated Instruction: The DI-Quest Instrument and Model. *Studies in Educational Evaluation*, 53, 41-54.
- Creswell, J. W. (2013). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage Publications.
- Creswell, J. W. & Poth, C. N. (2017). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. Sage Publications.
- Crucitti, P., Latora, V. & Porta, S. (2006). Centrality Measures in Spatial Networks of Urban Streets. *Physical Review E*, 73, 036125.
- Cruise, S. M., Hunter, R. F., Kee, F., Donnelly, M., Ellis, G. & Tully, M. A. (2017). A Comparison of Road and Footpath-based Walkability Indices and Their Associations with Active Travel. *Journal of Transport & Health*.

- CTAA (2012). *Employment Transportation Fundamentals*.
- Cummins & Gullone (2000). Why We Should Not Use 5-Point Likert Scales: The case for subjective quality of life measurement. *Proceedings, Second International Conference on Quality of Life in Cities* (pp.74-93). Singapore: National University of Singapore.
- Currie, G. & Delbosc, A. (2010). Modelling the Social and Psychological Impacts of Transport Disadvantage. *Transportation*, 37, 953-966.
- Daganzo, C. F. (2010). Structure of Competitive Transit Networks. *Transportation Research Part B: Methodological* 44, 434–446.
- Darvish, M., Yasaei, M. & Saeedi, A. (2009). Application of the Graph Theory and Matrix Methods to Contractor Ranking. *International Journal of Project Management*, 27, 610-619.
- Das, D. (2008). Urban Quality of Life: A Case Study of Guwahati. *Social Indicators Research*, 88, 297-310.
- Davies, T. & Johnson, S. D. (2015). Examining the Relationship Between Road Structure and Burglary Risk Via Quantitative Network Analysis. *Journal of Quantitative Criminology*, 31, 481-507.
- Dawan, P. (2000). *Geography of Abuja-Federal Capital Territory*. Minna, Famous Asaaly Press.
- Dawes (2007). Do Data Characteristics Change According to the Number of Scale Points Used? An Experiment Using 5-Point, 7-Point and 10-Point Scales. *International Journal of Market Research*, Vol. 50 Issue 1.
- De-Groot, J. & Steg, L. (2006). Impact of Transport Pricing on Quality of Life, Acceptability, and Intentions to Reduce Car Use: An Exploratory Study in Five European Countries. *Journal of Transport Geography*, 14, 463-470.
- De Klerk L. A. (1980). *Op Zoek Naar De Ideale Stad (In Search of the Ideal City)*. Van Loghum Slaterus, Deventer.
- Delbosc, A., & Currie, G. (2011b). The Spatial Tontext of Transport Disadvantage, Social Exclusion and Well-being. *Journal of Transport Geography*, 19(6), 1130-1137.
- Delbosc, A., & Currie, G. (2011c). Exploring the Relative Influences of Transport Disadvantage and Social Exclusion on Well-being. *Transport Policy*, 18(4), 555-562.

- Delbosc, A. (2012). The Role of Well-being in Transport Policy. *Transport Policy*, 23, 25-33.
- Deluka-Tibljias, A., Karleusa, B. & Dragicevic, N. (2013). Review of Multicriteria-Analysis Methods Application in Decision-making about Transport Infrastructure. *Gradevinar*, 65, 619-631.
- Deng, L. & Yuen, A. H. (2011). Towards a Framework for Educational Affordances of Blogs. *Computers & Education*, 56, 441-451.
- Desai, S. & Peerbhay, K. (2016). Assessing the Conditions of Rural Road Networks in South Africa Using Visual Observations and Field-based Manual Measurements: A Case Study of Four Rural Communities in Kwa-Zulu Natal. *Review of Social Sciences*, 1, 42-55.
- Devellis, R. F. (2016). *Scale Development: Theory and Applications*. Sage Publications.
- Devi, S. & Neetha, T. (2017). Machine Learning-based Traffic Congestion Prediction in a IoT-based Smart City.
- Diener, E., Emmons, R. A., Larsen, R. J. & Griffin, S. (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment*, 49, 71-75.
- Diener, E. & Lucas, R. E. (1999). 11 Personality and Subjective Well-being. *Well-being: Foundations of Hedonic Psychology*.
- Diener, E. & Suh, E. (1997). Measuring Quality of Life: Economic, Social, and Subjective Indicators. *Social Indicators Research*, 40, 189-216.
- Directorate, D. S., Statistics, I. M. F. B. O., Statistics, I. L. O. B. O. & Committee, C. O. I. S. S. 2002. *Measuring the Non-observed Economy: A Handbook*. Lippincott Williams & Wilkins.
- Dixon, W. J. & Tukey, J. W. (1968). Approximate Behavior of the Distribution of Winsorized t (Trimming/Winsorization 2). *Technometrics*, 10, 83-98.
- Dixon, W. J. & Yuen, K. K. (1974). Trimming and Winsorization: A Review. *Statistische Hefte*, 15, 157-170.
- Doi, K., Kii, M. & Nakanishi, H. (2008). An Integrated Evaluation Method of Accessibility, Quality of Life, and Social Interaction. *Environment and Planning B: Planning and Design*, 35, 1098-1116.
- Dolan, P., Peasgood, T. & White, M. (2006). *Review of Research on the Influences on Personal Well-being and Application to Policy Making*. London, DEFRA. Retrieved on August 25th 2017 from <http://www.defra.gov>.

- uk/science/project\_data/DocumentLibrary/SD12005/SD12005\_4017\_FRP.pdf.
- Dolma, S. (2010). The Central Role of the Unit of Analysis Concept in Research Design. *Istanbul University Journal of the School of Business*, 39, 169-174.
- Donovan, S., & Munro, I. (2013). Impact of Urban Form on Transport and Economic Outcomes. *NZ Transport Agency Research Report 513*. pp74.
- Dorosh, P., Wang, H. G., You, L. & Schmidt, E. (2012). Road Connectivity, Population, and Crop Production in Sub-Saharan Africa. *Agricultural Economics*, 43, 89-103.
- Dratva, J., Zemp, E., Dietrich, D. F., Bridevaux, P.-O., Rochat, T., Schindler, C. & Gerbase, M. W. (2010). Impact of Road Traffic Noise Annoyance on Health-related Quality of Life: Results from a Population-based Study. *Quality of Life Research*, 19, 37-46.
- Drost, E. A. (2011). Validity and Reliability in Social Science Research. *Education Research and Perspectives*, 38, 105.
- Dubois, D. & Prade, H. (1992). *Putting Rough Sets and Fuzzy Sets Together*. Intelligent Decision Support. Springer.
- Dugundji, E., Paez, A. & Arentze, T. (2008). *Social Networks, Choices, Mobility, and Travel*. UK: London, England, Sage Publication.
- Dutta, B. & Jackson, M. O. (2001). On the Formation of Networks and Groups: Draft Forthcoming in the Models of the Strategic Formation of Networks and Groups. Heidelberg: Springer Verlag.
- Eddington, R. (2006). *The Eddington Transport Study-The Case for Action-Sir*. Rod Eddington's Advice to Government-December 2006.
- Ejifor, C. (2013). *Blooming Night Markets in Abuja*. Entertaimant Naij.com, 2013.
- Ekstrom, A. & Williamson, M. (1971). Transportation and Urbanization. *Urban and Regional Planning*, No. 3, PP. 37-46.
- El-Din, H.S., Shalaby, A., Farouh, H.E. & Elariane, S.A. (2013). Principles of Urban Quality of Life for a Neighborhood. *HBRC Journal*, 9(1), pp.86-92.
- EL-Geneidy, A. M., Leninson, D. M. & Country, H. (2006). Access to Destinations: Development of Accessibility Measures. *Citeseer*.
- Ellder, E. (2014). Residential Location and Daily Travel Distances: The Influence of Trip Purpose. *Journal of Transport Geography*, 34, 121-130.

- Erath, A., Lochl, M. & Axhausen, K. (2009). Graph-Theoretical Analysis of the Swiss Road and Railway Networks over Time. *Networks and Spatial Economics* 9, 379–400.
- ESCAP (2009). Enhancing the Policy Impact of Transport Investment Analysis (E/ESCAP/FAMT/SG O/3). Background Paper for the Forum of Asian Ministers of Transport, ESCAP, Bangkok. Retrieved on June 29th, 2017 from [www.unescap.org/ttdw/FAMT/FAMT1/Documents/English/FAMT\\_SG\\_O\\_3E.pdf](http://www.unescap.org/ttdw/FAMT/FAMT1/Documents/English/FAMT_SG_O_3E.pdf).
- Estlander, K., (2015). *Assessment of Welfare Impacts in Transport System Planning*. Thesis for the Degree of Doctor of Science in Technology, Aalto University.
- Evans, A. N. (2013). *Using Basic Statistics in the Behavioral and Social Sciences*. Sage Publications.
- Ewing, R. & Cervero, R. (2010). Travel and the Built Environment: A Meta-analysis. *Journal of the American Planning Association*, 76, 265-294.
- Farinmade, A. Soyinka, O. Siu, K.W. (2018). Assessing the Effect of Urban Informal Economic Activity on the Quality of the Built Environment for Sustainable Urban Development in Lagos, Nigeria. *Sustainable Cities and Society*. 2018 Aug 1;41:13-21.
- FCDA, (1979). The Master Plan for Abuja the New Federal Capital of Nigeria. In: Authority, F. C. D. A. F. C. T. (ed.). Lagos, Government Printing Office.
- FCTTS, (2010). Federal Capital Territory - Transport Secretariat White Paper on Land Transport Policy. In *SECRETARIAT, F. C. T.* (ed.). Abuja: Adam Smith International.
- Femi, S. A. G. (2012). Characterization of Current Transportation Challenges in the Federal Capital Territory, Nigeria. *Journal of Sustainable Development*, 5(12), 117.
- Feng, C.-M. & Hsieh, C.-H. (2009). Implications of Transport Diversity for Quality of Life. *Journal of Urban Planning and Development*, 135, 13-18.
- Feng, J. (2016). Mobility and Quality of Life of the Elderly in Urban China: The Role of Household Structure. *Mobility, Sociability and Well-being of Urban Living*. Springer.
- Florea, D., Covaciu, D. & Timar, J. (2016). Analysis of the Influence of One-Way Streets on the Urban Road Networks Connectivity. *International Congress of Automotive and Transport Engineering, 2016*. Springer, 653-667.

