A Theoretical Model for Telemedicine:
Social and Value Outcomes in Sub-Saharan Africa

DOCTORAL DISSERTATION

By
Mengistu Kifle

Department of Computer and System Sciences
Stockholm University/Royal Institute of Technology

2006

Submitted to Stockholm University in partial fulfillment of the requirements for the degree of Doctor of Philosophy
ABSTRACT

The Sub-Saharan Africa (SSA) region is faced with limited medical personnel and healthcare services to address the many healthcare problems of the region. Poor health indicators reflect the overall decline in socio-economic development. Shortages of access to health services in the region is further complicated by the concentration of health services in urban areas, the region’s multiple medical problems (over 70% of HIV/AIDS cases in the world); and the brain drain phenomenon – it is estimated one-third of African physicians emigrate to North America and Europe. The result is that the SSA region is left with about 10 physicians, and 20 beds, per 100,000 patients. Telemedicine has been found to offer socio-economic benefits, reduce costs, and improve access to healthcare service providers by patients, but previous attempts to move various information technologies from developers in the industrial world to the developing world have failed because of a clear neglect of infrastructural and cultural factors that influence such transfers. The objective of this study is to address key factors that challenge the introduction of telemedicine technology into the health sector in SSA in particular, and by extension, other developing countries with similar socio-economic structures.

This research offers a distinctive perspective, focusing on visually-based clinical applications in the SSA region, and considerable attention to the national infrastructure and cultural impact of telemedicine transfer (social and value) outcomes. Two research models and its associated hypotheses are proposed and empirically tested using quantitative data collected from SSA physicians and other health professionals. The study also contributes to the ongoing debate on the potential of telemedicine in improving access and reducing costs. This research can help to understand the socio-economic impact of telemedicine outcomes in a comprehensive way. The finding from the survey shows the rapid advances in telemedicine technology specifically, visual clinical applications may become an essential healthcare tool in the near future within SSA countries.

Keywords: Telemedicine/ e-health, Sub-Saharan Africa, Least developed Countries, Visually based Clinical Applications, Information and Communication Technology (ICT) Transfer, Partial Least Squares, Culture
ACKNOWLEDGEMENTS

I thank and honor God, The Almighty, for bringing me to this world and for taking me through my entire educational career and helping me to complete this dissertation. Throughout the whole doctoral process many people have supported me and this is the right time to express my gratitude and thank them all. I would like to thank my supervisor Dr. Lars Asker for all his valuable advice and encouragements throughout the whole time it took me to complete this research and write the dissertation.

I extend special thanks external advisors Dr. Victor Mbarika and Dr. Chitu Okoli for their close guidance through the dissertation process. Further I thank them for our collaboration and all their encouragement that has culminated in several journal papers and a book chapter published within the telemedicine research stream.

I owe many thanks to a number of colleagues and friends have been important throughout the dissertation process. Many thanks to Professor Love Ekenberg for encouragement and valuable support. Special thanks to all who read and provided diverse valuable comments on this text. Specifically, I want to thank Brother Al Bloch for proofreading the final text and providing very helpful suggestions resulting in substantial improvements of the language in this dissertation.

Thanks to Ato Tesfaye Biru, for introducing me to the National Telemedicine Committee and other persons in Ethiopia. Special thanks to Dr. Fassil Shiferaw and Dr. Samson Bayu for helping me to distribute and collect the numerous questionnaires used in the studies. Further, members of the Ethiopia National Telemedicine Committee, as well as all the friends and colleagues who have inspired and positively influenced this research work, deserve many thanks for all their support.

I would also like to express my gratitude to all of DSV for their generous support over these years. My thanks goes to Professor Louise Yngström for her very kind support. My sincere thanks also goes to Birgitta Olsson, Rodolfo Candia and Fatima Santala for their help in all practical and administrative matters during the research process.

Finally, I would like to thank my wife, Selamawit Alene for her loving support, encouragement, friendship and for her patience during this dissertation process. She consistently reminded me of what is most important in life: God the Almighty and all His Goodness. I extend thanks to our families for standing with Selamawit and our children Nahome and Amanuel. Without you this would not have been possible. I especially wish to thank my mother, Tirunish W/Goigris for her very positive attitude towards education in our family. I thank my sisters and brothers, for always being there and for supporting me in innumerable ways during my dissertation process. In particular, special thanks to my sister Tirsit and her family for their emotional support which inspired me through this long journey.
# TABLE OF CONTENTS

Abstract ................................................................................................................................................. ii

Acknowledgements................................................................................................................................. iii

Table of Contents................................................................................................................................. iv

List of Figures ......................................................................................................................................... viii

List of Tables .......................................................................................................................................... ix

List of Abbreviations............................................................................................................................. x

Chapter 1 Introduction .......................................................................................................................... 1

1.1 The Digital Divide ............................................................................................................................. 6

1.2 Sub-Saharan African Countries: Geo-economic and Socio-economic Characteristics .......... 8

1.3 Motivations and Rationale for Research ....................................................................................... 13

1.4 Research Questions .......................................................................................................................... 17

1.4.1 National Infrastructure for Telemedicine in Sub-Saharan Africa ........................................... 17

1.4.2 Cultural and Social Issues Influencing Telemedicine in Sub-Saharan Africa ........................ 18

1.5 The Research Approach .................................................................................................................. 19

1.6 Contributions and Publications ...................................................................................................... 20

Chapter 2: Literature Review ............................................................................................................... 23

2.1 Introduction ...................................................................................................................................... 23

2.2 Theoretical Underpinning (Previous Related Work) ...................................................................... 25

2.2.1 Arab Policy and IT (APIT) and Arab Culture and IT (ACIT) .................................................. 25

2.3 Review Methods ............................................................................................................................... 26

2.4 Telemedicine in Context .................................................................................................................. 28

2.4.1 Telemedicine Definitions ........................................................................................................ 28

2.4.2 The History of Telemedicine ................................................................................................... 29

2.4.3 Telemedicine Practices ............................................................................................................ 31

2.5 Theoretical Foundations .................................................................................................................. 32

2.5.1 Telemedicine Transfer Outcomes ........................................................................................... 34

2.5.2 National Level ............................................................................................................................ 36

2.5.2.1 National ICT Policies .......................................................................................................... 36

2.5.2.2 National E-health (Telemedicine) Policy ............................................................................. 38

2.5.2.3 Security and Standard Policies ......................................................................................... 40
2.5.2.4 National IT Infrastructure ................................................................. 44
2.5.2.5 Culture and Technological Culturation ........................................ 49

2.5.3 Organizational Level ...................................................................... 54
  2.5.3.1 Organizational Factors ............................................................. 54
  2.5.3.2 Environmental Factors ............................................................ 57
2.5.4 Individual Level ............................................................................. 59
  2.5.4.1 Individual Acceptance of Telemedicine ...................................... 59

Chapter 3 Research Method, Model and Hypotheses ............................. 63

3.1 Research Methods in Information Systems ....................................... 63
  3.1.1 Philosophical Basis for IS Research .......................................... 65
  3.1.2 Quantitative Research ................................................................. 67
  3.1.3 Measurement ............................................................................. 68
  3.1.4 Choice of Statistical (Data) Analysis Techniques ....................... 69
  3.1.5 Choice of Quantitative Research Methodology ......................... 71
3.2 Research Model ................................................................................ 73
3.3 Overall Model of Telemedicine Outcomes ....................................... 74
3.4 National Infrastructural Model of Telemedicine Outcomes ............ 78
3.5 Cultural Model of Telemedicine Outcomes ..................................... 80
3.6 Research Hypotheses of Telemedicine Outcomes in Sub-Saharan Africa ......................................................... 82
  3.6.1 National Infrastructural Hypotheses of Telemedicine Outcomes 83
  3.6.2 Cultural Hypotheses of Telemedicine Outcomes ...................... 86

Chapter 4 Pre-Test and Pilot Test ......................................................... 90

4.1 Background for Instrument Creation .............................................. 90
  4.1.1 Instrument Creation ................................................................. 91
4.2 Pre-test, Pilot Study Procedures ....................................................... 92
4.3 Result of Pilot Test ........................................................................... 93
  4.3.1 Sample .................................................................................... 94
  4.3.2 Data Collection Methods ......................................................... 94
  4.3.3 Responses ............................................................................. 95
  4.3.4 Data analysis .......................................................................... 95
4.4 Assessment of Measurement Model ................................................ 96
  4.4.1 Reliability ............................................................................. 97
  4.4.2 Convergent validity ............................................................... 97
  4.4.3 Discriminant Validity ............................................................. 98
Chapter 5: Main Study Procedure and Report .................................................. 113

5.1 Questionnaire Design ............................................................................. 113
5.2 Instrument .................................................................................................. 115
5.3 Philosophical Basis for the Study ............................................................... 115
  5.3.1 Data collection procedures ................................................................. 115
  5.3.2 Survey Administration ...................................................................... 116
  5.3.3 Statistical – Data Analysis Technique .................................................. 119
5.4 Data Analysis Procedure ......................................................................... 119
  5.4.1 Characteristics of the Respondents ...................................................... 120
  5.4.2 Test for Response Bias ...................................................................... 121
  5.4.3 Cronbach’s Alpha Reliability ............................................................... 122
5.5 Testing and Refining the Measurement (Outer) Model ................................ 124
  5.5.1 Confirmatory Factor Analysis .............................................................. 124
  5.5.2 Checking for Cross-Loading ............................................................... 127
  5.5.3 Composite Reliability ...................................................................... 129
  5.5.4 Average Variance Extracted ............................................................... 130
  5.5.5 Convergent validity ......................................................................... 131
  5.5.6 Discriminant Validity ....................................................................... 131
5.6 Assessment of the Structural (Inner) Model and Hypotheses .................... 133
  5.6.1 Results: Overall Model of Telemedicine Factors .................................. 134
  5.6.2 Results from the National Infrastructure Model of Telemedicine Factors .... 140
  5.6.3 Results on the Cultural Model of Telemedicine Factors ...................... 142
  5.6.4 Resulting Hypotheses ....................................................................... 147
5.7 Validation of the Main Study .................................................................. 150
  5.7.1 Pilot Study ........................................................................................ 150
  5.7.2 Statistical Power ............................................................................... 150
  5.7.3 Reliability ........................................................................................ 151
  5.7.4 Internal and External Validity ............................................................. 151

Chapter 6: Discussion and Conclusion .............................................................. 153

6.1 Discussion of Results .............................................................................. 153
  6.1.1 Impacts of Telemedicine Capabilities on Telemedicine Transfer Outcomes .... 154
    6.1.1.1 Telemedicine capabilities were positively related to telemedicine value outcomes. 154
    6.1.1.2 Telemedicine capabilities are positively related to telemedicine social outcomes. 155
6.1.2 Impacts of Telemedicine Social Outcomes on Telemedicine Value Outcomes .............................................. 156
  6.1.2.1 Telemedicine social outcomes are positively related to telemedicine value outcomes. .................. 156
6.1.3 Impacts of Policies on Telemedicine Transfer Outcomes .................................................................................. 157
  6.1.3.1 General ICT policies are positively related to telemedicine capabilities. .............................................. 157
  6.1.3.2 e-Health policies are not significantly related to telemedicine capabilities ........................................... 158
  6.1.3.3 Data security policies are positively related to telemedicine capabilities. ............................................ 160
6.1.4 Impacts of Policies on ICT infrastructure ...................................................................................................... 162
  6.1.4.1 General ICT policies are not significantly related to ICT Infrastructure ............................................... 162
  6.1.4.2 e-Health and data security policies are positively related to ICT Infrastructure .................................... 163
6.1.5 Impact of ICT Infrastructure on Telemedicine Transfer Outcomes .............................................................. 164
  6.1.5.1 ICT Infrastructure is positively related to telemedicine capabilities .................................................... 164
6.1.6 Impact of Health Environment on Telemedicine Transfer Outcomes ............................................................. 166
  6.1.6.1 Telemedicine Readiness is related to telemedicine capabilities .......................................................... 166
  6.1.6.2 Health Infrastructure is positively related to telemedicine capabilities .............................................. 167
  6.1.6.3 Health Infrastructure is not directly related to Telemedicine Social Outcomes .................................. 168
6.1.7 Impacts of Telemedicine Transfer Implementation on Telemedicine Transfer Outcomes ...................... 171
  6.1.7.1 Implementation Effectiveness is positively related to telemedicine capabilities .................................. 171
  6.1.7.2 Decision-making factors are positively related to telemedicine capabilities .................................. 172
6.1.8 Impacts of Culture on Telemedicine Transfer Outcomes .............................................................................. 173
  6.1.8.1 Power Distance as well as interactions between implementation effectiveness and decision-making factors are positively related to telemedicine capabilities ........................................ 173
  6.1.8.2 Uncertainty Avoidance, as well as interactions between implementation effectiveness and decision-making factors, are not significantly related to telemedicine capabilities .................. 176
  6.1.8.3 Technology Culturation and interactions between implementation effectiveness and decision-making factors are not significantly related to telemedicine capabilities ................................ 177

6.2 Contributions and Implications of the Research ................................................................................................. 178
  6.2.1 Contribution of the Research .................................................................................................................... 179
  6.2.2 Implications for Practice .......................................................................................................................... 181

6.3 Implications for Research and Recommendations for Further Research ....................................................... 183

6.4 Limitations of the Research ............................................................................................................................ 185

6.5 Conclusion ....................................................................................................................................................... 187

References ............................................................................................................................................................... 190

Appendices .............................................................................................................................................................. 229
LIST OF FIGURES

Figure 1.1 The Research Evolution.............................................................. 5
Figure 1.2 Map of Africa.............................................................................. 9
Figure 2.1 APIT/ACIT Research Model of ITT.............................................. 26
Figure 2.2 Items Used in Estimating Telemedicine Transfer Outcomes........ 33
Figure 3.1 Deductive Research Approach.................................................. 65
Figure 3.2 Overall Model of Telemedicine Outcomes................................. 77
Figure 3.3 National Infrastructure Model of Telemedicine Outcomes.......... 79
Figure 3.4 Cultural Model of Telemedicine Outcomes................................ 81
Figure 5.1 Research Process and Administration........................................ 118
Figure 5.2 Overall Model with Significant and Insignificant Path............... 139
Figure 5.3 National Infrastructure Models with Significant and Insignificant Path... 141
Figure 5.4 Modified Cultural Model - Interaction ........................................ 144
Figure 5.5 Cultural Model With Significant and Insignificant Path............... 146
Figure 6.1 Supplementary Analyses.......................................................... 169
LIST OF TABLES

Table 1.1  Funding of Telemedicine Technology in Industrialized and SSA Countries……  7
Table 1.2  Basic Socio-economic Statistics for Sub-Saharan Africa…………………………  10
Table 1.3  Summaries of Motivations and Rationales for Research .................................  17
Table 1.4  Lists of Research Publications ....................................................................  21
Table 2.1  Maturity Level trend of Telemedicine Diffusion...........................................  24
Table 2.2  APIT/ACIT Research Construct of ITT .......................................................  25
Table 3.1  Comparisons between SEM Techniques .........................................................  70
Table 3.2  Guidelines for QPR Research .....................................................................  72
Table 3.3  Relationships between Hypothesized Variables ...........................................  76
Table 3.4  Hypotheses – National Level .....................................................................  85
Table 3.5  Hypotheses – Cultural Level .....................................................................  89
Table 4.1  Important Definitions for this Study .............................................................  90
Table 4.2  Demography Results Pilot Study .................................................................  96
Table 4.3  Cronbach’s Alpha Pilot Study ....................................................................  97
Table 4.4  Convergent Reliability Pilot Study ...............................................................  98
Table 4.5  Discriminant Validity Pilot Study .................................................................  99
Table 4.6  Comparison Pilot and Final Survey .............................................................. 100
Table 4.7  Items in Study Instrument, with Sources with Theory ............................... 101
Table 5.1  Demography Results Main Study ............................................................... 120
Table 5.2  Cronbach’s Alpha Main Study ................................................................. 123
Table 5.3  Confirmatory Factors analysis .................................................................... 125
Table 5.4  Cross-Loading Items ............................................................................... 127
Table 5.5  Average Variance Extracted .................................................................... 130
Table 5.6  Convergent Reliability ............................................................................... 131
Table 5.7  Matrix of Latent Construct ...................................................................... 132
Table 5.8  Path Coefficients and $R^2$ for over all Models. ........................................... 134
Table 5.9  Path Coefficients and $R^2$ for National Infrastructure Model .................. 140
Table 5.10 Path Coefficients and $R^2$ for Cultural Model ........................................ 145
Table 5.11 Hypotheses Results ................................................................................. 147
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACIT</td>
<td>Arab Culture and Information Technology</td>
</tr>
<tr>
<td>AISI</td>
<td>African Information Society Initiative</td>
</tr>
<tr>
<td>AMA</td>
<td>American Medical Association</td>
</tr>
<tr>
<td>APIT</td>
<td>Arab Policy and Information Technology</td>
</tr>
<tr>
<td>DICOM</td>
<td>Digital Imaging and Communication in Medicine</td>
</tr>
<tr>
<td>DOT</td>
<td>Digital Opportunity Task</td>
</tr>
<tr>
<td>HL7</td>
<td>Health Level 7</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>ICTT</td>
<td>Information and Communication Technology Transfer</td>
</tr>
<tr>
<td>IFIP</td>
<td>International Federation for Information Processing</td>
</tr>
<tr>
<td>IMIA</td>
<td>The International Medical Informatics Association</td>
</tr>
<tr>
<td>IS</td>
<td>Information System or Information Science</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
</tr>
<tr>
<td>LDC</td>
<td>Least developed country</td>
</tr>
<tr>
<td>NII</td>
<td>National Information Infrastructure</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Government Organization</td>
</tr>
<tr>
<td>PLS</td>
<td>Partial Least Square</td>
</tr>
<tr>
<td>POTS</td>
<td>Plain Old Telephone Service</td>
</tr>
<tr>
<td>QPR</td>
<td>Quantitative Positivist Research</td>
</tr>
<tr>
<td>SEM</td>
<td>Structural Equation Modeling</td>
</tr>
<tr>
<td>SSA</td>
<td>Sub-Saharan African</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Program</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction

Sub-Saharan African (SSA) is facing continuous health threats characterized by spread of infectious diseases, high levels of infant and maternal mortality, low level of life expectancy, and deteriorating healthcare facilities. For example, the World Health Organization (WHO) reports that in 2004, an estimated 40 million people worldwide — 37.2 million adults and 2.7 million children under the age of 15 — were living with HIV/AIDS. More than 70 percent of these people (28.1 million) live in Sub-Saharan Africa; another 15 percent (6.1 million) live in South and Southeast Asia (WHO, 2004; Musa et al., 2005b). Another major health concern is malaria, which is responsible for as many as half of the deaths of African children under the age of five. The disease kills more than one million children — 2,800 per day — each year in Africa alone. In regions of intense transmission, 40% of toddlers may die of acute malaria. There is, however, a good chance of survival if appropriate medical attention is provided in a timely manner. Other diseases that plague the continent and lead to loss of millions of lives every year in Africa include dysentery, cholera, typhoid, yellow fever, and diarrhea, as well as many others (WHO, 2005).

These poor health indices reflect the overall decline in socio-economic development. Shortage of access to health services in the region is further complicated by the concentration of healthcare services in urban centers. An estimated 70% of SSA populations live in rural areas. The rural communities have no access to, or are far from, health facilities, resulting in over 65% of SSA population lacking essential healthcare services. Healthcare services, trained healthcare personnel and construction of health facilities have deteriorated in the last decade (WHO, 2004). For example the SSA, with 24% of the global burden of disease, has only 3% of the world’s health workers, and spends less than 1% of the world’s health expenditure (WHO, 2006). A combination of factors is at the root of the severe shortage of skilled health professionals in the region, not least of which is the brain drain. Telemedicine initiatives represent an attempt to address some of these pressures, and have a real potential to improve accessibility and quality of healthcare (Kifle et al., 2004b, 2005a, 2006a; Mbarika, 2004; Mitchell, 2000).
Telemedicine, which literally means “medicine at a distance”, encompasses all medical activities: diagnosis, treatment, prevention, education, and research (Craig, 1999). Telemedicine is further defined as the use of information technologies to exchange health information and provide healthcare services across geographical, time, social, and cultural barriers (Reid, 1996). Many definitions of telemedicine emphasize the distance aspect, and use of the Internet to solve problems related to accessibility and quality of healthcare services (Wootton, 1996, 1997; Bashshur et al., 1997). In general, telemedicine technology includes both store-and-forward - asynchronous (Bellon et al., 1995; Cross, 1996; Della Mea, 1999; Fredriksen et al., 1997; Provost et al., 1998), as well as live videoconferences – synchronous (Bergmo, 2000; Wootton, 1999; Wootton et al. 2000) transmissions around the globe via satellite networks. In the last decade, pilot studies have shown the potential benefits of telemedicine for patients and healthcare providers. The results demonstrated the socio-economic impacts of telemedicine, and its potential in the area of improving accessibility, containing costs, and providing quality care (Bashshur, et al. 2002; Brady, 2005; Brauchli et al., 2004; Craig et al., 2005; Kuntalp et al., 2004; Kifle et al., 2006b).

Despite high hopes, however, telemedicine has been slow to come into routine use. Numerous studies document the diverse problems related to telemedicine technology diffusion in general (Barrett and Brecht, 1998; Brady, 2005; Kuan and Chau, 2001; Tulu et al., 2005); these studies often point to scarcity of resources (Janczewski and Shi, 2002; Tulu and Chatterjee, 2003; Wootton, 2003), poor telecommunication infrastructures such as bandwidth (Adam, 1996, 2001; Bashshur, 2005), and the impact of the Internet (Avgereu, 2000; Mbarika et al., 2005). Other frequently mentioned factors in the literature are non-technological issues such as organizational (AaS, 2001; Hu et al., 2000), human elements (Chau and Hu, 2002a; Crote and Viera, 2002; Hu et al., 1999; Kifle et al., 2005b), policy (Anderson, 2000; Gilbert, 1997; Kumekawa et al., 1997a, 1997b; Varghese and Scott, 2004), socio-economic (Bashshur et al., 1997; Jennett et al., 2003a, 2003b, 2004, 2005; Kamel, 1995; Madon, 2000; Odedra-Straub, 1996; Scott et al., 1999, 2004, 2005) and cultural issues (Bagchi et al., 2003; Banai, 1992; Checchi et al., 2001, 2002; Choe, 2004; Ford, 2003; Hill et al., 1998; Hofsted and Franke, 1991; Kaplan, 2000; Leidner and Kayworth, 2006; McCoy, 2002; Myers and Tan, 2002; Okoli,
2003; Straub et al., 2002) as primary barriers to telemedicine becoming a routine part of a healthcare system. However, the majority of attention is focused on the evaluation of technology aspects of telemedicine (Bashshur, 1998; Jennett et al., 2005; Tulu et al., 2005), where the challenges are often people, organizational, and social rather than mostly technological (AaS, 2001; Ash, 1997; Dolitte and Cook, 1999; Han, 2005; Hu et al., 2000; Kifle et al., 2006c; Robinson et al., 2003; Teo et al., 2003; Whitten and Allen, 1995). In the past decade, researchers have tried to come up with research models that focus on the integration of non-technological and technological barriers of telemedicine (Bashshur et al., 2002; Field, 1997; Håkansson, 2001; IOM, 1996; Jennett et al., 2004).

To integrate this insight into the practice of telemedicine, however, is not straightforward; it continues to be a major issue in telemedicine research strategies and understanding. This study examines Information and Communication Technology Transfer (ICTT) as it applies to telemedicine in SSA, and by extension to other developing countries. ICTT issues have received considerable attention among Information System (IS) researchers: only a limited number of studies, however, have focused on ICTT outside of Europe and the USA (Avgerou, 2003; Bada, 2002; Braa et al., 2004; Dutta, 1997, 2001; Edeger, 2000; Mbarika et al., 2001; Montealegre, 1999; Okoli, 2003a; Straub et al., 2001; Tan et al., 2005). Even so, no known study has examined telemedicine transfer within SSA. Previous attempts to move various information technologies from partners (developers) in the developed countries to the developing world have failed because of a clear neglect of the infrastructure, socio-economic and cultural factors that impact such transfers (Avgerou and Walsham, 2000; Aynu et al., 2003; Hill et al., 1998; Loch et al., 2000, 2003; Meso and Duncan, 2000; Meso et al., 2005; Straub et al., 2001). Hence, the origin and motivation for this work is to address some of the key factors (infrastructure, socio-economic and cultural) that pose challenges for introducing telemedicine technology into the health care system in developing countries in general, and SSA in particular.

To examine key factors that impact the transfer of telemedicine technology, I focus on various pertinent issues from the perspective of infrastructure, socio-economic and cultural factors (i.e. ICT infrastructure and culture at the national level). The focus on national infrastructure and culture is critical, because these subjects underscore a better
understanding of how technical and non-technical telemedicine diffusion issues are related, in order to improve telemedicine transfer outcomes in SSA countries. Thus, I concentrate on surveying the literature, developing theoretical conceptual models, and hypothesizing upon their interrelationship in determining telemedicine social and value outcomes in Sub-Saharan Africa (SSA). I adopt a quantitative positivist research approach (Dube and Pare, 2003; Lee, 1999; Mingers, 2004; Straub et al., 2004) as philosophy and methodology to guide my empirical research (Vassey et al., 2002; Popper, 1968, p. 104–122). To validate this study, I conducted a quantitative survey of SSA physicians. I used the Partial Least Squares (PLS) statistical analysis method to test my structural and measurement model (Anderson and Gerbing, 1998; Barclay et al., 1995; Chin and Newsted, 1999; Chin, 1998a, 1998b; Falk and Miller, 1992; Gefen et al., 2000; Loehlin, 1987). The resultant study focuses on the answers to two research questions:

**Research Question 1**
*What aspects of national infrastructure influence the transfer of telemedicine outcomes in SSA?*

**Research Question 2**
*What cultural and implementation factors influence the transfer of telemedicine outcomes in SSA?*

By addressing these two research questions, this dissertation aims to give the IS and telemedicine communities an understanding of, and perspective on the fundamental challenges of, telemedicine transfer in developing countries in general, and SSA in particular. In order to answer the research questions, a step-by-step research approach is presented in Figure 1.1.

The dissertation proceeds as follows: In this introductory chapter, I justify the need for this study. I first describe the digital divide that characterizes Sub-Saharan Africa. Next, I present the geo-economic, socio-economic, and health characteristics of
SSA countries, and the importance and rationale of the research. Then, I discuss the two research questions presented above. Finally, I address the research approach of this study. In Chapter 2, I review the literature of telemedicine transfer, focusing on national and cultural factors that influence telemedicine outcomes in SSA. This review serves as a theoretical foundation upon which to establish a conceptual research model. In Chapter 3, I present a research method, model and hypotheses that offer an explanation of these effects. In Chapter 4, I describe overviews of the pre-test and pilot test, with their results and recommendations for the main study. In Chapter 5, I present the research approach and methodology used to conduct the main study, and report its findings. In Chapter 6, I discuss the results of the main study together with their implications, and make recommendations for further research.

Figure 1.1: The Research Evolution
1.1 The Digital Divide

Technology distribution and access scarcities characterize the most critical issues in the diffusion of ICT and telemedicine applications (Avgerou, 2000; Cherry, 2004; Mbarika et al., 2001; Meso and Duncan, 2000; Rolland and Monteiro, 2002). The digital divide has been defined as “… the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access Information and Communications Technologies (ICTs) and to their use of the Internet for a wide variety of activities…” (OECD, 2001). The digital divide is one of the biggest issues facing the world today. As United Nations Secretary General Kofi Annan stated in December 2003:

“Now it is up to all of us to build an information society from trade to telemedicine, from education to environmental protection. We have in our hands, on our desktops and in the skies above, the ability to improve the standards of living for millions upon millions of people.” (WSIS, 2003, p.19)

However, more than 80% of people around the developing world have never heard a dial tone or surfed the web (Mbarika et al., 2005). Developing countries account for less than 5% of Internet users worldwide (Cherry, 2004); currently, there are more Internet hosts and servers in one state in the USA than in the entire African continent (ITU, 2004).