- Fonseca, A., Flintsch, G. W., Garvin, M. J., Sotelino, E. D. & Barkhi, R. (2007). Contemporary Network Theory: Concepts and Implications for Transportation Infrastructure Management. *Transportation Research Board, 86th Annual Meeting*, 2007.
- Forkenbrock, D. J. (1990). Putting Transportation and Economic Development into Perspective. Transportation and Economic Development. *Transportation and Economic Development*, 1990s November 5-8, 1989 1990 Williamsburg, Virginia, USA.
- Forkenbrock, D. J. (2004). Transportation Policy Strategies for Iowa to Advance the Quality of Life.
- Forkenbrock, D. J., Benschhoff, S. & Weisbrod, G. E. (2001). Assessing the Social and Economic Effects of Transportation Projects. *Transportation Research Board*.
- Forsyth, A., Oakes, J. M., Lee, B. & Schmitz, K. H. (2009). The Built Environment, Walking, and Physical Activity: Is the Environment more Important to Some People than Others? *Transportation Research Part D: Transport and Environment*, 14, 42-49.
- Francesca, C., Ana, L.-N., Jerome, M. & Frits, T. (2011). *Help Wanted? Providing and Paying for Long-term Care*. Health Policy Studies, OECD Publishing.
- Frank, L. & Kavage, S. (2009). A National Plan for Physical Activity: the Enabling Role of the Built Environment. *Journal of Physical Activity and Health*.
- Frank, L. D. (2000). Land Use and Transportation Interaction: Implications on Public Health and Quality of Life. *Journal of Planning Education and Research*, 20, 6-22.
- Frank, L. D., Sallis, J. F., Saelens, B. E., Leary, L., Cain, K., Conway, T. L. & Hess, P. M. (2010). The Development of a Walkability Index: Application to the Neighborhood Quality of Life Study. *British Journal of Sports Medicine*, 44, 924-933.
- Fresno (2014). *Urban Form, Land Use, and Design. General Plan*. Retrived on Octorber 28th, 2018 from <https://www.fresno.gov/darm/wp-content/uploads/sites/10/2016/11/GP3Urban Form.pdf>.
- Gabriel, Z. & Bowling, A. (2004). Quality of Life from the Perspectives of Older People. *Ageing & Society*, 24, 675-691.

- Gao, M., Ahern, J. & Koshland, C. P. (2016). Perceived Built Environment and Health-related Quality of Life in Four Types of Neighborhoods in Xi'an, China. *Health & Place*, 39, 110-115.
- Garcke, S. E. (1939). Comfort in Travel Section I: By Road. *Proceedings of the Institution of Automobile Engineers*, 33, 663-671.
- Garrison, W. L. (1960). Connectivity of the Interstate Highway System. *Papers in Regional Science*, 6, 121-137.
- Garrison, W. L. & Marble, D. F. (1961). *The Structure of Transportation Networks*. Evanston, IL: Transportation Center at Northwestern University.
- Gauthier, H. L. (1966). *Highway Development and Urban Growth in Sao Paulo, Brazil: A Network Analysis*. Ph.D. Thesis, Institute: Northwestern University. Retrieved from elibrary.ru.
- George, E. I. & McCulloch, R. E. (1993). Variable Selection Via Gibbs Sampling. *Journal of the American Statistical Association*, 88, 881-889.
- Gerard De Jong, R., Leeds, I., Daly, A., Europe, R., Pieters, M. & De Jong, G. (2005). The Logsum as an Evaluation Measure: Review of the Literature and New Results. *Paper Presented at the 45th Congress of the European Regional Science Association*, 2005. 27.
- Geurs, K., Wee, V. B., Annema, J. & Banister, D. (2013). Accessibility: Perspectives, Measures and Applications. *The Transport System and Transport Policy: An Introduction*. Edward Elgar, 207-226.
- Geurs, K. T., Van Wee, B. & Rietveld, P. (2006). Accessibility Appraisal of Integrated Land-use—Transport Strategies: Methodology and Case Study for the Netherlands Randstad Area. *Environment and Planning B: Planning and Design*, 33, 639-660.
- Ghorveh, G. M. (2017). Does Street Quality Affect Transit Users' Route Choice?
- Giacomin, D. J. & Levinson, D. M. (2015). Road Network Circuitry in Metropolitan Areas. *Environment and Planning B: Planning and Design*, 42, 1040-1053.
- Girling, C., & Kellett, R. (2005). *Skinny Streets and Green Neighborhoods: Design for Environment and Community*. Island Press.
- Giuliano, G. & Dargay, J. (2006). Car Ownership, Travel and Land Use: A Comparison of the US and Great Britain. *Transportation Research Part A: Policy and Practice*, 40, 106-124.



- Giusti, C., Lee, C., Lord, D. & Wieters, M. (2008). Transportation Infrastructure and Quality of Life for Disadvantage Populations: A Pilot Study of El Cenizo Colonia in Texas. *Research Report SWUTC/08/167162e1*. <http://swutc.tamu.edu/publications/technicalreports/167162-1.pdf> (Accessed 10.11. 09).
- GlobalSecurity (2016, December 12th, 2016). *Urban Environment*. Retrieved from [www.globalsecurity.org/militaarty/library/arm](http://www.globalsecurity.org/militaarty/library/arm).
- Goetzke, F., Gerike, R., Paez, A. & Dugundji, E. (2015). Social Interactions in Transportation: Analyzing Groups and Spatial Networks. *Transportation*, 42, 723-731.
- Gorter, C., Nijkamp, P. & Vork, R. (2000). Analysis of Travellers' Satisfaction with Transport Chains. *Transportation Planning and Technology*, 23, 237-258.
- Granovetter, M. (1983). The Strength of Weak Ties: A Network Theory Revisited. *Sociological Theory*, 1, 201-233.
- Gucuyener, A. (2014). *Transportation and Development Corridors*. Retrieved on January 29th, 2014 from Hazar/strateji Eastitusu
- GUK (2015). The Weighted Scoring Method.: Finance Resources and Templates for Economic Appraisal Guidance. Retrieved on August 15th, 2017 from. [Nibusinessinfo.co.uk](http://Nibusinessinfo.co.uk).
- Gupta, J., Pouw, N. R. & Ros-Tonen, M. A. (2015). Towards an Elaborated Theory of Inclusive Development. *The European Journal of Development Research*, 27, 541-559.
- Gutierrez, J., Monzon, A. & Pinero, J. (1998). Accessibility, Network Efficiency, and Transport Infrastructure Planning. *Environment and Planning A*, 30, 1337-1350.
- Hagerty, M. R., Cummins, R. A., Ferriss, A. L., Land, K., Michalos, A. C., Peterson, M., Sharpe, A., Sirgy, J. & Vogel, J. (2001). Quality of Life Indexes for National Policy: Review and Agenda for Research. *Social Indicators Research*, 55, 1-96.
- Haggett, P. & Chorley, R. J. (1969). *Network Analysis in Geography*. London, Edward Arnold London.
- Hair, J. F. (2007). *Research Methods for Business*. Retrieved from Digitalcommons. [www.http://kennesaw.edu](http://kennesaw.edu).
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E. & Tatham, R. L. (1998). *Multivariate Data Analysis*. Prentice Hall, Upper Saddle River, NJ.

- Hair, J. F., Ringle, C. M. & Sarstedt, M. (2011). PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing theory and Practice*, 19, 139-152.
- Hair, J. F., Sarstedt, M., Ringle, C. M. & Mena, J. A. (2012). An Assessment of the Use of Partial Least Squares Structural Equation Modeling in Marketing Research. *Journal of the Academy of Marketing Science*, 40, 414-433.
- Hajrasouliha, A. & Yin, L. (2014). The Impact of Street Network Connectivity on Pedestrian Volume. *Urban Studies Journal Limited*.
- Handy, S. L. (1996). Understanding the Link between Urban Form and Nonwork Travel Behaviour. *Journal of Planning Education and Research*, 15(3), 183-198.
- Handy, S., Paterson, R. G. & Butler, K. (2003). *Planning for Street Connectivity: Getting from Here to There* (No. PAS Report No.515). trid.trb.org.
- Handy, S., Tal, G. B. & G, D. M. (2010). *Draft Policy Brief on the Impacts of Network Connectivity Based on a Review of the Empirical Literature*. Air Resources Board. Retrieved on November 22nd, 2017 from [www.arb.ca.gov/cc/sb375/policies/connectivity/netconnectivity\\_brief.pdf](http://www.arb.ca.gov/cc/sb375/policies/connectivity/netconnectivity_brief.pdf).
- Hankey, S., Lindsey, G. & Marshall, J. D. (2017). Population-level Exposure to Particulate Air Pollution During Active Travel: Planning for Low-Exposure, Health-Promoting Cities. *Environmental Health Perspectives*, 125, 527.
- Hansen, W. G. (1959). How Accessibility Shapes Land Use. *Journal of the American Institute of Planners*, 25, 73-76.
- Hanson, S. (2010). Gender and Mobility: New Approaches for Informing Sustainability. *Gender, Place & Culture*, 17, 5-23.
- Hanson, S. & Huff, J. (1986). Classification Issues in the Analysis of Complex Travel Behavior. *Transportation*, 13, 271-293.
- Haringercorestrategy (2010). Environmental Factors: JSNA Environmental Section (Transport, Fuel Poverty, Green and Open Space, CO2 Emission and Fluvial Flood). Haringey.
- Harriet, T., Poku, K. & Emmanuel, A. K. (2013). An Assessment of Traffic Congestion and Its Effect on Productivity in Urban Ghana. *International Journal of Business and Social Science*, 4, 225-234.
- Hasan, M. M. & Kim, J. (2017). Granger Causality Method to Detect Spatial Dependency in a Road Traffic Network and its Application in Traffic Flow Prediction (No. 17-02706). trid.trb.org.

- Hawkins, C. (2007). Street Network Connectivity and Local Travel Behaviour: Assessing the Relationship of Travel Outcomes to Disparate Pedestrian and Vehicular Street Network Connectivity. University of British Columbia.
- Henderson, S. R. (2011). City Centre Retail Development in England: Land Assembly and Business Experiences of Area Change Processes. *Geoforum*, 42, 592-602.
- Henry, G. T. (1990). *Practical Sampling*. Sage.
- Hillman, M., Henderson, I. & Walley, A. (1973). *Personal Mobility and Transport Policy*, XXXIX. Retrieved on August 15th, 2017 from [http://www.psi.org.uk/images/uploads/Personal\\_Mobility\\_and\\_Transport\\_Policy.pdf](http://www.psi.org.uk/images/uploads/Personal_Mobility_and_Transport_Policy.pdf).
- Hjorthol, R. J., Levin, L. & Siren, A. (2010). Mobility in Different Generations of Older Persons: The Development of Daily Travel in Different Cohorts in Denmark, Norway and Sweden. *Journal of Transport Geography*, 18, 624-633.
- Ho, R. (2006). Handbook of Univariate and Multivariate Data Analysis and Interpretation with SPSS. CRC Press.
- Hoelter, J. W. (1983). The Analysis of Covariance Structures: Goodness-of-fit Indices. *Sociological Methods & Research*, 11, 325-344.
- Hoffmann-Axthelm, D. (1993). *Die Dritte Stadt*. Frankfurt/M, 133ff-179.
- Holzapfel, H. (2015). Urbanism and Transport: Building Blocks for Architects and City and Transport Planners. London and New York: Routledge.
- Hongwei, M. & Xizhao, Z. (2015). An Evaluation Method for the Connectivity Reliability Based on the Transportation Network of Critical Links. *International Journal of Transportation*, 3.
- Hopkins, M. (1987). Network Analysis of the Plans of Some Teotihuacán Apartment Compounds. *Environment and Planning B: Planning and Design*, 14, 387-406.
- Hou, N., Popkin, B. M., Jacobs, D. R., Song, Y., Guilkey, D., Lewis, C. E. & Gordon-Larsen, P. (2010). Longitudinal Associations Between Neighborhood-level Street Network with Walking, Bicycling, and Jogging: The CARDIA Study. *Health & Place*, 16, 1206-1215.
- Howard, C. & Burns, E. (2001). Cycling to Work in Phoenix: Route Choice, Travel Behavior, and Commuter Characteristics. Transportation Research Record: *Journal of the Transportation Research Board*, 39-46.

- Hoyer, K. G. (1999). *Sustainable Mobility: the Concept and its Implications*. Doctor of Philosophy Thesis, Institute of Environment, Technology and Society, Roskilde University Centre.
- Hsu, A.-L., Feng, Z., Hsieh, M.-Y. & Xu, X. S. (2009). Identification by Machine Vision of the Rate of Motor Activity Decline as a Lifespan Predictor in *C. Elegans*. *Neurobiology of Aging*, 30, 1498-1503.
- Huang, A., Gallegos, L. & Lerman, K. (2017). Travel Analytics: Understanding How Destination Choice and Business Clusters are Connected Based on Social Media Data. *Transportation Research Part C: Emerging Technologies*, 77, 245-256.
- Huang, A. & Lenvinson, D. (2012). Accessibility, Network Structure, and Consumers' Destination Choice: a GIS Analysis of GPS Travel Data. *Proceedings of the 91st Annual Meeting of the Transportation Research Board*. Transportation Research Board of the National Academies, Washington, DC, 2012.
- Huber, D. (2009). *Exploratory Factor Analysis*. The COE Faculty Research Centre Modified and Updated for EPS 624/725 by: Horn, R. A. & Martin, W. (sp.08). Available at: <http://>.
- Huppert, F. A. & So, T. T. (2013). Flourishing Across Europe: Application of a New Conceptual Framework for Defining Well-being. *Social Indicators Research*, 110, 837-861.
- Ibrahim, M. F. & Chung, S. W. (2003). Quality of Life of Residents Living Near Industrial Estates in Singapore. *Social Indicators Research*, 61, 203-225.
- Ifegunni, J. (2015, December 7). *5 Major Markets in Abuja*. Retrieved on December 20th 2017 from <https://hotels.ng/travel/5-major-markets-in-abuja/>.
- Iida, Y. (1999). Basic Concepts and Future Directions of Road Network Reliability Analysis. *Journal of Advanced Transportation*, 33, 125-134.
- Internationalwellbeinggroup (2006). *Personal Wellbeing Index (Manual)*. Melbourne: Deakin University.
- Islam, M. (2008). District Balkh Roads Socio-Economic Impact Assessment in Afghanistan. B DISTRICT - 2008 - pdf.usaid.gov.
- Isoriate (2005). Evaluating Efficiency & Effectiveness in Transport Organization. *Transport – 2005*, XX, No 6, 240 – 247.

- Istock (2017). *Scottsdale Phoenix Arizona Suburb Housing Developemnt Neighbourhood*. Retrieved on May 2nd 2018 from <https://www.istockphoto.com>.
- ITE (2003). *Smart Growth Transportation Guidelines: An ITE Recommended Practice*. Institute of Transportation Engineers.
- ITE (2006). *Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*. ITE Proposed Recommended Practice.
- Jabareen, T. R. (2006). Sustainable Urban Forms: Topologies, Models and Concepts.
- Jackson, D. L. (2003). Revisiting Sample Size and Number of Parameter Estimates: Some Support for the N: Q Hypothesis. *Structural Equation Modeling*, 10, 128-141.
- Jackson, M. O. & Wolinsky, A. (1996). A Strategic Model of Social and Economic Networks. *Journal of Economic Theory*, 71, 44-74.
- Janssen, S.T.M.C. (1994). Road Classification and Categorization. ANNEX I, Safety Effects of Road Design Standards R-94-7. SWOV Institute for Road Safety Research, The Netherlands.
- Jayasinghe, A. & Munasinghe, J. (2013). A Study of the Urbanizing Pattern in Kegalle District, Sri Lanka with Connectivity Analysis. *International Journal*, 2, 2305-1493.
- Jiménez-Espada, M. & González-Escobar, R. (2016). Comments and Suggestions for Improvement of Mobility and Road Safety in the City of Cáceres. *Procedia Engineering*, 161, pp.1385-1390.
- Jenelius, E. (2009). Network Structure and Travel Patterns: Explaining the Geographical Disparities of Road Network Vulnerability. *Journal of Transport Geography*, 17, 234-244.
- Jenks, M., Kozak, D. & Takkanon, P. (2013). *World Cities and Urban Form: Fragmented, Polycentric, Sustainable?*. London and New York, Routledge.
- Jennings, B. M. & Krannich, R. S. (2013). A Multidimensional Exploration of the Foundations of Community Attachment Among Seasonal and Year-round Residents. *Rural Sociology*, 78, 498-527.
- Jensen, R. R. & Shumway, J. M. (2010). Sampling Out World. *Research Methods in Geography: A Critical Introduction*, 6, 77.
- Jolliffe, I. T. (1972). Discarding Variables in a Principal Component Analysis. I: Artificial Data. *Applied Statistics*, 160-173.

- Jolliffe, I. T. (2002). Principal Component Analysis and Factor Analysis. *Principal Component Analysis*, 150-166.
- Joreskog, K. G. & Sorbom, D. (1993). LISREL 8: Structural Equation Modeling with the SIMPLIS Command Language. Scientific Software International.
- JTLU (2011). *Line Structure Representation for Road Network Analysis*. <https://www.jtlu.org/index.php/jtlu/article/downloadSuppFile/744/240>.
- Judd, C. M. & Reis, H. T. (2014). Handbook of Research Methods in Social and Personality Psychology. Cambridge: University Press.
- Kaczynski, A. T., Koohsari, M. J., Stanis, S. A. W., Bergstrom, R. & Sugiyama, T. (2014). Association of Street Connectivity and Road Traffic Speed with Park Usage and Park-based Physical Activity. *American Journal of Health Promotion*, 28, 197-203.
- Kaewklungklom, R. Satiennam, W. Jaensirisak, S. Satiennam, T. (2017). Influence of Psychological Factors on Mode Choice Behaviour: Case Study of BRT in Khon Kaen City, Thailand. *Transportation Research Procedia*. 2017 Jan 1;25:5072-82.
- Kansky, K. & Danscoine, P. (1989). Measures of Network Structure. *Flux*, 5, 89-121.
- Kansky, K. J. (1963). Structure of Transportation Networks: Relationships Between Network Geometry and Regional Characteristics. Ph.D Dissertation, University of Chicago.
- Karou, S. & Hull, A. (2014). Accessibility Modelling: Predicting the Impact of Planned Transport Infrastructure on Accessibility Patterns in Edinburgh, UK. *Journal of Transport Geography*, 35, 1-11.
- Kartalopoulos, S. V. (2006). *Method and Circuit for Statistical Estimation*. Google Patents.
- Kentucky (2014). *Road Connectivity*. *Kentucky Transportation Cabinet*. An Official Website of the Commonwealth of Kentucky.
- Kenyon, S., Rafferty, J. & Lyons, G. (2003). Social Exclusion and Transport in the UK: a Role for Virtual Accessibility in the Alleviation of Mobility-related Social Exclusion? *Journal of Social Policy*, 32, 317-338.
- Kerner, B. S. (2009). Introduction to Modern Traffic Flow Theory and Control: The Long Road to Three-Phase Traffic Theory. Springer Science & Business Media.