In most developing countries, many villages still lack basic ICT infrastructure, such as telephone lines and power supplies, that influence telemedicine technology transfer (Avgerou, 2002; Messo et al., 2005). That is why the transfer of information systems in developing countries is usually described as a problem (Heeks, 2002a, 2002b; Madon and Sahay, 2000; Montealegre, 1999; Moore and Benbasat, 1991). Moreover, ICT utilization inequalities in the general population are found also in industrialized countries, determined by education level, gender, and income (Kvasny, 2005; Kvasny and Keil, 2002; Lu, 2001; Trauth, 2003). These inequalities are also seen within developing countries, where urban and upper-class citizens enjoy the benefits of
Internet and ICTs. However, it is clear that industrialized nations with the resources to invest in and develop ICT infrastructure are reaping enormous benefits from the information age (Bettis and Hitt, 1995; Porter, 2001). For example, in the case of industrialized countries almost all telemedicine projects have been sponsored by governments, while in the case of SSA countries most of the projects have been funded by international or Non-Governmental Organizations (NGO’s) (Kifle et al., 2005a) (See Table 1.1 Funding of Telemedicine Technology in Industrialized and SSA Countries). Specifically, when it comes to the health sector, the digital divides between developed and developing countries are wider than the gap observed in other productive and social sectors (Ratzan, 2000; Strecher, 2000; Street et al., 1997). Furthermore, productive sectors such as banking have accepted ICT faster, and allocate 5-10 percent budget for IT, while the healthcare sector is 10-15 years behind the productive sector, with only 2-3 percent of its budget allocated to IT (Gravitz, 2000; Lu and Farrell, 1990; Raghupathi and Tan, 2002).

Table 1.1: Funding of Telemedicine in Industrialized and SSA Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Common Application</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>Teleradiology, Telepsychiatry, Education</td>
<td>Government Grants</td>
</tr>
<tr>
<td>Europe</td>
<td>Teleradiology, Teledermatology, Telepsychiatry, and ENT</td>
<td>Government Grants</td>
</tr>
<tr>
<td>Japan</td>
<td>Teleradiology, Teleconsultation, Telehomecare</td>
<td>Government Grants</td>
</tr>
<tr>
<td>USA</td>
<td>Teleradiology, Teledermatology, Telepsychiatry</td>
<td>Federal, State, Research Funds, and fee for service.</td>
</tr>
<tr>
<td>SSA</td>
<td>Ethioopia</td>
<td>Teledermatology, Teleradiology</td>
</tr>
<tr>
<td></td>
<td>Mozambique</td>
<td>Teleradiology</td>
</tr>
<tr>
<td></td>
<td>Senegal</td>
<td>Teleradiology</td>
</tr>
</tbody>
</table>

The potential of telemedicine and its outcomes (social and value) depend on the level of the technology in place. The Internet is a “great equalizer” (Travica, 2002) in a very significant way in diffusion of ICT. For example, rapidly advancing ICTs potentially
have the power to help improve living conditions in South Asia (Hoffman and Novak, 1998; Lu, 2001). Furthermore, the Okinawa Charter on the Global Information Society (Kyushu-Okinawa, 2000), the G8 leaders established a Digital Opportunity Task (DOT) force, 2001, presented to the G8 summit in Genoa, concludes,

“… when wisely applied, ICTs offer enormous opportunities to narrow social and economic inequalities and support sustainable local wealth creation, and thus help to achieve the broader development goals that the international community has set. ICTs cannot of course act as a panacea for all development problems, but by dramatically improving communication and exchange of information, they can create powerful social and economic networks, which in turn provide the basis for major advances in development.”

The growth of ICTs provides opportunities to improve human development, and to confront social, economic, and health disparities (UNDP, 2005). Despite the heralded news that ICT will provide low cost, fast solutions to improving the healthcare services of world populations, the grim reality is that we are not going to easily close the gap and erase the inequities caused by the digital divide. Therefore, lacking basic national ICT infrastructure poses a problem to telemedicine transfer to developing countries (Jensen, 2000, 2001; Mbarika, 2001), and influences the socio-economic development of nations (Meso and Dunca, 2000, Musa et al., 2005a; Musa, 2006). Specifically, socio-economic development without adequate social infrastructure such as healthcare and education is severely curtailed (Mbarika et al., 2005).

1.2 Sub-Saharan African Countries: Geo-economic and Socio-economic Characteristics

Least developed countries (LDCs) are typically characterized as low-income countries suffering from long-term constraints against growth. In particular, these growth constraints include low levels of human resource development, and severe structural weaknesses in the economic, social, and political realms. These inherent
structural weaknesses explain why Sub-Saharan Africa is home to 33 of the 48 least developed countries of the world, according to World Bank definitions and criteria (World Bank, 2000); see Appendix I – Least Developed Countries) (Kifle et al., 2005a; Mbarika et al., 2005).

Sub-Saharan African countries are located south of the Sahara Desert in Africa. In the map below (Figure 1.2, Sub-Saharan Africa consists of all countries south of the Tropic of Cancer (latitude 23½° N).

![Map of Africa](https://example.com/map.png)

**Figure 1.2:** Map of Africa

In most studies of economic development, Africa is divided into two regions based on the general homogeneity of its development patterns: North Africa and Sub-Saharan Africa (World Bank, 2001). The development patterns of North Africa are
very similar to those of the Middle East; thus, these two socio-economic regions are often classified together, even though they are geographically on different continents. In the region of SSA, the Republic of South Africa is an unusual case: the apartheid policy, scrapped only in 1994, led to the development of an essentially dualistic socio-economic society: while the indigenous white population lives in a society much like Europe, the majority black population lives in conditions much like those in the rest of SSA. Because of this duality, the Republic of South Africa is often considered separately from the other countries in Sub-Saharan Africa. In this study, I will continue this tradition and look at Sub-Saharan Africa only, without consideration of the Republic of South Africa. I believe that, although there are citizens in parts of the Republic of South Africa who live in conditions similar to those in SSA, the pattern of the spread of technology to these individuals is significantly different from that in the rest of Sub-Saharan Africa (Kifle et al., 2005a; Mbarika et al., 2005; Okoli, 2003). Table 1.2 lists some basic socio-economic statistics for SSA.

**Table 1.2: Basic Socio-economic Statistics for Sub-Saharan Africa**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>SSA</th>
<th>Low Income</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social and Economic variables (2004)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>725.8 Million</td>
<td>2,343 M</td>
<td>6,365 M</td>
</tr>
<tr>
<td>Urbanization</td>
<td>34.4%</td>
<td>31.9%</td>
<td>47.2%</td>
</tr>
<tr>
<td>Population growth (annual %)</td>
<td>2.1%</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Life expectancy (years)</td>
<td>46.2</td>
<td>58.7</td>
<td>67.3</td>
</tr>
<tr>
<td>Illiteracy total (% age 15 and above)</td>
<td>36.7%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Surface area (Sq. Km)</td>
<td>24.3 Million</td>
<td>34.2 M</td>
<td>133.8 M</td>
</tr>
<tr>
<td>GNI per capita (current US$)</td>
<td>$601</td>
<td>$507</td>
<td>$6,329</td>
</tr>
<tr>
<td>GDP (current US$)</td>
<td>$523 Billion</td>
<td>$1,239B</td>
<td>$41,290B</td>
</tr>
<tr>
<td>Foreign aid per capita</td>
<td>$20.42</td>
<td>$9.28</td>
<td>$9.64</td>
</tr>
<tr>
<td><strong>Contribution of Different Sectors % of GDP (2004)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>15.7%</td>
<td>23.0%</td>
<td>-</td>
</tr>
<tr>
<td>Industry</td>
<td>27.7%</td>
<td>32.1%</td>
<td>-</td>
</tr>
<tr>
<td>Service</td>
<td>56.4%</td>
<td>44.9%</td>
<td>-</td>
</tr>
<tr>
<td><strong>Technology and Infrastructure (2003)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paved roads (% of total)</td>
<td>13.8%</td>
<td>16%</td>
<td>43%</td>
</tr>
<tr>
<td>Fixed lines (per 1,000 people)</td>
<td>1.41</td>
<td>2.7</td>
<td>16.3</td>
</tr>
<tr>
<td>Personal computers (per 1,000 people)</td>
<td>9.9</td>
<td>5.2</td>
<td>78.3</td>
</tr>
<tr>
<td>Internet users (per 1,000 people)</td>
<td>5.6</td>
<td>3.8</td>
<td>60.5</td>
</tr>
</tbody>
</table>

**Sources:** World Development Indicators Database, August 2003; WHO/UNICEF Joint monitoring Program, 2003; African Human Development Indicators – UNDP, 2003
A research focus on Sub-Saharan Africa is fundamental to the scope of my study, not only because this region has a different socio-economic structure than other more developed or developing countries around the world, but because it also has a different socio-economic structure than the more developed regions of North Africa and the Republic of South Africa. There is a substantial disparity among different regions of Africa in terms of the state of their economic structures and telecommunications infrastructures (Mbarika, 2001; Meso et al., 2005; Odedra-Straub, 1993). For example, most countries within the Sub-Saharan African region have a far lower telephone penetration (teledensity) and smaller income levels (per capita GDP) than North Africa and the Republic of South Africa (Jensen, 2001; Kifle et al., 2005a; Mbarika et al., 2005; Okoli, 2003).

In recent years, there has been a worldwide focus on SSA development issues. The region has been drawing tremendous international attention, especially for its many socio-political problems in general and its health problems in particular. For example, malaria, HIV/AIDS, and many other deadly diseases are known to claim millions of lives. Policy makers within the continent are investing much needed effort to seek possible solutions to Sub-Saharan Africa's multiple issues, including its health and other socio-economic problems. Even policy makers in the developed world (especially in Europe and the US) are investing time and effort to help developing countries such as those within the Sub-Saharan Africa region develop ICT infrastructures that could contribute to solving some of the region's priority problems. For example, realizing the importance of a well-developed Internet infrastructure for developing countries, the G8 nations agreed to form a task force that would spearhead efforts to boost Internet access and help bridge the digital divide by sharing information technology (Mbarika et al., 2002a). As the G8 members stated in their charter (CNN, 2000):

“Countries that succeed in harnessing information (and communications) technology potential can look forward to leapfrogging conventional obstacles of infrastructure development.”
With the creation of a U.S. Congress Sub-Committee on Africa, the United States demonstrates a more specific case of the developed world becoming concerned with helping the regions of Sub-Saharan Africa solve some major socio-economic problems, such as those related to healthcare. In 2001, Sub-Committee Chairman Ed Royce stated (Royce, 2001):

"Many Africans and others are concerned that African countries are being left behind as information and communications technology continues to transform economic, social, and cultural developments worldwide. Africa lags behind other regions of the world in usage of the Internet, the most powerful medium for mass communication the world has ever known."

Realizing the benefits that the Internet and related technologies are currently providing to Sub-Saharan Africa, he went on to refer to the following application of telemedicine technology: "Medical students in Senegal are being instructed by doctors in Belgium via video link." With such awareness and support from the U.S. Congress, from the Clinton (White House, 2000; USIA, 2000) to the Bush (Washington Office on Africa, 2002) administrations (the US government has committed billions of dollars to combat major area health problems in Africa such as malaria and HIV/AIDS), the assistance is already underway. For example, the U.S. Agency for International Development (USAID, 2001) Leland Initiative has a long history of multiple development projects in several African countries. This initiative “is a five-year, $15 million U.S. government effort to extend full Internet connectivity to 20 or more African countries. The Leland Initiative builds on existing capacity with the ultimate aim of facilitating Internet access throughout each country" (USAID, 2001). Also, the European Community has a resolution (AS-0191/2001) on Information and Communication Technologies, supporting policy innovation and coordination to address such problems as connectivity, telecommunication reform and technology transfer.

Combining the relevance and necessity of such an under-researched area, based on an under-researched region of the world, I believe that, with theories grounded in IT transfer, Information Science (IS) has the potential to contribute significantly to this
stream of research, especially as it relates to the region of Sub-Saharan Africa. Furthermore, an examination of the disparity between the more developed regions of North Africa and the Republic of South Africa and the less developed areas of Sub-Saharan Africa highlights the research focus on the regions.

1.3 Motivations and Rationale for Research

Telemedicine has been chosen as the topic for this research because, although it is still in its early stage, it is gaining considerable interest due to the use of many new telemedicine applications as its services expand. Much of the previous research in the area referred to situations in which the potential of telemedicine is undermined by such concerns as policies (Anderson, 2000; Courtright, 2004; Darkins and Cary, 2000; Fidler, 2001; Fujimoto et al., 2000; Scott et al., 2002), security and privacy (Blobel and Roger-Frace, 2001; Gilbert, 1997; Kumekawa et al., 1997a; Magennis and Mitchell, 1996; Sandberg, 1995; Stanberry, 2006; Tulu and Chatterjee, 2003), standards (Kumekawa et al., 1997b; Loane and Wootton 2002; Wachter, 2000; Williams and Singh, 1996), ICT infrastructure (Carbajal and Honea, 1999; Collen, 1999; Mbarika et al., 2005), lack of interest or resistance of physicians (Chau and Hu 2001, 2002a, 2002b; Croteau and Vieru, 2002; Kifle et al., 2005b; Friedma, 1997), reimbursement (Brady, 2005; Doolittle et al., 2004; Johnston et al., 2004; Whitten, 2002; Whitten et al., 2000a), organization and environment (Aas, 2001; Hu et al., 2000; Iacovou, 1995; Rogers, 1983; Whitten and Allen, 1995) and cultural situations (Hofstede, 2000; Leidner and Kayworth, 2006; McCoy et al., 2003a; Straub et al., 2002).

Furthermore, several studies report that telemedicine has the requisite technology, but faces such uncertainties as lack of long-term sustainability plans, lack of mature programs that can be the basis of definitive cost-benefit analysis, and limited acceptance of telemedicine by health providers (Bashshur, 2002; Kifle et al., 2006b). Yellowless (1997) also stated that telemedicine has been slower to implement than originally envisioned or expected. It has been difficult to move beyond single transmissions and limited projects into routine use. On a general level, it seems that the real telemedicine challenges are not of a technical nature, but relate instead to non-
technical factors such as individual or organizational considerations (Hu et al., 1999; Stanberry, 2000).

This study identifies and explores key factors and relationships related to the transfer of telemedicine in healthcare promotion. I believe that my particular interest in the national level of ICT infrastructure and culture, as well as my focus on SSA countries, adds another distinct dimension to the discussion. Because telemedicine may affect the lives of many SSA citizens, my study’s findings should be of interest not only to academia but also to health providers, telecommunication companies, international donor organizations, and policy makers.

Furthermore, my choice to examine factors influencing the transfer of telemedicine technology studies is based on the following rationales:

First, recent unfolding developments in ICT in the region, including use of the Internet for communicating with others (Edeger, 2000; Fredriksen et al., 1997; Kuntalp and Akar, 2004; Torres-Edejer, 2000), exchanging information via electronic links (Moore, 2002; Pal et al., 2005; Prednia, 1996; Prednia and Allen, 1995; Wallace, 1997), and participating in remote consultations (Brauchli et al., 2005; Doolittle and Cook, 1999; Kifle, 2006; Nesbitt et al., 2005). Previous research also shows that the future of telemedicine is being linked to e-government and the emergence of information and communication technologies in the SSA region (Kifle et al., 2006c; Madon, 2003).

Second, considering the region’s multiple medical problems, healthcare is unarguably one of the most fundamental needs for Sub-Saharan Africa. Both academic and practitioner literature report on the existing and fast-growing medical problems of Sub-Saharan Africa. These problems stimulate new approaches such as telemedicine for improving access and reducing costs, as well as achieving the Millennium Development Goal (Moore, 2002; WHO, 2004; ITU, 1998, 2004; Kifle et al., 2004a, 2005b, 2006a, 2006b; Mbarika and Okoli, 2003; Mbarika, 2004).

Third, issues related to shortage of medical personnel and facilities in Sub-Saharan African countries. For example, the Sub-Saharan Africa region, with 24% of the global burden of disease, has only 3% of the world’s health workers, and spends less than 1% of the world’s health expenditure (Kifle et al., 2006d); 23% of SSA countries have no medical schools, and 47% have only one (Hagopian et al., 2004). Also, many developing
countries face an acute shortage of doctors, particularly specialists and sub specialists. Sub-Saharan Africa has, on average, fewer than 10 doctors per 100,000 people, and 14 countries within the region do not have a single radiologist (Fraser and McGrath, 2000). The specialists and services that are available are concentrated in cities. Given that 70% of Sub-Saharan Africa’s population inhabits rural areas, the availability of healthcare in the more remote areas is indeed a major problem.

Fourth, many parts of SSA are affected by the “brain drain” phenomenon: many qualified specialists leave their countries to work in Western Europe and North America. WHO (2006) figures show that physicians trained in Sub-Saharan Africa and currently practicing in OECD (Organization for Economic Cooperation and Development) member countries represent 23% of the existing doctor workforce in the countries of origin. For example, it is estimated in Ethiopia that about one-third of the medical doctors have already left the country (IOM, 2004). The Director-General of the WHO, Dr. Lee, has noted,

“… brain drain from Africa is severely limiting the ability of health workers to combat the HIV/AIDS epidemic and achieve any substantial progress towards the Millennium Development Goals (2015).” However, “The high burden of disease in developing countries often makes it difficult for health systems in these countries to attain the same level of specialist skills as industrialized countries. Technology transfer is one way to improve specialist skills whilst at the same time reducing the burden of disease. Technology transfer using telemedicine is a cost-effective method that richer countries can employ to aid capacity building in the health care systems of poorer countries” (Lee, 2003).

Fifth, lack of experience and misdiagnosis, as well as wrong medications, are major problems among Sub-Saharan African physicians; medical errors are a significant cause of death in SSA countries. Most studies show that medical error is not due to gross physician negligence in most cases; rather, it is due to the absence of infrastructure that can support decision-making during treatment of patients (Bashshur et
Sixth, healthcare providers in developing countries and international organizations have begun to consider telemedicine as a solution to the existing healthcare problems (ITU, 2000; UNDP, 2001; WHO, 2005; WB, 2001; Wootton, 2001b). In addition, the effects of ICTs on local factors such as government policies, economics, politics, social, cultural and infrastructure issues have also attracted the interest of international researchers and practitioners (Avgerou and Walsham, 2000; Cherry, 2004; Kvasny, 2005; Odedra-Straub, 1996); for example, Working Group 9.4 of the International Federation for Information Processing (IFIP) studies the social and cultural implications of information and telecommunication technologies and systems in developing counties. These studies highlight socio-economic and cultural differences (Bada, 1995, 2000; D’Mello, 2003; Heeks, 2002b; Moyo, 1996; Musa, 2006) and the impact of these relations on information technology, which is becoming more recognized (AMCIS, 2004; Information Society, 2002; Mansell and Whet, 1998).

However, despite the number of telemedicine initiatives in SSA countries, most studies are based on developed countries, and not generally applicable to developing countries. Lu and Farell (1990) state that the transfer of IT development experiences from developed to developing countries requires a good understanding of its special local environment (such as national infrastructure and culture). Furthermore, Straub et al. (2001) state that “The transfer of information technology from industrialized to developing countries generally involves a process of injecting the technology of the industrialized world and its associated methodologies into developing nation hosts.” (Straub et al. 2001, p. 8) In the case of telemedicine, the issue may not only be physician resistance or cost, but may also include other factors such as infrastructure, policy, e-readiness, and culture that are also crucial in the case of developing countries (Audet, et al., 2004; Yarbrough et al., 2005). See table 1.3 for the summaries of motivations and rationales for the study.
Table 1.3: Summaries of Motivations and Rationales for Research

<table>
<thead>
<tr>
<th>First</th>
<th>Recently unfolding developments in ICT in the SSA region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>Considering the region’s multiple medical problems</td>
</tr>
<tr>
<td>Third</td>
<td>Issues related to the shortage of medical personnel and facilities in SSA countries</td>
</tr>
<tr>
<td>Fourth</td>
<td>Issues related to brain drain of medical personnel from the SSA region</td>
</tr>
<tr>
<td>Fifth</td>
<td>Lack of experience and misdiagnosis among SSA physicians</td>
</tr>
<tr>
<td>Sixth</td>
<td>Considering telemedicine as a solution, and understanding local environment, among healthcare providers and research communities</td>
</tr>
</tbody>
</table>

1.4 Research Questions

In this study I emphasize the need to look at the problem from two different perspectives or levels: first, that of national infrastructure (national level); and second, that of culture (cultural perspectives) through which one can examine how technical and non-technical issues interact to produce effective telemedicine (social and value) outcomes in Sub-Saharan Africa. I describe these two levels as they relate to telemedicine in Sub-Saharan Africa, and present specific research questions for this study.

1.4.1 National Infrastructure for Telemedicine in Sub-Saharan Africa

The most important requirements for telemedicine outcomes to succeed at the national level include: national ICT infrastructure, as well as the government’s attitudes and policies towards ICT in health and healthcare development. The research community has done several studies that indicate the importance of ICT diffusion at the national level (Adam, 1997; Avgerou, 1989, 2003; Bada, 2002; Braa et al., 2004; D’Mello, 2003; Dutta, 1997; Madon, 2000; Mbarika et al., 2002c; Meso and Duncan, 2000; Odedra et al., 1993; Rolland and Monteiro, 2002; Tulu et al., 2005). National Information Infrastructures (NIIs) are shared common resources for the community. They support and enable a wide variety of activities, and are not especially tailored to telemedicine. Thus, studying telemedicine as an NII is relevant because telemedicine is intended as a communication infrastructure common to all health care, not just as
separate applications between a limited number of institutions and individuals. However, such a comprehensive telemedicine infrastructure in SSA is not yet in place, and one of the challenges to transfer of telemedicine is related to this question. This research and my empirical investigation will show the impact of National Information Infrastructure on telemedicine outcomes in Sub-Saharan Africa.

Research Question 1

What aspects of national infrastructure influence the transfer of telemedicine outcomes in the SSA?

1.4.2 Cultural and Social Issues Influencing Telemedicine in Sub-Saharan Africa

The second aspect, as important as NII, is to investigate the effects of national culture on the outcomes of telemedicine transfer in SSA. Researchers in developing countries have studied the effects of culture on technology adoption and use (Adler 1986, Akrich, 2000; Avgerou, 2002; Heeks, 2002; Hill et al., 1998; Hofstede, 2000; Loch et al., 2000, 2003; Myers and Tan, 2002; Rose and Straub, 1998; Straub, 1994; Walsham, 2001, 2002). This research illustrates that IT in developing countries involves not simply the technology transfer (telemedicine) and IT diffusion principles developed in the industrialized world in a new context. Rather, the cultural context of SSA is so different that we would expect significant differences in the way telemedicine is introduced and diffused in this region. Cultural analyses have shown that the crucial issue might not relate only to cultural resistance, but also include other factors such as ICT infrastructure, socio-economics, policy, and education that also vary in local settings.

Several studies have reported on IT in developing countries (Avgerou and Walsham 2000; Walsham, 2002; Straub et al. 2001). However, they focus on the effects of culture on IT technology, while there are few studies on the impact of culture and social issues on the adoption and use of telemedicine in the SSA environment. Therefore, the present study focuses on the impact of culture on the use of ICTs within the healthcare environment of SSA countries, specifically on telemedicine transfer. In light
of the probable importance of culture in telemedicine transfer; I will investigate a second question in this study.

**Research Question 2**

*What cultural and implementation factors influence the transfer of telemedicine outcomes in the SSA?*

1.5 The Research Approach

In order to address both research questions and carry out the research objective, I follow and apply Straub’s et al. 2004 quantitative positivist research recommendation (Straub et al., 2004, p. 380-246) and adopt generally accepted scientific methods, *i.e.*, the underlining ontology and epistemology (Chin, 1997) as well as methodology (*i.e.* data collected, evaluated and interpreted).

I will carry out research regarding telemedicine transfer to developing countries that is unique in the context of visually-based clinical application and healthcare (value and social) outcomes, particularly in the SSA region. I begin my studies by reviewing theories and models, and following scientific methods including: literature review - Webster and Watson, 2002; data collection techniques (administred by postal and web-based survey - Palvia *et al*., 2004; Hischhem and Klien, 2003); data analysis techniques (the data was analyzed with Partial Least Square techniques to eliminate possible subjectivity on the part of the researcher; I obtained valid and reliable results to answer my research questions - Chin, 1998b); and data evaluation and interpretation (I followed guidelines in Straub *et al*., 2004 to maintain quantitative positivist research rigor (*i.e.* “standard” and “systematic” validation), which increases the reliability of the research results such that I may build an accurate condition for the generalisability of the results (Gefen *et al*., 2000; Lee and Baskerville, 2003).

To summarize, the factors influencing the transfer of telemedicine technology, particularly the application of visually-based clinical telemedicine, I studied by applying the quantitative positivist paradigm research philosophy. Moreover, I used a quantitative method with positivist tradition in a deductive manner to discover causal
relationships within my model. Hypotheses and research questions have also been tested. Finally, the observed relationships have been compared with supporting and contradictory literature that I reviewed.

1.6 Contributions and Publications

The major contributions of the thesis are theory extensions, and the testing of the infrastructural and cultural models that focus on the transfer of telemedicine technology, as it applies to visually-based clinical applications in SSA. Two research models were proposed, and empirically tested using quantitative data collected from SSA physicians and other health professionals. The study also contributes to the ongoing debate on the potential of telemedicine in improving access and reducing costs. The results suggest that the two proposed research models adequately explain telemedicine transfer (social and value) outcomes. Based on the results achieved, implications are presented for IS research, along with some perspective directions for policy-makers as well as telemedicine technology providers for promoting an image-based application. Thus, the findings of this study provide valuable insights for SSA healthcare providers implementing visually-based telemedicine applications. Especially in the current economic situation of deteriorating healthcare facilities, these findings give researchers and practitioners a better idea about policy makers’ concerns for telemedicine outcomes, so that they may adjust their health policy appropriately.

Moreover, during the course of the research, other articles were published in relation to this work (See Table 1.4 for a list of research publications and Appendix XI - summary of related publications). Three appeared in journals, three were revised and resubmitted to journals, and the seventh was published as a book chapter. In addition to these journal papers, in at least seven other articles the results have been reported at international conferences. Thus, these related works reflect the different experiences and results that, has greatly contributed to the development work underlying this dissertation.
### Table 1.4: Publications

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title and Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kifle M., Mbarika V., and Brandy, R. (2006c)</td>
<td>&quot;The Diffusion of Telemedicine in Ethiopia: Potential Benefits, Present Challenges, and Potential Factors”, <em>Communications of the Association for Information System (CAIS) (Forthcoming)</em></td>
</tr>
</tbody>
</table>


Chapter 2: Literature Review

This chapter provides a review of the relevant literature upon which this dissertation is based. In the first section, previous related works on information technology transfer are reviewed. Then I present the review methods, to gain an understanding of telemedicine (social and value) outcomes in developing countries in general, and in SSA in particular.

In the second section relevant definitions, concepts and historical facts related to telemedicine are introduced. The notions of image-based clinical applications and store-and-forward e-mail telemedicine are discussed. The general telemedicine practices are presented in the end.

The third section discusses literature on telemedicine outcomes based on diffusion of innovation theory, Information Technology (IT) implementation factors, and culture, to shed light upon factors determining telemedicine outcomes.

2.1 Introduction

In the healthcare sector, rising costs and new types of health problems result in increasing pressure on the healthcare system, and stimulate new approaches for improving access and reducing cost of healthcare (Becher and Chassin, 2001; Brady, 2005; Mitchell, 2000; Moor, 2002 Nesbitt et al., 2005). Telemedicine initiatives represent potential solutions to improve healthcare accessibility and quality. In general, telemedicine has advantages where there is relatively inadequate or non-existent access to healthcare resources (Craig, 1999), uneven geographical distribution of expertise (Wright, 1997, 1998), and continuing increases in the cost of healthcare services (Whitten, et al., 2000b). In these circumstances telemedicine improves access to healthcare, reducing the cost. Also, by improving communication between health centers (peripheral) and secondary or tertiary hospitals, telemedicine has been shown to speed up the referral process, reduce unnecessary referrals, and improve quality of care (Harris, 2002; Huston and Huston, 2000; Kifle et al., 2005a, 2006b). In some cases, telemedicine may be cheaper than the conventional practice (Edworthy, 2001; Kifle et al., 2006b; McIntosh and Cairns, 1997).
Telemedicine has been applied to a wide area of image-dependent medical specialties, such as radiology, pathology, cardiology and dermatology (Brauchi et al., 2004; Nordrum et al., 1998; Wootton, 2003). In addition, telemedicine has also been applied to medical education, home care, military and prison applications, and urgent distance care. To a certain degree, the literature of telemedicine agrees that its maturity level may be higher with such image-dependent specialties as radiology and pathology (Bashshur et al. 2005; Heinzelmann et al., 2003; Krupinski et al., 2002; Tulu et al., 2005; Wootton, 2003) (See Table 2.1). It is not surprising that these image-dependent specialties have been most successful in terms of establishing quality standards, outlined by such professional organizations as Digital Imaging and Communication in Medicine (DICOM) (Weisser et al., 2006).

At present, there is a growing body of evidence that store-and-forward (asynchronous) telemedicine, using low-cost digital imaging devices, provides a means of medical diagnosis (Heinzelmann et al., 2005; Kifle et al., 2006b; Martinez et al., 2004; Swinfen and Swinfen, 2002; Struber, 2004; Taylor et al., 2003; Vassallo et al., 2001a, 2001b). This type of application is less expensive, as there is no live interaction between the sender and receiver, and is used for non-emergency situations where diagnosis is made after results arrive. Additionally, there has been growing interest in low-cost telemedicine initiatives in the developing world (Brauchli et al., 2004; Fraser et al., 2001; Mitka, 1998; Rigby, 2002; Wootton, 2001b).