- Kessides, C. (1993). *The Contributions of Infrastructure to Economic Development. A Review of Experience and Policy Implications*, World Bank Publications.
- Khumya, T. & Kusakabe, K. (2015). Road Development, and Changes in Livelihood and Mobility in Savannakhet, Lao PDR. *Development in Practice*, 25, 1011-1024.
- Kiel, J., Smith, R. & Ubbels, B. (2013). Review of Transport and Economic Models. *Deliverable 3.1 of the IC-EU Project*. Leuven: TML.
- Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling*. Guilford Publications.
- Knabe, A. P. (2012). *Applying Ajzen's Theory of Planned Behavior to a Study of Online Course Adoption in Public Relations Education*. Marquette University.
- Knuman, M. W., Christian, H. E., Divitini, M. L., Foster, S. A., Bull, F. C., Badland, H. M. & Giles-Corti, B. (2014). A Longitudinal Analysis of the Influence of the Neighborhood Built Environment on Walking for Transportation: the RESIDE Study. *American Journal of Epidemiology*, 180, 453-461.
- Koppelman, F. S. & Pas, E. I. (1983). *Travel-activity Behavior in Time and Space: Methods for Representation and Analysis*. School of Engineering, Duke University.
- Koulakezian, A. (2016). *Dynamic Route Guidance Algorithms for Robust Roadway Networks*. University of Toronto.
- Krathwohl, D. R. (2009). *Methods of Educational and Social Science Research: The Logic of Methods*. Waveland Press.
- Krejcie, R. V. & Morgan, D. W. (1970). Determining Sample Size for Research Activities. *Educational and Psychological Measurement*, 30, 607-610.
- Krysiak, J. & Finn, J. (2013). *Research for Effective Social Work Practice*. London and New York: Routledge.
- Kutter, E. (1974). Mobilität als Determinante Städtischer Lebensqualität. Beiträge zu Verkehr in Ballungsräumen. *Jahrestagung der DVWG in Köln*.
- Lachene, R. (1975). Networks and the Location of Economic Activities. *Papers of the Regional Science Association*.
- Laerd, S. (2013, December 21). *One-way ANOVA in SPSS*. Retrieved on November, 21th 2016 from <https://statistics.laerd.com/spss-tutorials/>.
- Larsen, R. J., Diener, E. & Emmons, R. A. (1985). An Evaluation of Subjective Well-being Measures. *Social Indicators Research*, 17, 1-17.

- Latham, B. (2007). *Sampling: What is it. Quantitative Research Methods*. Texas Tech University.
- Latora, V. & Marchiori, M. (2001). Efficient Behavior of Small-World Networks. *Physical Review Letters*, 87, 198701.
- Lay, M. G. (1992). *Ways of the World: A History of the World's Roads and of the Vehicles that Used Them*. Rutgers: University Press.
- Lazar, J., Feng, J. H. & Hochheiser, H. (2017). *Research Methods in Human-Computer Interaction*. Morgan Kaufmann.
- Lebo, J. & Schrling, D. (2001). Design and Appraisal of Rural Transport Infrastructure – Ensuring Basic Access for Rural Communities. *Technical Paper*. Washington, DC.: World Bank.
- Lee, K. J., Jang, H. I. & Choi, H. (2017). Korean Translation and Validation of the WHOQOL-DIS for People with Spinal Cord Injury and Stroke. *Disability and Health Journal*.
- Lee, R. J. & Sener, I. N. (2016). Transportation Planning and Quality of Life: Where Do They Intersect? *Transport Policy*, 48, 146-155.
- Lee, Y. J. (2008). Subjective Quality of Life Measurement in Taipei. *Building and Environment*, 43, 1205-1215.
- Lee, Y. (1998). Highway Network Connectivity, Traffic Flow Pattern, and Economic Development of China's Hainan Island. *Asian Geographer*, 17, 115-126.
- Lehigh-Valley-Planning-Commission (2011). *Street Connectivity: Improving the Function and Performance of Your Local Streets*. Pennsylvania Allentown.
- Leslie, E., Coffee, N., Frank, L., Owen, N., Bauman, A. & Hugo, G. (2007). Walkability of Local Communities: Using Geographic Information Systems to Objectively Assess Relevant Environmental Attributes. *Health & Place*, 13, 111-122.
- Leung, L. & Lee, P. S. (2005). Multiple Determinants of Life Quality: The Roles of Internet Activities, Use of New Media, Social Support, and Leisure Activities. *Telematics and Informatics*, 22, 161-180.
- Levine, J. & Garb, Y. (2002). Congestion Pricing's Conditional Promise: Promotion of Accessibility or Mobility? *Transport Policy*, 9, 179-188.
- Levinson, D. (2012). Network Structure and City Size. *PloS One*, 7, e29721.
- Levinson, D. M. & Huang, A. (2010). *A Positive Theory of Network Connectivity*. Available at SSRN 1736212.



- Leyden, K. M. (2003). Social Capital and the Built Environment: the Importance of Walkable Neighborhoods. *American Journal of Public Health*, 93, 1546-1551.
- Li, G. & Weng, Q. (2007). Measuring the Quality of Life in City of Indianapolis by Integration of Remote Sensing and Census Data. *International Journal of Remote Sensing*, 28, 249-267.
- Li, H., Graham, D. J. & Majumdar, A. (2015). Effects of Changes in Road Network Characteristics on Road Casualties: An Application of Full Bayes Models Using Panel Data. *Safety Science*, 72, 283-292.
- Li, S. (2017). Cycling in Toronto: Route Choice Behavior and Implications to Infrastructure Planning. University of Waterloo.
- Lighthill, M. J. & Whitham, G. B. (1955). On Kinematic Waves. II. A Theory of Traffic Flow on Long Crowded Roads. Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, 1955. *The Royal Society*, 317-345.
- Limi, A., You, L. & Wood-Sichra, U. (2017). Spatial Autocorrelation Panel Regression: Agricultural Production and Transport Connectivity.
- Lin, J. & Ban, Y. (2013). Complex Network Topology of Transportation Systems. *Transport Reviews*, 33, 658-685.
- Lindelow, D., Svensson, Å., Brundell-Freij, K. & Hiselius, L. W. (2017). Satisfaction or Compensation? The Interaction Between Walking Preferences and Neighbourhood Design. *Transportation Research Part D: Transport and Environment*, 50, 520-532.
- Liu, Y., Hyde, A. S., Simpson, M. A. & Barycki, J. J. (2014). Emerging Regulatory Paradigms in Glutathione Metabolism. *Advances in Cancer Research*, 122, 69.
- Lloyd, K. M. & Auld, C. J. (2002). The Role of Leisure in Determining Quality of Life: Issues of Content and Measurement. *Social Indicators Research*, 57, 43-71.
- Loksha & Mahesha (2016). Impact of Road Infrastructure on Agricultural Development and Rural Road Infrastructure Development Programmes in India. *International Journal of Humanities and Social Science Invention ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714.*
- Looker (2016). Making a Weighted Average Measure. Looker Discourse [Online]. Retrieved on August 5th 2017 from <https://discourse.looker.com/t/>.

- Lotfi, S. & Koohsari, M. J. (2009). Analyzing Accessibility Dimension of Urban Quality of Life: Where Urban Designers Face Duality Between Subjective and Objective Reading of Place. *Social Indicators Research*, 94, 417-435.
- Lowe, J. C. & Moryadas, S. (1975). *The Geography of Movement*. Boston: Houghton Mifflin Company.
- Lynn, P. & Lugtig, P. (2017). Total Survey Error for Longitudinal Surveys. *Total Survey Error in Practice*. 2017, Jan 27:279-98.
- Lyngby, K. (2008). *General Study of the Impact of Rural Roads in Nicaragua*. Denmark: Danish International Development Assistance.
- M. Nevill, A., Lane, A. M., Kilgour, L. J., Bowes, N. & Whyte, G. P. (2001). Stability of Psychometric Questionnaires. *Journal of Sports Sciences*, 19, 273-278.
- Maat, K. & Timmermans, H. J. (2009). Influence of the Residential and Work Environment on Car Use in Dual-earner Households. *Transportation Research Part A: Policy and Practice*, 43, 654-664.
- Maparu, T. S. & Mazuder, T. N. (2017). Transport Infrastructure, Economic Development and Urbanization in India (1990–2011): Is There Any Causal Relationship? *Transportation Research Part A: Policy and Practice*, 100, 319-336.
- Marchenko, Y. (2007). Power Analysis and Sample-size Determination in Survival Models with the New Stpower Command. *Power*.
- Marsh, H. W., Hau, K.-T. & Wen, Z. (2004). In Search of Golden Rules: Comment on Hypothesis-Testing Approaches to Setting Cutoff Values for Fit Indexes and Dangers in Overgeneralizing Hu and Bentler's (1999) Findings. *Structural Equation Modeling*, 11, 320-341.
- Marshall, S. & Banister, D. (2007). *Land Use and Transport: European Research Towards Integrated Policies*. Emerald Group Publishing Limited.
- Marshall, W. & Garrick, N. (2010). Street Network Types and Road Safety: A study of 24 California Cities. . *Urban Design International*, 15, 133–147.
- Marshall, W. E. & Garrick, N. W. (2011). Does Street Network Design Affect Traffic Safety? *Accident Analysis & Prevention*, 43, 769-781.
- Marshall, W. E. & Garrick, N. W. (2012). Community Design and How Much We Drive. *Journal of Transport and Land Use*, 5.
- Maslow A. H., Franger, R. & Fadiman, J. (1970). *Motivation and Personality*. New York, Harper & Row.