**Table 2.1:** Maturity Level trend of Telemedicine diffusion (based on technological Complexities, delivery options, cost, business models), Source: (Heinzelmann et al., 2003)

<table>
<thead>
<tr>
<th>Clinical Application</th>
<th>Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiology</td>
<td>MATURING</td>
</tr>
<tr>
<td>Pathology</td>
<td></td>
</tr>
<tr>
<td>Psychiatry</td>
<td></td>
</tr>
<tr>
<td>Dermatology</td>
<td></td>
</tr>
<tr>
<td>Cardiology</td>
<td>GROWING</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td></td>
</tr>
<tr>
<td>Pediatrics</td>
<td>EMERGING</td>
</tr>
<tr>
<td>Emergency Medicine</td>
<td></td>
</tr>
<tr>
<td>Rare diseases</td>
<td></td>
</tr>
</tbody>
</table>
2.2 Theoretical Underpinning (Previous Related Work)

In the Arab Policy and Information Technology (APIT) and Arab Culture and Information Technology (ACIT) study, Checchi et al., (2002) and Straub et al., (2001) investigated ICT policies and culture at the national level, defining ITT/ICT outcomes which I borrowed for my study. ICT infrastructure and policies work at the national level. Transfer implementation factors, culture-specific beliefs, and technology culturation operate at the cultural level. Thus, for the overall model of telemedicine transfer outcomes incorporating national infrastructure and cultural models, I adopted the APIT/ACIT model of IT transfer as my primary theoretical underpinning.

2.2.1 Arab Policy and IT (APIT) and Arab Culture and IT (ACIT)

The APIT/ACIT research conducted in the area of information technology transfer to the Arab world is based on policies and culture (see Figure 2.1 and Table 2.2; Checchi et al., 2002; Straub et al., 2001). Checchi answered three questions: (1) how do national Information Technology (IT) policies and Technology Infrastructure (TI) affect Information Technology Transfer (ITT)? (2) Which transfer implementation factors affect ITT? and (3) What role do culture and technological culturation play in ITT (Loch et al., 2000)? Checchi et al. (2002) and Straub et al. (2001) both reviewed the pertinent literature to identify experiences with ITT, and stated that relatively few studies empirically tested cross-cultural impact on the adoption and diffusion of new IT. However, a few studies (Al-Gahtani, 2003; Cooper, 1994; Raman and Yap, 1996; Okoli 2003; Straub, 1994; Straub et al., 1997; Tan et al., 1995, 1998) conclude that culture has a marked impact on ITT. Checchi also noted that other studies of national ICT infrastructures and policies by Hill, Loch, Straub, El-Sheshai and Kamel commented on their impact on information technology transfer.

Table 2.2 APIT/ACIT Research Constructs of Information Technology Transfer, Source: (Checchi et al., 2002)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>National ICT Polices/Technological Infrastructure</td>
<td>Status of the technology infrastructure of the nation. Polices aimed at encouraging or impeding ICT</td>
</tr>
<tr>
<td>Transfer Implication Factors</td>
<td>Factors that influence the success or failure of the deployment of a technology or technologies</td>
</tr>
<tr>
<td>Construct</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Culture-specific Beliefs and Values</td>
<td>Cultural and social responses of individuals and groups; beliefs and values; socio-culturally influenced motivations. This set is limited to those beliefs and values that are expected to have an influence on the adoption of ICT, and specific to the culture or ethnic group being studied.</td>
</tr>
<tr>
<td>Technological Culturation</td>
<td>Influence of external, technologically advanced cultures on individuals/groups/culture as a whole</td>
</tr>
<tr>
<td>Information Technology Transfer (ITT/ICT) outcomes</td>
<td>Measures of outcomes include: prediction of success; actual use; intention to use; diffusion; success of system development.</td>
</tr>
</tbody>
</table>

![Figure 2.1 APIT/ACIT Research Model of Information Technology Transfer, Source: (Checchi et al., 2002)](image)

### 2.3 Review Methods

The field of telemedicine has undergone rapid development in the last fifteen years; in recent years a number of studies have addressed the feasibility (technical and non-technical) and maturity level of visually-based clinical telemedicine applications. Relatively few studies, however, provide a tentative demonstration of the social value of telemedicine applications in developing countries (Wootton, 2001b). Moreover, as far as
I am aware, there have so far been no attempts to gather the social and value telemedicine impacts on developing countries in the form of literature review, although my literature review of assessment in telemedicine is included in this study to demonstrate the status of telemedicine practice in the literature. Therefore, to review the literature I established criteria (See Appendix - III for details of the search criteria) and surveyed the literature to clarify the current state of telemedicine outcomes (social and value), including its potential in the area of providing higher quality care, improving access and containing costs in developing countries in general, and in SSA in particular. The literature review indicates an objective view of what is really known at present about the outcomes (social and value) of telemedicine. Thus I have examined all related articles that discuss outcomes (social and value) of telemedicine in terms of policy (ICT, e-health, and data security), infrastructure, organization and environment, culture and its impact, to prove the benefit of telemedicine based on quality, cost and access (See Table 4.7).

The literature review concentrated mainly on journal and conference papers, as well as research published in peer-reviewed journals. I have conducted an in-depth literature analysis of all articles available about telemedicine issues, socio-economics, technology, policy and culture. Initial screening of the articles was based on abstracts. Selection of relevant articles was based on the information obtained from the abstracts. I have considered articles that report socio-economic impacts of telemedicine in terms of access, cost, and quality of care.

The search revealed that the vast majority of telemedicine publications do not appear in mainstream IS journals, but instead are published in interdisciplinary healthcare and specialized medical informatics journals, such as Journal of Telemedicine and Telecare, Telemedicine Journal and e-health, Journal of Medical Systems, IEEE Transactions on Information Technology, IEEE Transactions on Biomedicine, British Medical Journal (BMJ), and so on.
2.4 Telemedicine in Context

2.4.1 Telemedicine Definitions

In the literature I found other terms related to telemedicine, such as tele-health, e-health and medical informatics. “Telemedicine” as a word has also been debated, as some individuals feel strongly that it should be replaced with terms such as “tele-health”, “e-health”, “e-health care” or “e-clinical care” (Wootton, 2001a). This prefix “e-” is characterized by the emergence of electronic business models and applied telecommunications in many fields, including clinical care, health care, home health care, consumer health informatics, public health care, and more (Tan et al., 2005). Bashshur (2002) stated: “the evolution and expansion of concepts and definitions in the field reflects telemedicine’s dynamism and evolution, mirroring in turn the healthcare system in general and the enabling information technology that supports it.”

There are several definitions of telemedicine. The literal meaning of telemedicine is “medicine at a distance”. Telemedicine is defined as the use of information technologies to exchange health information and provide health care services across geographical, time, social, and cultural barriers (Reid, 1996). In 1997, Wootton gave the following definition: “Telemedicine is the provision of health care consultation and education using telecommunication networks to communicate information.” I also found it defined as “… the use of Information Technology to overcome geographical and other barriers to the practice of healthcare” (ITU, 2001). Bashshur et al. (1997) defines telemedicine as “the exchange of information at a distance, whether that information is voice, an image, elements of a medical record, or commands to a surgical robot.” The WHO (1997) defines it as “the delivery of health-care service, whereby distance is a critical factor, by health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, and for continuing education of health care providers as well as research and evaluation, all in the interest of individuals and their communities.” The European Commission’s Healthcare Telemetric Commission definition is “rapid access to shared and remote medical expertise by means of
telecommunications and information technologies no matter where the patient or relevant information is located.”

Tan et al. (2005) stated: “we can observe that all these telemedicine definitions are similar in their use of the words ‘telecommunication’, ‘information technology’, and ‘medicine’. The words ‘distant’ or ‘geographical location’ imply that there is a distance between the patient and the health service provider so that it is difficult or impossible to give classical way of face-to-face care. The words ‘telecommunication’ and ‘information technology’ imply the tools used to overcome the distance gap between the health care providers and their patients.”

It is also important to observe that the purpose of any telemedicine effort is to cure or prevent disease, and improve the quality, accessibility or cost of healthcare, as stated by Bashshur (2002), “Some may question whether this is telemedicine, telehealth, e-health, health informatics, or bio-health informatics. It does not really matter what we call it or where we draw boundaries …collaborative effort from various fields of science, including what we call now telemedicine is necessary.”

2.4.2 The History of Telemedicine

Telemedicine is one of the first innovative information systems to be integrated into healthcare services in the last fifty years (Darkins and Cary, 2000; Kuntalp and Akar, 2004). It was an important issue in healthcare long before the information system sector realized what it was or how important it would become, ever since the late 1960s (Bashshur et al., 1997). The roots of telemedicine can be traced as far back as 1876 when the telephone was invented. Even as early as the 1920s and 1930s, the concept of linking patients and doctors without the physical presence of either party at the same location surfaced publicly. In 1924, a picture of a patient interacting with a doctor on television appeared on the cover of the magazine “Radio News”, (Field, 1996). Interestingly, the first television transmission did not occur until 1927, three years later.

Today, the telephone is still an important component of telemedicine. During the days when it was reserved primarily for those who could afford it, physicians and pharmacists used it to teleconsult with each other about their patients. Some patients also used the telephone to reach their physicians for emergency services in developed
countries. Eventually, it was used to transmit basic clinical information: for example, in 1948 X-ray images were sent between New York and Pennsylvania through telephone lines (Viegas, 1998). Of course, telemedicine today encompasses more than just the use of low-cost telephone technology.

A critical phase in the development of telemedicine was the emergence of radio and television, around the latter part of the 19th century. First used to provide medical advice for seafarers who required medical attention while at sea, radio is still being used on board aircraft to provide medical assistance for passengers. As for television, physicians use it to aid in neurological examination, as well as to teleconsult with other experts (Field, 1996). Among the first demonstrations of the capability of interactive video for telemedicine was the use of a two-way closed circuit television system to link the Nebraska Psychiatric Institute and Norfolk Hospital with the University of Nebraska (Wittson and Benschoter, 1972).

Generally, significant breakthroughs in the diffusion of telemedicine may be analyzed in three historical periods (Tan et al., 2005). The first period is marked by an effort to improve clinical care in specialty areas, including teleradiology, telecardiology, teledermatology and telepsychiatry. Longer distances were being covered through the use of satellite signals instead of phone lines. The majority of projects undertaken during this pre-computing era, however, were mainly focused on proof-of-concept research in the form of technological feasibility studies (Kifle et al., 2006a). Most of these projects were in fact attempts to provide medical services to astronauts who certainly did not have quick access to medical care. Even though it was expensive to staff and direct projects that operated with standard analog televisions, governments picked up the costs of their funding. When the funds were exhausted, however, projects dwindled and the number of telemedicine projects showed a marked decrease.

Fortunately, the second telemedicine period was characterized by the development of digital technology. During this period, computers became commonplace and digital communication methods emerged quickly. It was soon discovered that interactive video could be used over wide area surface networks at a much lower cost than the analog television system of the first era. Telemedicine projects were now making use of computer-based digital teleconferencing systems. Among the most significant
projects of this period was telemedicine for rural areas (Wootton, 1996; Bashshur, 2002). Here, it was argued that real cost savings would materialize because of reduced travel costs, while at the same time there would be better health outcomes for patients due to more timely illness diagnosis (Kifle et al., 2006b).

Apparently some very challenging barriers to the diffusion of telemedicine also came to light during this period. Barrett and Brecht (1998) identify these impediments as lack of technology standards, liability, licensure, confidentiality, and reimbursement. Even so, the large number of images and data to be transmitted in teleradiology and telepathology led to the development of DICOM, the first set of standards by the American College of Radiology and the National Electrical Manufacturers. At the same time, Internet use and communications via email were proliferating among physicians and other health professionals for exchanging text, images, and video from around the world. Concerns over escalating health care costs in both the US and the EU, coupled with the diffusion of these e-technologies, gave rise to renewed interest in telemedicine.

Today, we are in the third telemedicine diffusion phase. The key challenges we face have to do with improved standards, use of wireless technologies, security, confidentiality and privacy issues, legal questions on jurisdiction and reimbursement for telemedicine services, the need for large-scale formative and summative evaluation of the implementation of telemedicine, and its impact on the access, cost, and quality of health care delivered.

2.4.3 Telemedicine Practices

Telemedicine technologies have been and are still being used for: (1) clinical services; (2) diagnostic and information services; and (3) learning in the health care sector.

Clinical applications support the access and delivery of clinical care at a distance; they capture, organize, store, and share clinical information among providers as well as between providers and patients. The information collected is typically needed for patient assessment, diagnosis, and treatment. For example, rural hospitals can obtain readings of teleradiological images from urban centers that normally would have the capability and resources to employ senior and highly qualified radiologists.
Diagnostic and information services include four subcategories: teleconsulting, teleconferencing, telereporting, and telemonitoring. In teleconsultation, a patient consults with a health care provider by means of a telemedicine service. A teleconference has two or more health care workers communicating over a video link to share the responsibility for the patient, who is usually not present in this scenario. Both telereporting and telemonitoring involve the transmission of relevant health information by a clinician to a remote center for interpretation. After analysis, the information is sent back to the clinician. There is only one small difference between the last two subcategories: in telemonitoring, patient data are collected continuously or at intervals, whereas in telereporting, the transmission is usually done only once.

E-learning applications provide for online, Internet-based, and remote delivery of training and education services, such as continued medical education (CME) for physicians and other health care professionals via videoconferencing.

2.5 Theoretical Foundations

Diffusion of innovation theory, Information Technology (IT) implementation, and culture can provide important insights into the factors influencing telemedicine transfer in Sub-Saharan Africa. In the following subsections, I present a detailed review of the literature in three levels of factors related to telemedicine transfer outcomes: the national level, referring to the macro environment (policy, IT infrastructure, culture-specific beliefs and values, and technological culturation); the organizational level context, referring to organizational and environmental factors; and individual level factors, which refer to individual characteristics of a user that are useful to the adoption of new technology (See Figure 2.2). These dimensions are derived from a combination of various classification schemata proposed in early studies. However, it is necessary to clarify the research scope of potential factors impacting transfer of telemedicine and the research focus. Accordingly, the research scope could include more issues related to national, organizational and individual levels than our study focused on. Although all potential factors are significant for telemedicine transfer outcomes, it is not possible to include all those factors in my research. Therefore, this research focuses on
national, infrastructural, and cultural factors impinging on transfer of telemedicine outcomes on national level.

![Diagram](image)

**Figure 2.2**: Items Used in Estimating Telemedicine Transfer Outcomes

In general, the literature review emphasizes that the use of telemedicine is motivated by its effectiveness and efficiencies; therefore I focused on evaluating telemedicine outcomes and their benefits in areas of providing high quality care, improving accessibility and/or containing costs of healthcare (Bashshur *et al.*, 2000; Håkansson, 2001; HTU, 2003, 2005; IOM, 1996; Lugn, 2006). Each of these telemedicine outcomes includes distinct methodologies for assessing approaches. Generally, access refers to geographic separation (Penchansky and Thomas, 1981); cost refers to the relationships between cost and benefits as compared with the alternatives (McIntosh and Cairns, 1997); and quality refers to the satisfaction of patients and physicians as well as technical quality (Bashshur, 1997). In a review of telemedicine, Bashshur *et al.*, (2002) noted, “Telemedicine is a complex innovation bundle in that it is a
technical as well as an organizational and social innovation.” However, the research on this aspect of telemedicine is limited, and the major problems relate to a framework for research and evaluation.

I have also focused on visually-based clinical applications at the level of maturity (radiology, dermatology, pathology, ophthalmology), application purpose (diagnostic, consultation, monitoring) and how communication infrastructures are utilized (technology, bandwidth, synchronous, asynchronous) as well as national policies (ICT, e-health, security and standard) and cultural (uncertainty avoidance, power distance and technology culturation) areas. Further, I have examined the impacts of national infrastructures and culture that can make a difference in telemedicine transfer outcomes at the national level.

2.5.1 Telemedicine Transfer Outcomes

Based on the existing literature, telemedicine offers socio-economic benefits, reduces costs, and improves access to healthcare service providers and patients. Economic benefits in terms of cost saving are the major factors that motivate the adoption of technology (Groth, 1993; Augur and Callaugher, 1997). Moreover, social benefits in terms of increased access to specialized healthcare (Gilbert and Foster, 2001), improved interaction and opportunities for follow-up (Badal, 1999), and reduced isolation of healthcare service providers (Wootton, 2001a) are other reasons to adopt telemedicine.

The International Standards Organization (ISO) recommends that health outcomes have to be based on some agreement ensuring the purpose and important to be measured. The IOM model (Field, 1996) defines outcome indicators in relation to access, cost, and quality of care. Access refers to the ability of an individual or group to obtain needed services (Penchansky and Thomas, 1981). Cost refers to the economic evaluation of telemedicine compared with traditional alternatives depending on transport costs, volume, time sensitivity of care, and the cost of the alternative (Dolittle et al., 1998). Quality refers to the satisfaction of clients and providers and the process of care for technical quality (Hailey et al., 1999).
The socio-economic benefit of telemedicine is well received in Europe and the United States. The rationale for telemedicine in these regions is to increase the accessibility and quality of healthcare, as well as reduce its cost, despite the fact that the structure, funding, health care policies, organizational features or a combination of these in the two regions’ health care systems are quite different. Furthermore, most telemedicine services are developed under the umbrella of funded activities. In terms of telemedicine diffusion, much current international telemedicine activity is focused on such visual applications as teleradiology, or second opinion consultation clinical applications (Hailey et al., 2002). In developing countries, telemedicine is also emerging. Healthcare policy, structure and organizational features are public in nature, and motivated by increasing access and quality of care as well as reducing healthcare costs. Craig and Patterson (2005) note that there are basically two reasons for the implementation of telemedicine in developing countries: 1) because there are no alternatives (i.e. problems related to access and its potential role in the delivery of medical care to patients, as well as health care provider perspectives), and 2) because telemedicine has geographic advantages over traditional medicine (i.e. increasing access and cost benefits of telemedicine compared with traditional alternatives). Moreover, the implementation of telemedicine in developing countries is considered a major innovation not only at the technology level, but also at the cultural and social levels of the healthcare system (Bashshur et al., 2002). In general, a main objective of telemedicine in developing countries is to facilitate cost-effective delivery of healthcare services to the majority of the population in rural and urban areas (Hailey, 2005; Hailey et al., 2002; Perednia and Allen, 1995; Roine et al., 2001)

My review addressing social outcomes shows majority reliance on increased opportunity to obtain services in rural areas, reduce barriers to care, and in some cases reduce the amount of time required to seek care. The major value outcome of telemedicine applications is cost-effectiveness of analysis; other value outcomes studied included cost-consequence, comparing costs to other consequences such as economic, technical and health consequences (Kifle et al., 2006b; McCarthy et al., 2000; McDonald et al., 1998; Ohinmaa et al., 2001; Scott, 2001).
According to the result of my review, there are still very limited data on social and value telemedicine outcomes. Most articles surveyed are reports on the feasibility of visually-based telemedicine applications; only a few studies report clinical outcomes and value analysis. A review of the literature indicates that at present, most evidence regarding the social and value impacts of telemedicine deals with teleradiology, telepathology, teledermatology and teleophthalmology (Tulu et al., 2005). However, even in these visual clinical applications, most available academic and practitioner literature refers only to pilot projects and short-term outcomes; I found a few articles related to telemedicine effectiveness and cost efficiency issues in the SSA region. This view is supported by Wootton, et al. (2000) who suggests that telemedicine effectiveness and cost effectiveness studies tend to be few, and often lack scientific evidence and good rigorous evaluative data. He notes further that most articles published on telemedicine in developing countries are not peer-reviewed. I found a small number of research papers focused on the effectiveness and cost effectiveness of telemedicine, and a few on other major problems of telemedicine review, related to framework and assessment of structural effects to evaluate improved accessibility, cost containment, and providing high quality healthcare services (Aoki, 2003; Hailey and Jennett 2004; Bashshar, 2004; IOM, 1996; Roine et al., 2001; Scott, 2001; Scoot et al., 2005; Wilkin, 1992; Whitten and Adams, 2003).

2.5.2 National Level

2.5.2.1 National ICT Policies

According to the UNCSTD (1997) definition, “A national ICT policy is an integrated set of decisions, guidelines, laws, regulations and other mechanisms geared to directing and shaping the production, acquisition, and use of ICTs.” This extensive phrasing reflects a policy that will inevitably intersect with a number of other areas. Thus, “specific technology policies that guide the development of information systems in a specific country”, indicating “the level of support for technological development” (Loch et al., 2000) is a widely recognized factor that affects both the diffusion of telemedicine
and the intensity of telecommunications (Courtright, 2004; Gurbaxani et al., 1990b; Kamel 1995; Kraemer et al., 1992).

Moreover, government policies are highly instrumental in the diffusion of computing in a society (Gurbaxani et al., 1990a). This reality is significant within the context of Sub-Saharan Africa, where governments control most of the ICT infrastructure (Mbarika, 2001; ITU, 2000, 2001) and uphold different policies that influence the acquisition and use of the infrastructure by private organizations. For example, some countries of Sub-Saharan Africa consider computers as luxury items, compared to other socio-economic problems such as safe drinking water or communicable diseases. Furthermore, the SSA governments often operate national telecommunications, and the average telecommunications revenue per subscriber line in SSA is twice that of Europe, and four to six times as much as in the United States (Paltridge, 1994; Mbarika et al., 2002b).

Another major ICT policy issue in Sub-Saharan Africa is the privatization of the telecommunications sector. In many SSA countries, governments own and manage the sector that provides phone lines for Internet, fax, and e-mail access (Checchi et al., 2002; ITU, 2001; King et al., 1994). These services are very important for the transfer of telemedicine technologies. Bashshur et al., (2000) says, “the potential functions of telemedicine, as well as the process and outcomes, depend heavily on the specific technological infrastructure in place.” However, some SSA countries’ government policies restrict privately owned telecommunication services. Therefore, some services can be very expensive, and often are of poor quality due to lack of competition. This fact significantly impacts telemedicine transfer by its indirect effect on the ICT infrastructure (Kim and Bretschneider, 2004; Okoli, 2003; Mbarika et al., 2005).

Moreover, some governments administering telecommunications systems ban the importation of equipment, thereby compelling users to use the equipment the governments themselves provide. Other policy-related problems include neglect of ICT infrastructure in the rural areas. Furthermore, many SSA countries have very low levels of per capital income, and the major source of economic output is agriculture. In addition, the African Information Society Initiative (AISI), one of the studies to review informatics policy in ten SSA countries, reported that limited financial resources, poor institutional
capability, and inadequate access to human resources and technological know-how plague SSA attempts to harness ICTs.

Various studies have examined the effects of ICT policies on the development of ICT infrastructure (Checchi et al., 2002; Dutta, 2001; Gurbaxani et al., 1990b; Hakken, 1991; Handy and Mokhtarian, 1995; IDRC, 1998; King et al., 1994; Kraemer et al., 1992; Raman and Yap, 1996; Tractinsky and Jarvenpaa, 1995; Wild and McCube, 1996). Most of these studies argue that national ICT policies influence and promote ICT diffusion. In the case of African countries within the domain of AISI, a number of studies have been undertaken, such as reviewing informatics policies in ten SSA countries. This study defined national informatics policy as a “plan for the development and optimal utilization of information technology”. Today almost all SSA countries have ICT policies for socio-economic development, even though the follow-up and action plans differ from country to country. These action plans and their impact are formally measured by the effect of policy context on the adoption of a particular technology. Thus, to increase the success of policies, the availability of funding the status of the existing infrastructure, top management support and on-going commitment and considering the local context of the system are all important factors for the outcome of telemedicine.

2.5.2.2 National E-health (Telemedicine) Policy

The literature on e-health and telemedicine policy, in general, is relatively recent, and remarkably sparse; the few extant articles point out the need to address the e-health policy issue at both national and international levels. During the last five years, however, most national governments have developed ICT policies for healthcare (WHO, 2004). The objectives and goals of the various governments are rather similar. Nevertheless, the level of defining the policies and translating them into projects and programs differs from country to country (Fujimoto et al., 2000; Johnston et al., 2004; Klecun-Dabrowska, 2000; Scott et al., 2002).

Scott et al. (2002) defined e-health policy as “a set of statements, directives, regulations, laws and judicial interpretations that direct and manage the life cycle of e-health.” According to the WHO, policies help to develop a vision of the future, define
short, medium, and long-term references, determine objectives, set out priorities, delegate roles and define means of action and institutional arrangements (Cassels and Janovsky, 1998; Walt et al., 1999; WHO, 2000). Policy and decision makers within the health system must see telemedicine as part of the larger domain of health service delivery, as they work to integrate telemedicine services into the traditional delivery system (Mitchell, 2000). ITU Recommendation SG 2/6-98 (1998) includes encouraging National Ministries of Health to work together to develop a unified telemedicine policy. Moreover, Jennett et al., (2004) recommends that “e-health be integrated into existing healthcare systems in a policy, not just a practicable manner, and that this be achieved with a ‘global’ perspective.” However, many telemedicine projects in developing countries, particularly in SSA countries, are implemented and evaluated as stand-alone (pilot) initiatives. Sanders and Bashshur (1995) state that much of the appeal of telemedicine remains intuitive, and is based on fragmentary rather than systematic empirical research.

The nature of telemedicine makes it essential to develop national policy with an eye to international policy, and vice versa. Therefore, it is necessary to consider both globally acceptable policy (national, regional and international) principles and domestic policy (integrated at national level of decision-making)(Jennett et al., 2004; Murray and Evans, 2003). Thus, the World Health Organization (WHO) explored the concept of Global Health Governance (GHG) in a series of discussion papers (Dodgson et al., 2002; Fidler, 2001; Loughlin and Berridge, 2002; Scott et al., 2002; Walt, 1994). At the national level, few countries have developed national health information and technology strategies; few countries possess policy statements to guide their telemedicine infrastructure development. For example, in 1999 Australia presented its first national ICT plan (Health Online) for the health sector; (Puskin and KumeKawa, 2001; Scott et al., 2002).

In combination with policies on ICT and health, some countries establish national health information task forces. For example, in Ethiopia a national telemedicine committee, composed of the Ministry of Health, Ethiopian Telecommunication Cooperation, and the Medical Faculty at Addis Ababa University, was established in 2001 to execute existing telemedicine projects, prepare a vision within the framework of the national health policy, formulate telemedicine projects, and create awareness among
stakeholders (Kifle, 2006). A number of papers discuss the actual need for a “policy” in telemedicine (Rigby, 1999; Scott et al., 2002; Vargnes and Scotte, 2004). Researchers believe that telemedicine has a significant healthcare and social role to increase health outcomes (clearly defined benefits) such as equality (accessibility of resources), user satisfaction (improvement in quality), and lower total costs (cost-effectiveness, affordability) (Docteur and Oxley, 2004). On the other hand, privacy, confidentiality, and payment for services have emerged as significant policy issues for telemedicine implementation. However, policy development severely lags behind telemedicine development. Scott et al., (2002) emphasizes that establishing a guiding philosophy or policy in planning a telemedicine program is the key to success. The WHO argues strenuously for “informatics” policies that are, in a national context, carefully integrated across sectors, standardized, and attentive to local and regional interests (WHO, 1998, p. 10).

In addition, telemedicine is seen primarily as a new part of healthcare policy. For example, countries such as Sweden have made explicit policies for telemedicine. In developing countries, planning of national policies can become a condition of access to aid (Cassels and Janovsky, 1998; Walt, 1994; Walt et al., 1999).

Moreover, telemedicine policy can support decision-making in the context of greater public awareness and cost benefits of proposed options. At the same time, however, the absence of some public policies has posed problems for telemedicine, as other policies have been devised specifically to encourage its development and implementation. For example, these policies include demonstration project funding, technical assistance, and infrastructure development that support not only healthcare but also all sectors of the socio-economic development. As Hämäläinen and Hyppönen (2006) stated, the evaluation of health policies is not very common and a need exists for multi-disciplinary evaluation covering the whole implementation chain from policy objectives to its impacts.

2.5.2.3 Security and Standard Policies

The evolution and growth of telemedicine is mostly focused on the use of ICT to provide healthcare services and access to healthcare information across distance.
The use of these ICT networks techniques is the primary difference between telemedicine and traditional face-to-face care delivery; therefore, privacy, confidentiality and standards are key issues associated with care delivery and the use of Internet for care delivery. Hence, privacy, confidentiality and security issues emerge when care is delivered across a distance or via Internet. For example the 2001 Telemedicine Report to Congress notes, “The Internet will most likely play a key role …” and it identifies “privacy, security, and confidentiality” as key issues affecting the industry (HIPAA, 1996, 2003).