- Matarrita-Cascante, D., Luloff, A., Krannich, R. S. & Field, D. R. (2006). Community Participation in Rapidly Growing Communities in Southern Utah. *Community Development*, 37, 71-87.
- Mayr, R. (1959). Comfort in Railway Travel. *The Railway Gazette*, 9, 266-269.
- McCormick, B. P. & McGuire, F. (1996). Leisure in Community Life of Older Rural Residents. *Leisure Sciences*, 18, 77-93.
- McDaniel, J. (2011). *What are the Benefits of Using Weighted Average?* . Spaling [Online]. Retrieved on June 14, 2017 from: <https://www.sapling.com/8592694/>.
- McGroder, D. E. A. (2009). The Impact of the North Coast Highway on Socio-Economic Status and Family Life of Residents in Bogue Village , Jamaica. . *Asian Social Science*, 5.
- McMahon, S. (2002). The Development of Quality of Life Indicators—A Case Study from the City of Bristol, UK. *Ecological Indicators*, 2, 177-185.
- Medugu, N. I. (2009). Overview of FCT, Abuja and its Planning Concept. Abuja.
- Meisel, D. (2010). *Bike Corrals: Local Business Impacts, Benefits, and Attitudes*. Portland State University School of Urban Studies and Planning. Retrived on August 20th, 2016 from [http://bikeportland.org/wp-content/uploads/2010/05/PDX\\_Bike\\_Corral\\_Study.pdf](http://bikeportland.org/wp-content/uploads/2010/05/PDX_Bike_Corral_Study.pdf).
- Mendes, J. F., & Motizuki, W. S. (2001). Urban Quality of Life Evaluation Scenarios: the Case of São Carlos in Brazil. *CTBUH Review*, 1(2), 13-23.
- Metz, D. (2012). Demographic Determinants of Daily Travel Demand. *Transport Policy*, 21, 20-25.
- Metz, D. H. (2000). Mobility of Older People and Their Quality of Life. *Transport Policy*, 7, 149-152.
- Mhangara, P., Mudau, N., Mboup, G. & Mwaniki, D. (2017). Transforming the City of Cape Town from an Apartheid City to an Inclusive Smart City. *Smart Economy in Smart Cities*. Springer.
- Michalos, A. C. (2014). Encyclopedia of Quality of Life and Well-being Research. Netherlands, Springer..
- Miciukiewicz, K. & Vigar, G. (2012). Mobility and Social Cohesion in the Splintered City: Challenging Technocentric Transport Research and Policy-making Practices. *Urban Studies*, 49, 1941-1957.

- Min, S. K., Jeon, W. T. & Kim, D. K. (2006). Quality of Life of North Korean Defectors in South Korea. *Journal of Korean Neuropsychiatric Association*, 45, 269-275.
- Mishra, S., Welch, T. F. & Jha, M. K. (2012). Performance Indicators for Public Transit Connectivity in Multi-Modal Transportation Networks. *Transportation Research Part A: Policy and Practice*, 46, 1066-1085.
- Moeinaddini, M., Asadi-Shekari, Z. & Shah, M. Z. (2014). The Relationship Between Urban Street Networks and the Number of Transport Fatalities at the City Level. *Safety Science*, 62, 114-120.
- Mohamed, A. A., Van Nes, A., Salheen, M. A., Kohlert, C. & Schwander, C. (2013). The Socio-Economic Implications of the Spatial Configuration in Greater Cairo Metropolitan Area. *Proceedings of Ninth International Space Syntax Symposium*, October 31-November 3, 2013, Seoul, Korea. Eds.: Kim, YO, Park, HT, Seo, KW Paper 95, 2013. Sejong: University Press.
- Mollenkopf, H., Baas, S., Marcellini, F., Oswald, F., Ruoppila, I., Szeman, Z. & Wahl, H. (2005). Mobility and the Quality of Life. Enhancing Mobility in Later Life: Personal Coping. *Environmental Resources and Technical Support*, 279-288.
- Montgomery, M., et al (2004, May). *NSW Road Classification Review. Information Paper and Invitation for Submissions*. Retrieved on October 23rd, 2018 from <https://www.rms.nsw.gov.au/business-industry/partners/supplier/lgr/doc/>.
- Monteiro, J., Robertson, G. & Atkinson, B. (2014). *Networks in Transportation—Theory*.
- Morgado, P. S. & Costa, N. (2005). Graph-Based Model to Transport Networks Analysis through GIS. . Proceedings of European Colloquium on Quantitative and Theoretical Geography, Greece, Athens, 2-5 September, 2005 Athens.
- Munsoncity (Producer). (2013, November 20, 2017). Which Street Pattern Represents Your Continent? *Munson's City, Architecture, Urbanism, and Munson*. Retrieved From <https://munsoncity.com/2013/10/09/which-street-pattern-represents-your-continent/>.
- Muriel-Villegas, J. E., Alvarez-Uribe, K. C., Patino-Rodriguez, C. E. & Villegas, J. G. (2016). Analysis of Transportation Networks Subject to Natural Hazards—Insights from a Colombian Case. *Reliability Engineering & System Safety*, 152, 151-165.

- Næss, P., Nicolaisen, M. S., & Strand, A. (2012). Traffic Forecasts Ignoring Induced Demand: A Shaky Fundament for Cost-Benefit Analyses. *European Journal of Transport & Infrastructure Research*, 12(3).
- Nagne, A. D. & Gawali, B. W. (2013). Transportation Network Analysis by Using Remote Sensing and GIS a Review. *International Journal of Engineering Research and Applications*, 3, 70-76.
- Najaf, P., Thill, J.-C., Zhang, W. & Fields, M. G. (2017). Direct and Indirect Effects of City-Level Urban Form on Traffic Safety: A 2 Structural Equation Modeling Analysis 3. *Structural Equation Modeling*, 3, 4.
- Najafi, A. & Samani, M. K. (2010). Planning Road Network in Mountain Forests Using GIS and Analytic Hierarchical Process (AHP). *Caspian Journal of Environmental Sciences*, 8, 151-162.
- Nakamura, K. (2016). The Spatial Relationship Between Pedestrian Flows and Street Characteristics Around Multiple Destinations. *IATSS Research*, 39, 156-163.
- Neatt, K., Millward, H. & Spinney, J. (2017). Neighborhood Walking Densities: A Multivariate Analysis in Halifax, Canada. *Journal of Transport Geography*, 61, 9-16.
- Newing, H., Eagle, C., Puri, R. & Watson, C. (2011). *Conducting Research in Conservation: A Social Science Perspective*. London and New York: Routledge.
- Newman, M. (2010). *Networks: An Introduction*. Oxford: University Press.
- Ney, S. (2001). Understanding Accessibility, in L. Giorgi and R. J. Pohoryles (eds.). *Transport Policy and Research: What Future?* Ashgate, Aldershot, UK.
- Niazi, S. S. (2017). The New Silk Roads (NSR) Diplomacy: Myth or Reality? . Inter-Regional Connectivity: South Asia and Oceania.
- Nor, K. M., & Pearson, J. M. (2008). An Exploratory Study into the Adoption of Internet Banking in a Developing Country: Malaysia. *Journal of Internet Commerce*, 7(1), 29-73.
- NYCDOT (2014). *The Economic Benefits of Sustainable Streets*. (New York City DOT 2013). Retrieved on January 20th 2017 from <https://www.ssti.us/2014/>.
- Nykamp, D. Q. (2017). *An Introduction to Networks*. Retrieved on 20th January 2018 from Math Insight. <http://mathinsight.org>.

- Oakes, J. M., Forsyth, A. & Schmitz, K. H. (2007). The Effects of Neighborhood Density and Street Connectivity on Walking Behavior: The Twin Cities Walking Study. *Epidemiologic Perspectives & Innovations*, 4, 16.
- Obafemi, A. A., Eludoyin, O. S. & Opara, D. R. (2011). Road Network Assessment In Trans-Amadi, Portharcourt In Nigeria Using GIS. *International Journal for Traffic and Transport Engineering*, 1, 257-264.
- Osborne, D. (1978). Techniques Available for the Assessment of Passenger Comfort. *Applied Ergonomics*, 9, 45-49.
- Obregon-Biosca, S. & Junyet-Comas, R. (2010). Socioeconomic Impact of the Roads: Case Study of the “Eix Transversal” in Catalonia, Spain. *Journal of Urban Planning and Development*, 137, 159-170.
- Odunuga, M. (2014). *5 Amazing Places to Visit in Abuja*. Retrieved on January 20th 2018 from <https://connectnigeria.com/articles/2014/01/5>.
- Office-Of-Research-Integrity (2005). *Research on Research Integrity*. Retrieved from <https://ori.hhs.gov/content/research-research-integrity-rri-conference-2006>.
- Ojekunle, J. A (2016). Operational Characteristics of Public Transportation in the Federal Capital Territory, Abuja, Nigeria.
- Olawale, T. N. & Adesina, K. I. (2013). An Assessment of the Relationship Between Road Network Connectivity and Tourists’ Patronage in Lokoja Metropolis, Kogi State. *Journal of Natural Sciences Research*, 3, 1-11.
- Oluseyi, O. F. (2006). Analysis of Inter-Connectivity Levels of Urban Street Networks and Social Interactions in Enclosed Neighborhood in Johannesburg RSA. *Humanity & Social Sciences Journal*, 1, 79-95.
- Oniyangi A: (2012). Bus Mass Transit Services in Abuja. *A Paper Presented at Workshop on a Framework, Road Map and Financing Options for National Mass Transit in Nigeria*, Organized by Technical Committee on Mass Transit Development with the Assistance of the Nigerian Infrastructure Advisory Facility (NAIF) Transport, Hilton Total Abuja, May 7 – 8.
- Onyeji, E. (2016, December 24). 10 Abuja Markets to Buy good, cheap commodities for Christmas. *Premium Times*.
- Openshaw, S. (1983). *Multivariate Analysis of Census Data: The Classification of Areas*.