Generally, in their early days, most telemedicine programs had relatively low political profiles (Blobel, 2000; IOM, 1996, pp 83; Williams and Singh, 1996). Most clinical applications operated at the university hospital level. The programs did not provoke much legal controversy at the organizational and national levels; therefore, decision makers and researchers did not appear immediately concerned with possible legal and security implications (Louwerse, 1998; Shinn, 1975). Today, however, the use of telemedicine addresses issues relating to reimbursement, licensure, standards and medical liability (Stanberry, 1998, 1999). Privacy and confidentiality have also emerged as significant policy issues. Moreover, other issues related to availability and integrity of the system affect the diffusion of telemedicine, such as failure at a crucial moment, and the vulnerability of the Internet to eavesdropping (Anderson, 2000; Brender, et al., 2000).

There are several definitions of information system security. The US national information security glossary NSTISSI no. 4009 (Wikipedia, 2005) defined information system security as: “the protection of information systems against unauthorized access to, or modification of, information whether in storage, processing or transit, and against the denial of service to authorized users or the provision of service to unauthorized users, including those measures necessary to detect, document, and counter such threats.” Protection of information systems is in general divided into administrative (policies and procedures), physical (buildings and equipment), and technical (computer, hardware and software). Based on this division and standards that are addressing all aspects of healthcare information security and confidentiality, researchers have developed different frameworks which are classified as technical security service (access control, audit control, authorization control, data authentication and entry authentication) (Blobel and Roger-France, 2001; HIPAA, 2003), and non-technical (administrative procedures and
physical safe guards) (Janczewski and Shi, 2002) aspects of security. However, it is very important to incorporate both security infrastructure as well as security policy aspect of healthcare information security and confidentiality system, which are to be considered to enhance telemedicine implementations (Tulu and Chatterjee, 2003).

Many telemedicine publications address the need to develop security and standards policies, but very little literature about privacy, confidentiality, standards, and security is actually to be found in SSA countries. Standards and security policies are new and relatively few in developing countries (Casmir, 2005), so most of the existing literature have drawn from focuses on the ICT in general, and the experiences of the USA and the EU in particular. For example, the International Medical Informatics Association (IMIA) has produced a series of monographs on issues involving maintaining security and confidentiality of health data; the European Commission held a working conference with health professionals, medical informaticists and security specialists, which came into force in the EU in 1997 with directive 95/46/EC; and the Journal of the American Medical Association (JAMA) established standards and guidelines for Medical and Health Information. The ITU, the WHO, UNESCO, and the UNTD have produced the few studies that examine the effects of security and standards issues in developing countries.

In industrialized countries, telemedicine technology brings with it concerns about privacy, security, and confidentiality for a long period, more than security issues in other sectors (Loane and Wootton, 2002; Nagle, 1995). These issues necessitate initiating a process to address risks specifically associated with their application to Information Systems (telemedicine). Thus, the key issues of information systems security are related to the preservation of confidentiality, integrity, availability, and accountability of the Information Systems. For example, data about patients must be kept confidential, and must be made available only to those who need them for authorized and agreed-upon purposes. Data integrity must be preserved so that the information is accurate, appropriate for the purposes for which it is to be used, and neither corrupted nor destroyed. Correspondingly, it must be available when it is required and a chain of accountability must be created so that a designated individual is always responsible for the various items of information within the system and for disclosures made from the system. Indeed,
security and confidentiality of electronic medical (data and image) transactions over networks (terrestrial and satellite transmission media) are major concerns for all telemedicine providers, patients, and other stakeholders (O’Connor, 1996; Shortliffe and Perrault, 2001; Taylor et al., 1997).

The American Medical Association (1996) calls on those “who use telemedicine systems to have a responsibility to make prudent and reasonable use of those technologies necessary to apply current and future confidentiality and privacy principles and requirements to telemedicine interactions” (AMA, 1997). Furthermore, in Guidelines for the Protection of Health Informatics Association (2001), it is noted that, “telemedicine transmissions are vulnerable to security breaches through telecommunication line linkages.” Therefore, telemedicine should have a confidentiality policy in place, and this policy should contain a clear statement of the confidentiality expectations of all staff (healthcare or IT) providing telemedicine services (Blobel, 2000; Tucker, 1992).

International organizations such as the WHO and the ITU have noted that the security and confidentiality of electronic medical transactions over networks is a legal and legislative issue, requiring national governments and international organizations to develop legal frameworks and laws to govern them (Gostin, 1997; ITU, 2000; WHO, 2004). Because of the unique combination of patient data, video imaging, and electronic clinical information generated between two distant sites during a telemedicine encounter, privacy concerns that normally pertain to patient data may be magnified within the telemedicine arena, or may be different in character altogether (Van de Velde and Degoulet, 2003; Wu and Guo, 2001).

Standardization is one of the most important issues for the successful development and deployment of telemedicine systems, since many standards are developed independently of the organization originally preparing the standard. Examples of standards relevant to telemedicine system development and deployment include: Health Level 7 for Electronic Data Exchange (WWW.hl7.org); IEEE P1073 – Instrumentation and IEEE P1157 – Data Model from the Institute for Electrical and Electronic Engineers (IEEE); and Imaging from Digital Imaging and Communication in Medicine (DICOM). Many issues concerning policy forming and decision making about
the implementation of telemedicine systems are related with the construction of an open standardized environment. The role of standards in telemedicine must be viewed in the context of healthcare organizations, the technology drive, and the different interests of the different actors. Any individual organization or project involved in telemedicine applications has to make its own decisions concerning official standards, \textit{de facto} standards, and proprietary solutions (Grimson \textit{et al.}, 2000; Iakovidis, 2000).

For all information system users, the Open Systems Interconnection (OSI) standards address many functions, such as capacity, transmission rates, protocols, and security. Additionally, healthcare information systems security standards are critical for ensuring the confidentiality and integrity of health information. However, telemedicine is different from other technologies in terms of both continuity and standards. Considering the wide range of technologies and applications used, standards need to be developed for the management of a national committee for telemedicine (Berler \textit{et al.}, 2006; Loane and Wootton, 2002). Continuity is needed for the delivery of a reliable, efficient, safe and quality level of healthcare, as well as a reliable telephone and electrical power system. Jennet and Siedlecki (2001) conclude: “The success of the telemedicine venture is contingent on the development of policy to support and enable the use of technology in delivering quality care and equal access to stakeholders. The policy enabling this success ensures that: privacy, confidentiality, integrity and availability are ensured; equality of appropriate access is provided; cultural diversity is respected; and the telemedicine service is timely, cost effective and patient centered.”

2.5.2.4 National IT Infrastructure

As I stated earlier, telemedicine is health care delivery in which physicians examine patients remotely using ICTs. To enable the use of telemedicine, a country needs a solid ICT infrastructure (Adam, 1996, 1997; Avgerou, 2003; Datta and Mbarika, 2004; Heeks, 2002a ; Puskin and Sanders, 1995). According to McLaughlin (2000, p. 2), an ICT infrastructure is defined as “… a physical system of telecommunications pathways and connections that transmit voice, video, and data … encompassing a web of telecommunications, information, and computing technologies.” Internet refers to the
interconnection of computer networks using a standard packet switching protocol for communications (Verhoef, 2000).

Telecommunication has been used since early days of HF radio to support healthcare delivery (Bashshur, 2003). Radio technologies are also used in many developing countries to support isolated health workers (Wootton, 2001b). Today, more reliable telecommunication networks such as landline and satellites are used for medical consultation in developing countries. Furthermore, the use of the Internet is having a significant impact on the way in which telemedicine can be delivered. Use of the Internet for store-and-forward image and video transmission, patient records, and patient consulting is on the rise (Brauchli et al., 2004). This emergent use of the Internet for telemedicine applications illustrates the potentialities of future developments based on merging information systems, patient data, and interactive consulting at the desktop.

Although the Internet has significantly affected the processes of healthcare delivery, it is only one of the tools used in “digitizing” and improving the management of healthcare information. However, in SSA countries, there is usually a concern about speed and transmission rate, data availability and the reliability of connectivity. This has a big impact on the safety and quality of the image transmission through Internet. Therefore, available technology must be identified (Plain Old Telephone System, POTS; Integrated Services Digital Network, ISDN, or Asynchronous Transfer Mode, ATM), and telemedicine clinical applications using it must be balanced with it. For example, if we use POTS connection for video conferencing, we know that there will be relatively slow data transmission and low quality images.

Due to various socio-economic and political problems faced by most countries of Sub-Saharan Africa, the region is reported to have the lowest levels of most ICT-related infrastructures in the world (Goodman, 1991; Mbarika, 2001, 2002b). The literature reports extremely low levels of basic telephone penetration, less than one phone line per 100 people, in most Sub-Saharan Africa countries (ITU, 2001; World Bank, 2001). A primary reason for such low levels of ICT infrastructure is the cost of acquiring and maintaining telecommunication infrastructure (Mbarika et al., 2002c).

Moreover, in the existing literature, technology resources such as the Internet are consistently demonstrated to be an important factor for successful
Information Technology (IT) adoption (Kuan and Chau, 2001; Wolcott, 2005). However, SSA also remains at the bottom of the list of developing regions in Internet usage (1.4% of the total population compared to 12.7% of the world) (Gyamfi, 2005). Also, the discrepancy between Internet infrastructures in urban and rural areas in SSA countries is even greater; in urban areas the coverage is better, whereas telemedicine could be most useful in remote rural areas, which include more than 60% of the SSA population. Even if most of the services and users of the Internet are concentrated in urban areas, the international links are poor in most SSA countries. For example, the Internet links between US and Europe (56 Gbps), Asia-Pacific (18 Gbps) and Africa (0.5 Gbps) (Telegeography, 2003) account for only 0.2 percent of the worlds’ total international Internet capacity.

Furthermore, SSA countries share a common set of issues regarding telecommunications. These problems include a huge gap between supply and demand, a strong distribution imbalance favoring urban over rural areas, poor quality of service, a long wait for new service, and peak traffic demands that exceed network capacity (Mbarika, 2001). Again, the digital divide between urban and rural areas is still at its most extreme in SSA, compared to other regions of the world. For example, more than 75% of the SSA countries’ telephone lines are concentrated in the capital cities (Musa, et al., 2005b). One reason for this situation is that in many Sub-Saharan countries, governments are still the main provider of national ICT infrastructure. Unfortunately, government officials are not always the most astute visionaries in understanding and implementing what businesses need. Moreover, the public networks are characterized by insufficient bandwidth, low telephone line penetration, low call completion rates, and lack of value-added telecommunication services.

On the other hand, the price and availability of telecommunication infrastructure are affected by competition, market access and regulation; these facts have been the driving force in the rapid expansion and use of mobile phones in all SSA countries (Mbarika et al., 2005, 2002c). Thus, in some SSA countries the number of mobile phones is greater than the number of fixed telephone landlines (ITU, 2004). For example, the average for SSA is 10 landlines per 1,000 persons and 74 mobiles phones per 1,000 people. It is also important to have satellite-based technology for Internet
access in rural areas, before good wired infrastructure develops. Many SSA countries’ rural areas have also been covered with satellite-based technology, because of the low cost and long range of mobile base stations. However, the focus on satellite-based technology may limit investments in wired infrastructure (more sustainable optical fiber-based), needed for Internet access.

A considerable amount of researches argue that ICT infrastructure in particular (the Internet) is a necessary prerequisite for effective telemedicine outcomes. For example, the Internet enables care providers to gain rapid access to patient information, and also to consult with each other electronically. In addition, the Internet supports a shift toward more community-centered care, by facilitating patient gathering of health-related data, and communication with care providers. The Internet can also support numerous health-related activities such as administrative transactions and professional education.

In general, the uneven distribution of modern telecommunication infrastructure and costs across the country are often a major component of telemedicine projects (Musa et al., 2005b). These costs can be very high in areas where the information infrastructure is underdeveloped, unreliable, or non-existent. SSA rural areas in particular have the least access to telecommunication and Internet infrastructure; yet these same areas would most likely benefit the most from telemedicine services (Wootton et al., 1997). Moreover, the bandwidth and the technology approach vary widely depending on the clinical telemedicine application and the technology approach used. Different telemedicine technologies require different capacities or "bandwidth" of infrastructure, ranging from regular telephone line bandwidth, required by low-tech store-and-forward, to expensive broadband infrastructure required by real-time full motion television (Yogesan et al., 2000). Another factor affecting the cost of telemedicine is the fast-changing nature of the technology. For example, evolving technology such as data compression is likely to significantly change the transmission times and capacity required in the future for sending diagnostic images.

In some SSA countries, some critics have predicted the eventual collapse of the Internet from the traffic load. Even when operating at full speed, it is difficult for the Internet media to transmit large amounts of information at sufficient rates to avoid delays
and degradation of images. For example, in Ethiopia, teleradiology image transfer via dialup connection takes on average 10-15 minutes (Kifle et al., 2006d). Moreover, any distortion in message content or timing reduces the quality of the received message, and could prevent accurate decisions or correct interpretation. Other new network media are capable of carrying more information at faster speeds, but it will be a long time before such speed is available in developing countries.

The limitation and availability of communication infrastructure and bandwidth also determine the types of telemedicine clinical application area and purpose used. The two main delivery types of telemedicine are: (1) real-time, also known as videoconferencing "synchronous"; and (2) store-and-forward telemedicine, also known as "pre-recorded" or "asynchronous.” Real-time telemedicine applications require more bandwidth, and the interaction between the participants is essentially immediate, without time and space variation, whereas in the case of store-and-forward telemedicine, information is gathered (text, data, images, etc.) in electronic or digital form, and sent to the other participant (receiving site), who views it at a convenient time and reports back to the sending site.

Beyond general Internet availabilities and use, for telemedicine in particular to be successful, a country needs human resources (for maintaining the system), and electrical power and computer equipment (hardware and software) to build and maintain Internet applications. Sub-Saharan Africa has been called “the lost continent of the information technologies” (Odedra et al., 1993, p. 25). It has fewer computers and lower ICT expenditures per capita than any other geographically comparable region (Odedra et al., 1993). Similarly, there are few schools with computer science programs to develop an indigenous base of software developers. Furthermore, SCAN-IT studies identified the situation of IT industries lacking IT professionals (ECA, 2004).

However, much of the research into telemedicine technologies has taken place in OECD countries, in particular the US, Australia, Canada and Europe. These countries have a relatively appropriate infrastructure already in place, and extending and expanding the existing health and telecommunications infrastructure have facilitated rollout. In addition, these societies already have significant technology diffusion, and the general community functions at a comparatively high level. For developing countries
without a developed telecommunication infrastructure, the transfer of telemedicine presents specific problems. The deployment of telemedicine benefits from the growing availability of telecommunication infrastructures and services. For example, a government-sponsored national initiative in the United States, the National Information Infrastructure (NII) initiative, was implemented to increase infrastructure for telecommunications and computer technology in all sectors, including health care. These major initiatives also include the importance of Internet and high-speed network connection to use telemedicine technologies.