- Orfeuill, J. P. & Soleyret, D. (2002). Quelles Interactions Entre les Marchés de la Mobilité à Courte et à Longue Distance? *Recherche-Transports-Sécurité*, 76, 208-221.
- Osman, H. E. (2004). *Space Energy and Total Thermal Comfort*. Master Thesis, Architecture Department, Faculty of Engineering, Cairo University, Egypt.
- Othman, F., Yusoff, Z. M., Sadek, E. S. & Adnan, N. A. (2015). GIS-based Measures of Burglary and Connectivity to Housing Layout. *25th International Business Information Management Association Conference-Innovation Vision 2020: From Regional Development Sustainability to Global Economic Growth, IBIMA 2015*. International Business Information Management Association, IBIMA.
- Özbil, A., Peponis, J. & Stone, B. (2008). Modeling Street Connectivity, Pedestrian Movement and Land-use According to Standard GIS Street Network Representations: A Comparative Study. *The 4th Joint Conference of the Association of European Schools of Planning*, 2008.
- Pallant, J. (2013). *SPSS Survival Manual. United Kingdom (UK)*. McGraw-Hill Education.
- Papi, J., Hellman, B., Antonissen, T., Falco, F., Vizcarra-Mir, B. & Dezes, L. (2007). *The Socio-Economic Benefits of Roads in Europe*. The European Union Road Federation.
- Papinski, D., Scott, D. M. & Doherty, S. T. (2009). Exploring the Route Choice Decision-Making Process: A Comparison of Planned and Observed Routes Obtained Using Person-based GPS. *Transportation Research Part F: Traffic Psychology and Behaviour*, 12, 347-358.
- Papoutsis, K. E. A. (2013). Impact Investigation of the Economic Crises to the Road Freight Sector in Thessaloniki, Greece. *Urban Transport XIX*, Ashurt: Witpress.
- Parfit, D. (1984). *Reasons and Persons*. Oxford: OUP.
- Parida, A. (2014). Role of Rural Road Connectivity (Pradhan Mantri Gram Sadk Yojana) in Accelerating Development & Improving Quality of Life. *International Journal of Innovative Research and Development*, 3.
- Parthasarathi, P. (2011). *Network Structure and Travel*. Doctor of Philosophy Thesis, University of Citeseer.

- Parthasarathi, P., Hochmair, H. & Levinson, D. (2014). Street Network Structure and Household Activity Spaces. *Urban Studies Journal*, 1-25.
- Paschke, S. R., Thiele, J. U. & Repke, H. (2009). *Analyse Heterogener*. Chemie Ingenieur Technik, 81.
- Pastor-Satorras, R. (2017). Modeling Face-to-face Social Interaction Networks.
- Patarasuk, R. (2011). Longitudinal Analysis of the Road Network Development and Land-Cover Dynamics in Lop Buri Province, Thailand, 1989--2006. Doctor of Philosophy Thesis, University of Florida.
- Patarasuk, R. & Binford, M. W. (2012). Longitudinal Analysis of the Road Network Development and Land-Cover Change in Lop Buri Province, Thailand, 1989–2006. *Applied Geography*, 32, 228-239.
- Peponis, J., Allen, D., French, S., Scoppa, M. & Brown, J. (2007). Street Connectivity and Urban Density. *6th International Space Syntax Symposium*, 2007. 1-12.
- Perry, J. & Felce, D. (1995). Objective Assessments of Quality of Life: How Much Do They Agree with Each Other? *Journal of Community & Applied Social Psychology*, 5, 1-19.
- Phillips, L., Henry, J., Hosie, J. & Milne, A. (2006). Age, Anger Regulation and Well-being. *Aging and Mental Health*, 10, 250-256.
- Pichardo-Muniz, A. (2011). The Role of Diseconomies of Transportation and Public Safety Problems in the Measurement of Urban Quality of Life. *Applied Research in Quality of Life*, 6, 363-386.
- Plomp, S. (2012). Measuring the Transportation Component of Accessibility.
- Pojani, D. (2011). Urban and Suburban Retail Development in Albania's Capital After Socialism. *Land Use Policy*, 28, 836-845.
- Poortinga, W., Steg, L. & Vlek, C. (2004). Values, Environmental Concern, and Environmental Behavior: A Study into Household Energy Use. *Environment and Behaviour*, 36, 70-93.
- Pope, J., Annandale, D. & Morrison-Saunders, A. (2004). Conceptualising Sustainability Assessment. *Environmental Impact Assessment Review*, 24, 595-616.
- Pretorius, Z., Lan, C., Prins, R., Knight, V., McLaren, N., Singh, R., Bender, C. & Kloppers, F. (2017). Application of Remote Sensing to Identify Adult Plant Resistance Loci to Stripe Rust in Two Bread Wheat Mapping Populations. *Precision Agriculture*, 18, 411-428.



- Program, S. S. H. R., Systematics, C. & Group, H. S. C. (2009). Performance Measurement Framework for Highway Capacity Decision Making. *Transportation Research Board of the National Academies*.
- Qian, Y.-S., Wang, M., Kang, H.-X., Zeng, J.-W. & Liu, Y.-F. (2012). Study on the Road Network Connectivity Reliability of Valley City Based on Complex Network. *Mathematical Problems in Engineering*, 2012.
- Rahman, T., Mittelhammer, R. C. & Wandschneider, P. R. (2011). Measuring Quality of Life Across Countries: A Multiple Indicators and Multiple Causes Approach. *The Journal of Socio-Economics*, 40, 43-52.
- Reardon, L. & Abdallah, S. (2013). Well-being and Transport: Taking Stock and Looking Forward. *Transport Reviews*, 33, 634-657.
- Reis, H. T. & Judd, C. M. (2000). *Handbook of Research Methods in Social and Personality Psychology*. Cambridge, University Press.
- Reynolds, A. J., Ou, S. R., Mondì, C. F. & Hayakawa, M. (2017). Processes of Early Childhood Interventions to Adult Well-Being. *Child Development*, 88, 378-387.
- Richards, L. G., Jacobson, I. D. & Kuhlthau, A. (1978). What the Passenger Contributes to Passenger Comfort. *Applied Ergonomics*, 9, 137-142.
- Rifaat, S. M., Tay, R. & De Barros, A. (2011). Effect of Street Pattern on the Severity of Crashes Involving Vulnerable Road Users. *Accident Analysis & Prevention*, 43, 276-283.
- Rifaat, S. M., Tay, R. & De Barros, A. (2012). Urban Street Pattern and Pedestrian Traffic Safety. *Journal of Urban Design*, 17, 337-352.
- Risser, R., Šucha, M. & Zamecnik, P. (2015). Enhancing the Development of Traffic Psychology in The Czech Republic.
- Rodrigue, J.-P., Comtois, C. & Slack, B. (2013). *The Geography of Transport Systems*. London, Routledge.
- Rodrigue, J.-P., Comtois, C. & Slack, B. (2016). *The Geography of Transport Systems*. Taylor & Francis.
- Rojas, M. (2008). Experienced Poverty and Income Poverty in Mexico: A Subjective Well-Being Approach. *World Development* 36(6): 1078–1093.
- Rose, H. M. (1969). *Social Processes in the City: Race and Urban Residential Choice*. Association of American Geographers.

- Rottier, H. (1980). *Stedelijke Structuren, een Inleiding Tot de Ontwikkeling van de Europese Stad (Urban Structures, an Introduction into the Development of the European City)*. Coutinho, Muiderberg.
- Rupp, A. A. & Sweet, S. J. (2011). *Analysis of Multivariate Social Science Data*. Taylor & Francis.
- Ryan, R. M. & Deci, E. L. (2001). On Happiness and Human Potentials: A Review of Research on Hedonic and Eudaimonic Well-being. *Annual Review of Psychology*, 52, 141-166.
- Saelens, B. E., Sallis, J. F. & Frank, L. D. (2003). Environmental Correlates of Walking and Cycling: Findings from the Transportation, Urban Design, and Planning Literatures. *Annals of Behavioral Medicine*, 25, 80-91.
- Salat, S., Bourdic, L., & Labbe, F. (2014). Breaking Symmetries and Emerging Scaling Urban Structures: A Morphological Tale of 3 Cities: Paris, New York and Barcelona. *International Journal of Architectural Research: ArchNet-IJAR*, 8(2), 77-93.
- Sarkar, C. & Webster, C. (2017). Healthy Cities of Tomorrow: the Case for Large Scale Built Environment–Health Studies. *Journal of Urban Health*, 94, 4-19.
- Sarkar, D. (2013). Structural Analysis of Existing Road Networks of Cooch Behar District, West Bengal, India: A Transport Geographical Appraisal. *Ethiopian Journal of Environmental Studies and Management*, Vol. 6, 74-81.
- Sarkar, S., Chawla, S., Parambath, S. P., Srivastava, J., Hammady, H., Filali, F., Znaidi, W. & Borge-Holthoefer, J. (2017). Effective Urban Structure Inference from Traffic Flow Dynamics. *IEEE Transactions on Big Data*.
- Sarmiento, O. L., Schmid, T. L., Parra, D. C., Diaz-Del-Castillo, A., Gomez, L. F., Pratt, M., Jacoby, E., Pinzon, J. D. & Duperly, J. (2010). Quality of life, Physical Activity, and Built Environment Characteristics Among Colombian Adults. *Journal of Physical Activity and Health*, 7, S181-S195.
- Scaparra, M. P. & Church, R. L. (2005). A GRASP and Path Relinking Heuristic for Rural Road Network Development. *Journal of Heuristics*, 11, 89-108.
- Schneider, I. E. (2013). *Quality of Life: Assessment for Transportation Performance Measures. Final Report*. Minnesota: University of Minnesota, Department of Transportation Research Services.
- Schumacker, R. E. & Lomax, R. G. (2004). *A Beginner's Guide to Structural Equation Modeling*. New Jersey: Lawrence Erlbaum Associates, Publishers.

- Scoppa, M. D. & Peponis, J. (2015). Distributed Attraction: The Effects of Street Network Connectivity upon the Distribution of Retail Frontage in the City of Buenos Aires. *Environment and Planning B: Planning and Design*, 42, 354-378.
- Scott, J. (2017). *Social Network Analysis*. Sage Publications.
- Seik, F. T. (2000). Subjective Assessment of Urban Quality of Life in Singapore (1997–1998). *Habitat International*, 24, 31-49.
- Sekaran, U. & Bougie, R. (2016). *Research Methods for Business: A Skill Building Approach*. John Wiley & Sons.
- Sener, I. N., Eluru, N. & Bhat, C. R. (2009). An Analysis of Bicycle Route Choice Preferences in Texas. *US Transportation*, 36, 511-539.
- Sengupta, R., Coondoo, D. & Rout, B. (2007). Impact of a Highway on the Socio-Economic Well-being of Rural Households Living in Proximity. *Contemporary Issues and Ideas in Social Sciences*, 3.
- Snellen, D.M.E.G.W. (2002). *Urban Form and Activity-Travel Patterns : An Activity-Based Approach to Travel in a Spatial Context Eindhoven: Technische Universiteit Eindhoven*, DOI: 10.6100/IR554456.
- Senlier, N., Yildiz, R. & Aktas, E. D. (2009). A Perception Survey for the Evaluation of Urban Quality of Life in Kocaeli and a Comparison of the Life Satisfaction with the European Cities. *Social Indicators Research*, 94, 213-226.
- Seu (2003). *Making the Connections: Final Report on Transport and Social Exclusion: Summary*.
- Sevtsuk, A. (2014). Location and Agglomeration The Distribution of Retail and Food Businesses in Dense Urban Environments. *Journal of Planning Education and Research*, 34, 374-393.
- Shahi, P. (2014). Development: Highway Connectivity is Key to Karnali's Progress. *Development* [Online]. Retrieved on January 20th, 2015 from: <http://www.ekantipur.com>.
- Sheridan, J., Coakes, L. & Peta, D. (2006). *SPSS 13.0 for Windows: Analysis without Aguish*. National Library of Australia.
- Siegenthaler, K. & Vaughan, J. (1998). Older Women in Retirement Communities: Perceptions of Recreation and Leisure. *Leisure Sciences*, 20, 53-66.
- Skach, B. (2016). *The Annapurna Road: Development and Tourism on the Annapurna Circuit*.

- Sohn, D.-W. (2016). Residential Crimes and Neighbourhood Built Environment: Assessing the Effectiveness of Crime Prevention Through Environmental Design (CPTED). *Cities*, 52, 86-93.
- Spinney, J. E., Scott, D. M. & Newbold, K. B. (2009). Transport mobility Benefits and Quality of Life: A Time-use Perspective of Elderly Canadians. *Transport Policy*, 16, 1-11.
- Sreelekha, M., Krishnamurthy, K. & Anjaneyulu, M. (2016a). Assessment of Topological Pattern of Urban Road Transport System of Calicut City. *Transportation Research Procedia*, 17, 253-262.
- Sreelekha, M., Krishnamurthy, K. & Anjaneyulu, M. (2016b). Interaction Between Road Network Connectivity and Spatial Pattern. *Procedia Technology*, 24, 131-139.
- Stacey, N. & Wilson, A. (2014). Industrial Marketing Research (RLE Marketing): Management and Technique. London: Routledge.
- Stanley, J. K., Hensher, D. A., Stanley, J. R. & Vella-Brodrick, D. (2011). Mobility, Social Exclusion and Well-being: Exploring the Links. *Transportation Research Part A: Policy and Practice*, 45, 789-801.
- Starnini, M., Lepri, B., Baronchelli, A., Barrat, A., Cattuto, C. & Pastor-Satorras, R. (2017). Robust Modeling of Human Contact Networks Across Different Scales and Proximity-sensing Techniques. *ArXiv Preprint*, ArXiv:1707.06632.
- Steg, L. & Gifford, R. (2007). Sustainable Transport and Quality of Life. Building Blocks for Sustainable Transport: Obstacles, Trends, Solutions. Emerald Group Publishing Limited.
- Streiner, D. L. (2006). Building a Better Model: An Introduction to Structural Equation Modelling. *The Canadian Journal of Psychiatry*, 51(5), 317-324.
- Suarez, E. L. & De Caceres, A. M. (2007). Assessment of Transport Infrastructure Plans: A Strategic Approach Integrating Efficiency, Cohesion and Environmental Aspects. E. López.
- Susan, N. C. & Njike, C. (2014). Evaluation of Urban Road Network Accessibility and Impedances in Umuahia Urban Using Geographic Information System.
- Susilo, Y. O., Williams, K., Lindsay, M. & Dair, C. (2012). The Influence of Individuals' Environmental Attitudes and Urban Design Features on Their Travel Patterns in Sustainable Neighborhoods in the UK. *Transportation Research Part D: Transport and Environment*, 17, 190-200.

- Taaffe, E. J., Morrill, R. L. & Gould, P. R. (1963). Transport Expansion in Underdeveloped Countries: A Comparative Analysis. *Geographical Review* 53: 503-529.
- Tabachnick, B. & Fidell, L. (2014). *Using Multivariate Statistics*. Harlow: Pearson Education Limited.
- Tabachnick, B. G., Fidell, L. S. & Osterlind, S. J. (2001). *Using Multivariate Statistics*. Boston: Allyn and Bacon.
- Taleai, M. & Amiri, E. T. (2017). Spatial Multi-criteria and Multi-scale Evaluation of Walkability Potential at Street Segment Level: A Case Study of Tehran. *Sustainable Cities and Society*, 31, 37-50.
- Tanaka, J. S. & Huba, G. J. (1985). A Fit Index for Covariance Structure Models Under Arbitrary GLS Estimation. *British Journal of Mathematical and Statistical Psychology*, 38, 197-201.
- Tasic, I., Zlatkovic, M., Martin, P. T. & Porter, R. J. (2015). Street Connectivity Versus Street Widening: Impact of Enhanced Street Connectivity on Traffic Operations in Transit-Supportive Environments. Transportation Research Record: *Journal of the Transportation Research Board*, 2, 57-68.
- Tater, A. (2017). Accessibility to Transport Facility: A Case Study of Jodhpur, Rajasthan. *Sustainable Smart Cities in India*. Springer.
- TCQSM (2003). "Defined Term". Transit Capacity and Quality of Service Manual. Retrieved on October 28th, 2018 from <https://definedterm.com/>.
- TDM, (2015). Accessibility: Evaluating People's To Reach Desired Goods, Services and Activities. *TDM Encyclopedia*. Victoria Transport Policy Institute.
- TDM, E. (2017). Roadway Connectivity: Creating More Connected Roadway and Pathway Networks. *Transport Demand Management (TDM), Encyclopedia*. Victoria, Canada Victoria Transport Policy Institute.
- Teo, T. (2011). Factors Influencing Teachers' Intention to Use Technology: Model Development and Test. *Computers & Education*, 57, 2432-2440.
- Tesfazghi, E. S., Martinez, J. & Verplanke, J. (2010). Variability of Quality of Life at Small Scales: Addis Ababa, Kirkos Sub-City. *Social Indicators Research*, 98, 73-88.
- Thaler, A. & Winkler, M. (2005). Die Fragmentierte Region. Eine Kritische Kommentierung des Planerischen Wachstumsparadigmas am Beispiel Hamburgs. *Raum Planung*, 120, 117-121.

- Thales, (2012). SMART CITY: The Interconnected City: Improving the Quality of Life of its Citizens. Retrieved on 16th September 2017 from [www.thalesgroup.com](http://www.thalesgroup.com).
- Tini, N. H. & Peter, Y. (2013). The Geospatial Pattern, Problems and Prospect of Development Control in Mubi Metropolis, Adamawa State, Nigeria. *Global Advanced Research Journal of Geography and Regional Planning*, Vol. 2(3) pp. 047-053.
- Thinkler, K. J., (1977a). *An Introduction to Graph Theoretical Methods in Geography*. Catmog No. 14, Norwich: Geo Abstracts.
- Tiwari, A. & Arora, G. (2012). *A Handbook for Socio-Economic Impact Assessment (SEIA) of Future Urban Transport (FUT) Projects*. Delhi: TRIPP, Indian Institute of Technology.
- Tiwari, G. (2014). Planning and Designing Transport Systems to Ensure Safe Travel for Women. *International Transport Forum*.
- Tiwari, G. & Jain, D. (2012). Accessibility and Safety Indicators for All Road Users: Case Study Delhi BRT. *Journal of Transport Geography*, 22 ,87-95
- Tkatchenko, R. (2013). Personal Mobility In The Context Of Sustainable Development. *Journal of Environmental Sustainability*, 3, 4.
- Tresidder, M. (2005). Using GIS to Measure Connectivity: An Exploration of Issues. *Portland State University: Field Area Paper*.
- Tribby, C. P., Miller, H. J., Brown, B. B., Smith, K. R. & Werner, C. M. (2017). Geographic Regions for Assessing Built Environmental Correlates with Walking Trips: A Comparison Using Different Metrics and Model Designs. *Health & Place*, 45, 1-9.
- Trinca, G. W., Johnston, I. R., Campbell, B. J., Haight, F., Knight, P., Mackay, G., Mclean, A. & Petrucelli, E. (1988). *Reducing Traffic Injury-A Global Challenge*.
- Trochim, W., Donnelly, J. P. & Arora, K. (2015). *Research Methods: The Essential Knowledge Base*, Nelson Education.
- Tsou, K.-W. & Cheng, H.-T. 2013. The Effect of Multiple Urban Network Structures on Retail Patterns—A Case Study in Taipei, Taiwan. *Cities*, 32, 13-23.
- Tukey, J. W. (1977). *Exploratory Data Analysis (Vol. 2)*. Retrieved from [pdfs.semanticscholar.org](http://pdfs.semanticscholar.org).

- Twaddle, H., Hall, F. & Bracic, B. (2010). Latent Bicycle Commuting Demand and Effects of Gender on Commuter Cycling and Accident Rates. *Transportation Research Record: Journal of the Transportation Research Board*, 28-36.
- UC, (2015). Travel Expenses Policy. In: *FINANCIAL* (ed.). University of Cincinnati
- UN-Habitat, (1997). *Urban Indicators Programme Phase One: 1994-1996*. Nairobi: United Nations Centre for Human Settlements (Habitat).
- Usani, U. U. (2005). The Future of Intra City Motor Transport in Abuja, the Federal Capital Territory of Nigeria. *WIT Transactions on The Built Environment*, Vol 77, © 2005 *WIT Press* www.witpress.com, ISSN 1743-3509 (on-line).
- Vaidya, B. C. (2003). *Geography of Transport Development in India*. Concept Publishing Company.
- Van Wee, B., Hagoort, M. & Annema, J. A. (2001). Accessibility Measures with Competition. *Journal of Transport Geography*, 9, 199-208.
- Vanvoorhis, C. W. & Morgan, B. L. (2007). Understanding Power and Rules of Thumb for Determining Sample Sizes. *Tutorials in Quantitative Methods for Psychology*, 3, 43-50.
- Vemuri, A. W. & Costanza, R. (2006). The Role of Human, Social, Built, and Natural Capital in Explaining Life Satisfaction at the Country Level: Toward a National Well-Being Index (NWI). *Ecological Economics*, 58, 119-133.
- Venables, A., Laird, J.J. & Overman, H.G. (2014). *Transport investment and Economic Performance: Implications for Project Appraisal*. UK Department of Transport Report.
- Venter, O., Sanderson, E. W., Magrath, A., Allan, J. R., Beher, J., Jones, K. R., Possingham, H. P., Laurance, W. F., Wood, P. & Fekete, B. M. (2016). Sixteen Years of Change in the Global Terrestrial Human Footprint and Implications for Biodiversity Conservation. *Nature Communications*, 7.
- VEPI, (2015). Abuja Municipal Area Council Registered Voters. Voter Education and Publicity INEC, Federal Capital Territory, Nigeria.
- Verzola, R. (2004). Towards a Political Economy of Information: Studies on the Information Economy, Foundation for Nationalist Studies.
- Vickerman, R. W. (1995). The Regional Impacts of Trans-European Networks. *The Annals of Regional Science*, 29, 237-254.

- Waddell, P. (2011). Integrated Land Use and Transportation Planning and Modelling: Addressing Challenges in Research and Practice. *Transport Reviews*, 31, 209-229.
- Wales, J. & Wild, L. (2012). The Political Economy of Roads: An overview and Analysis of Existing Literature. London: Overseas Development Institute.
- Walker, G. & Manson, A. (2014). Telematics, Urban Freight Logistics and Low Carbon Road Networks. *Journal of Transport Geography*, 37, 74-81.
- Walker, J. T. (1999). Statistics in Criminal Justice: Analysis and Interpretation, Jones & Bartlett Learning.
- Wan, H. L. (2016). Preliminary Data Analysis and Interpretation. *Organisational Justice and Citizenship Behaviour in Malaysia*. Springer.
- Warr, P. (2006). Roads and Poverty Reduction in Lao PDR. *Poverty Strategies in Asia*, 145.
- Wasserman, S. & Faust, K. (1994). Social Network Analysis: *Methods and Applications*, Cambridge: University press.
- Watling, D. (2008). Modelling and Evaluation of Reliability Impacts in Road Networks: Concepts and Methods for Traffic Assignment Models. *European Transport Conference (ETC)*.
- Watson, D., Clark, L. A. & Tellegen, A. (1988). Development and Validation of Brief Measures of Positive and Negative Affect: the PANAS Scales. *Journal of Personality and Social Psychology*, 54, 1063.
- Waugh, D. (1995). *Geography - An Integrated Approach*. Thomas Nelson and Sons Limited, Melbourne.
- Wheaton, B., Muthen, B., Alwin, D. F. & Summers, G. F. (1977). Assessing Reliability and Stability in Panel Models. *Sociological Methodology*, 8, 84-136.
- WHO, (1998). Development of the World Health Organization WHOQOL-BREF Quality of Life Assessment. *Psychological Medicine*, 28, 551-558.
- Williams, B. & Brown, T., Onsmann (2010). Exploratory Factor Analysis: A Five-step Guide for Novices (J). *Australasian Journal of Para-Medicine*, 8.
- Wright, C. (1979). Arcs and Cars: An Approach to Road Traffic Management Based on Graph Theory. *Graph Theory and Combinatorics*. London: Pitman.
- Xie, F. & Levinson, D. (2007). Measuring the Structure of Road Networks. *Geographical Analysis*, 39, 336-356.



- Xie, F. & Levinson, D. (2009). Topological Evolution of Surface Transportation Networks. *Computers, Environment and Urban Systems*, 33, 211-223.
- Yahya, F., Walters, R. J. & Wills, G. B. (2017). Clustering Goal-driven Security Factors for Protecting Data in Cloud Storage Using Exploratory Factor Analysis (EFA): An Empirical Study.
- Yang, C. & Liu, Q. (2012). Road Network Pattern Classification Using GEV Distribution Parameters. *International Journal of Engineering and Manufacturing (IJEM)*, 2, 21.
- Yang, C., Tu, Y. & Chen, X. (2009). Analysis Method for Topology Vulnerability of Transportation Network. *International Conference on Transportation Engineering*. Chengdu: American Society of Civil Engineers, ASCE, 2009. 3639-3644.
- Yao, Y. & She, Y. (2016). Rough Set Models in Multigranulation Spaces. *Information Sciences*, 327, 40-56.
- Yen, Y.-S. & Wu, F.-S. (2016). Predicting the Adoption of Mobile Financial Services: The Impacts of Perceived Mobility and Personal Habit. *Computers in Human Behavior*, 65, 31-42.
- Yilmaz, İ., Eydurhan, E., Kaygisiz, A. & Javed, K. (2011). Estimates of Genetic Parameters for Lactation Shape Parameters with Multivariate Statistical Technique in Brown Swiss Cattle.
- Yong, A. G. & Pearce, S. (2013). A Beginner's Guide to Factor Analysis: Focusing on Exploratory Factor Analysis. *Tutorials in Quantitative Methods for Psychology*, 9, 79-94.
- Yuan, H., & Lu, H. (2001). *Evaluation and Analysis of Urban Transportation Efficiency in China*. Institute of Transportation Engineering, Tsinghua University, Beijing, China, 2, 3.
- Zainudin, A. (2014). *A Handbook on Structural Equation Modeling*. Selangor: MPWS Rich Resources.
- Zeberced (2013). Abuja Industrial Park. *Zeberced Construction Group*.
- Zhang, H. (2011). *Uncovering Road Network Structure Through Complex Network Analysis*. Doctor of Philosophy Ph.D, Polytechnic University, Hong Kong.
- Zhang, L., Hong, J., Nasri, A. & Shen, Q. (2012a). How Built Environment Affects Travel Behavior: A Comparative Analysis of the Connections Between Land Use and Vehicle Miles Traveled in US cities.

- Zhang, Y., Bigham, J., Li, Z., Ragland, D. & Chen, X. (2012b). Associations Between Road Network Connectivity and Pedestrian-Bicyclist Accidents. *91st Annual Meeting of the Transportation Research Board*, Washington DC.
- Zhao, F., Sun, H., Wu, J., Gao, Z. & Liu, R. (2016). Analysis of Road Network Pattern Considering Population Distribution and Central Business District. *PloS One*, 11, 0151676.
- Zhao, G., Zheng, X., Yuan, Z. & Zhang, L. (2017). Spatial and Temporal Characteristics of Road Networks and Urban Expansion. *Land*, 6, 30.
- Zikmund, W. G., Babin, B. J., Carr, J. C. & Griffin, M. (2013). *Business Research Methods*, Cengage Learning.
- Zohrabi, M. (2013). Mixed Method Research: Instruments, Validity, Reliability and Reporting Findings. *Theory and Practice in Language Studies*, 3, 254.