In SSA countries, major difficulties are associated with the availability of telecom infrastructure at affordable costs. Other often-cited problems common in most SSA countries include instability of the electric power supply, limitation of international bandwidth, and difficulty in finding Internet connectivity beyond large cities. Even if access to infrastructure has relatively improved somewhat at the national level, and traffic costs are declining as a consequence of liberalization policies, the current costs of using the existing infrastructure can be prohibitive to most healthcare providers and practitioners. Part of the problem has to do with international links (standards adoption); another part relates to the lack of a policy on telecom infrastructures for telemedicine applications; yet another with deregulation and the widening gap between those who have access to infrastructure and those who do not.

2.5.2.5 Culture and Technological Culturation

A number of factors have been suggested that affect IS use in developing countries, such as infrastructure capability and economic and political differences. However, national culture manifestly influences IS above and beyond these factors (Straub, 1994). For instance, Jarvenpaa and Leidner (1999) found that certain national culture norms and values are essential in order to ensure IS implementation success. The effect of culture on IT diffusion has been studied by researchers (Straub, 1994; Straub et al., 1997), mostly based on Hofstede’s (1973) cultural construct, even if his model is criticized by several researchers (e.g. Alexander and Seidman, 1990; McSweeney, 2002). Hofstede’s theory was identified as a major contribution with a most significant impact on national culture research (Ford et al., 2003; Leidner and Kayworth, 2006). Many
researchers have confirmed the validity of Hofstede’s national level dimension, and employed it for empirical observation (Al-Gahtani, 2003; Choe, 2004; Downing et al., 2003; Loch et al., 2003; Srite, 2000; Straub, 1994; Tan et al., 1998; Walsham, 2002). Hofstede (2000) noted that the construct (power distance and uncertainty avoidance) could not be used to test individual level relationships, and should be used only at the national level. Furthermore, national culture reflects the core values and beliefs of individuals formed during childhood and reinforced throughout life (Triandis, 1980, 1982).

A considerable amount of research has focused on the adoption and diffusion of IT and culture in the US and Europe. Most of those studies on IT adoption are based on case studies, in particular country or comparative tests at the national level. Unfortunately, only a few studies examine technology acceptance outside the US (for example, Straub, 1994; Straub et al., 1997), even though “…there is a reason to believe that connections do exist between culture and the use of certain information technologies…” (Straub et al., 1997). Hofstede and Franke (1991) noted that successful systems are designed when their design is consistent with the underlying values and culture of the society in which they function.

Kluckhohn, (1951) defines culture as consisting of “…patterned ways of thinking, feeling and reacting, acquired and transmitted by symbols, distinctive achievements of human groups, including their embodiments in artifacts …” (p.86). National level culture characteristics were identified by Hofstede (1984), who defines culture as “…collective programming of the mind which distinguishes the member of one group or category of people from another…” (1991, p.5). The mental programming referred to consists of shared values, beliefs and norms. Further, he distinguishes three levels of mental programming: universal, collective, and individual. Several dimensions have been proposed (for comprehensive review, please refer to Myers and Tan, 2002). Among them, Hofstede’s dimensions are often employed for empirical observations (Myers and Tan, 2002) and for national culture issues by information system researchers (Ford et al., 2003). While working at IBM from 1967 to 1973, Hofstede also developed the original four dimensions of culture (i.e. Power Distance, collectivism vs. individualism, femininity vs. masculinity, and Uncertainty Avoidance). A fifth
dimension, long-term orientation, was added later. Hofstede (2000) defined the five basic dimensions of culture variability as follows. *Power Distance*: ‘the extent to which the less powerful members of organizations expect and accept that power is distributed unequally’ (Hofstede and Peterson, 2000, p. 28); the degree of inequality among people. *Uncertainty Avoidance*: ‘intolerance for uncertainty and ambiguity’ (Hofstede and Peterson, 2000, p.113); the degree to which a person prefers structured over unstructured conditions. *Individualism versus Collectivism*: ‘the extent to which individuals are integrated into groups’ (Hofstede and Peterson, 2000, p.51); the degree of acting as members of cohesive groups rather than as individuals. *Masculinity versus Femininity*: ‘assertiveness and competitiveness versus modesty and caring’ (Hofstede and Peterson, 2000, p.82); the degree to which masculine values prevail over feminine. *Confucian Dynamism* (long- versus short-term orientation). Each of these value clusters is rather complex; I refer the reader to Hofstede (2000) for a complete analysis. However, the first two of these dimensions, Power Distance and Uncertainty Avoidance, seem to be closely related to my analysis of telemedicine outcomes, and so I shall expand upon this construct.

Power Distance is a “…measure of the interpersonal power or influence between (a superior) and (a subordinate) as perceived by the (subordinate)…” (Hofstede, 2000); it describes the degree to which individuals accept that their superior has more power than they have, and the rightness or wrongness of a superior’s opinion or decision is determined primarily by that superior’s organizational status. In a society in which a large power distance separates people, the leveling effects of telemedicine technology are not desirable. In such a society, most people choose face-to-face interaction (Straub et al., 1997). Moreover, in high power distance cultures, individuals are not expected to disagree with their superiors. In most cases, they are more likely to rely on superior opinions to formulate their decisions, without consultation with subordinates. Generally, in large power distance countries, there is considerable dependence of subordinates on bosses (Hofstede, 2000). On the contrary, in small power distance countries, there is limited dependence of subordinates on bosses. Superiors in high power distance societies tend to exert much influence over the behavior of subordinates, who tend to be submissive rather than independent. Straub et al. (1997) found that high power distance
countries exhibit low technology adoption, whereas cultures that are low in power distance are more participatory and egalitarian.

Uncertainty avoidance is defined as the degree to which people in a culture prefer structured over unstructured situations. Structured situations are those in which there are clear rules as to how one should behave (Hofstede, 2000). The uncertainty avoidance dimension measures the degree to which individuals feel threatened by unknown or uncertain situations, and try to avoid ambiguous situations by establishing formal rules and rejecting deviant ideas and behaviors. Further, uncertainty avoidance evaluates the degree of tolerance within a culture for the ambiguity that is inherent in a continuously unfolding future. Societies generally attempt to manage uncertainty through rules, technology, law and rituals, in order to protect members from anxiety. In societies with high Uncertainty Avoidance, individuals have high need of technology’s benefits. Yet, individuals in societies with high Uncertainty Avoidance are more likely to listen to others’ opinions in order to reduce their uncertainty.

Although little, if any, of the current literature studies the impact of cultural factors specifically pertaining to telemedicine, there is considerable research examining the cultural dimensions of ICT transfer in general. The beliefs and values ingrained in people by their cultural context significantly affect their thinking and perspective, and hence their approaches to technology use (Kransberg and Davenport, 1972; Hofstede, 1984; Bertolotti, 1984; Hakken, 1991; Triandis, 1982; Hofstede and Frank, 1991; Baba, 1995; Ingold, 1996; Loch et al., 2000; Straub et al., 2002).

Straub et al. (2002) divides the culture construct into two sub-constructs. First, culture-specific beliefs and values represent specific beliefs or values that individuals might hold because of the influence of their cultural backgrounds. The second sub-construct of culture is Technology culturation, which represents a person’s exposure to a relatively technology-intense culture. In the context of studies of ICT diffusion in developing countries, technology culturation may indicate the degree to which a citizen of a developing country has been exposed to more technologically advanced cultures (Checchi et al., 2002). Laroche and Gulati (1995) define technology culturation as: “the cultural exposure and the experiences that individuals have with technology developed in other countries”. The usage of technology by society mostly depends on the degree of
technological culturation (Loch et al., 2003). This view emphasizes that technology culturation societies are more receptive to new technologies (Rose and Straub, 1989; Straub et al., 2003). Therefore, we can understand from these views the degree of exposure to which technology influences the degree and rate of diffusion of a new technology.

Various studies (Checchi et al., 2002; Straub et al., 2001, 2002) find that both cultural sub-constructs have a mediating effect on ICT implementation. In other words, beliefs, values and culturation impact both the effectiveness of ICT implementation and its outcomes. In general, cross-cultural analyses are important to show that what may work in one culture may not be appropriate in another (Hofstede and Franke, 1991). Specifically, one solution to the telemedicine implementation problem does not fit all situations, because it depends upon the value of the society in which it serves.

In a more recent study, Leidner and Kayworth (2006) reviewed literature to understand the relation of IT and culture at various levels, including national, organizational and group. The study is based upon the impact of culture on IT (culture information system development; culture, IT adoption and diffusion; culture IT use and outcomes; culture, IT management and strategy), impact of IT on culture (IT’s influence on culture), IT culture and cultural fit. The study further suggested that ‘the IT-culture studies must consider several forms of conflict that result from the intersection of national, organizational, and subunit cultures, values embedded in specific IT, and IT culture (p. 373). Further, Leidner and Kayworth reviewed the three types of values: group member values ‘the values held by members of a group that signify the espoused beliefs about what is important to the particular group’; values embedded in a specific IT, ‘the values that are assumed in the work behaviors that the IT is designed to enable’; and the general IT values, ‘the values that a group ascribes in general to IT (p. 374). In addition, the three types of values and conflicts result in a reorientation of values that IT influences the introduction of IT culture. These conflicts include: system conflict, ‘the conflict introduced by a specific system that brings the issue of culture to the surface’; contribution conflict ‘the perceived relevance, or irrelevance, of IT to complement the
group’s values”; and vision conflict, ‘the values they associate with IT and the values they perceive to be embedded in a particular information system (p. 375).

2.5.3 Organizational Level

2.5.3.1 Organizational Factors

Information technology has been used in both developed and developing countries to support operational, tactical, and strategic processes within healthcare organizations (Abdulgader and Kozar, 1995; Chieochan et al., 2000). However, a number of external and internal factors influence the transfer of information technology in the organization, such as organizational culture, bureaucratic structure, user acceptance, and the role of manager policies and national information infrastructure. Generally, the literature reports that most IT investments within healthcare organizations do not meet their objective, and the reasons for this are rarely technical in origin; rather, organizational and human factors are the most cited reasons for the failure of IT investment (Aas, 2001; Ash, 1997; Hu et al., 2000; Kaplan, 1997; Jennett et al., 2003a).

Today healthcare organizations are dealing with new technology such as telemedicine. These technologies significantly enhance the quality and increase access to healthcare, reducing the total cost of healthcare and, as a result of easy access to the most appropriate specialist experiences, increase the overall quality of healthcare delivered (Bergmo, 1996; Chodroff, 1995; Dlamini, 2001; Hjelm, 2005; Kifle et al., 2006a; Westrup, 2000; Wootton et al., 2004). Despite the great availability of image-based clinical telemedicine solutions, implementation of these new technologies faces difficulty (Aas, 1999; Jennett et al., 2005; Robinson et al., 2003). Many reasons for this are identified by the research community, however, two of the primary causes of the problem are that healthcare organizations are highly mechanistic in their structural dimensions, which are formal and centralized, and the environment in which the organization operates (Kamal and Themistocleous, 2006). Bashshur (2004) notes, “Telemedicine is a complex innovation bundle in that it is a technical as well as an organizational and social innovation.” He discusses telemedicine facing such uncertainties as lack of long-term sustainability plans, lack of mature programs, limited acceptance of telemedicine by health providers and organizations, lack of a standard for file sharing, legal issues;
Unauthorized access to infrastructure and equipment cost affect the wide diffusion of telemedicine in healthcare organizations. Furthermore, Kienzle et al. (2000) note: ‘benefits for telemedicine service providers in the current environment are less obvious and must be viewed from a broader health system perspective’ (p. 15).

Lakhanpal (1994) reviews the literature on traditional innovation research in organizations, and notes the following four categories of relevant factors: (1) individual factors (individual innovators, leaders and individuals in key position); (2) organizational factors (broader organizational factors, environmental factors and characteristics of the innovation); (3) environmental factors (external factors – general and specific, internal factors – manager and organizational characteristics); and (4) communication factors (the process by which an innovation is communicated through certain channels over time among the members of a social system).

Kamal and Themistocleous (2006) review the literature on information technology innovation adoption in government organizations through enterprise application integration technology, and proposes a conceptual framework addressing: (1) organizational factors (formalization, centralization, critical mass, project championship, return on investment, benefits, managerial capability, barriers); (2) technological factor (IT capability, evaluation framework, technology risk, citizen data privacy/security); (3) financial factors (cost, financial capabilities), (4) environmental factors (external pressure, market knowledge, citizen satisfaction, community size, internal pressure); (5) support factors (financial, top management, vendor, administrative). All these studies (Kamal and Themistocleous, 2006; Lakhanpal, 1994; Rogers, 1983) are of great value in understanding why telemedicine adoption has been successful or not in various organizations, and the factors influencing telemedicine transfer in organizations. However, the results of these studies applied in health care organizations may possibly overlook some significant characteristics that should be addressed when telemedicine is introduced into organizations specifically in developing countries. Therefore, some structural components of healthcare organizations that influence telemedicine diffusion should be included, such as horizontal specialization, functional differentiation, size of the unit, planning and control system, internal communication, and decentralization of
power (Damanpour, 1991; Donabedian, 1983; Kamal and Themistocleous, 2006; Meyer and Rowan, 1997).

In healthcare, organizational adoption of telemedicine technology has been driven by justifiable motivations, such as healthcare services improvement in organizational performance, effectiveness and efficiency, as well as competitiveness enhancement. For some researchers (such as Hu et al., 2000), organizational readiness and the availability of the appropriate conditions and needs are a motivation for the adoption of telemedicine in healthcare organizations. Others (Harkke et al., 2003) state that a telemedicine initiative can be challenged by organizational inertia and the prevalence of outdated organizational culture and work processes. Another consideration for telemedicine implementation in organizations is physician decisions in the process of planning and implementing telemedicine (Sheng et al., 1999).

Telemedicine adoption by healthcare organizations can be negatively affected by the complexity of an organization’s structure, and the conflicting roles of key actors such as physicians and managers. Moreover, physicians’ unfamiliarity with the technology (telemedicine), and ineffective management (Sheng et al., 1999), as well as organizational culture and medical norms, limit the diffusion of telemedicine in organizations (Robinson et al., 2003). Aas (2001) notes that the success of telemedicine in healthcare organizations depends upon physician acceptance and organizational readiness. These factors include the commitment of telemedicine managers, and logistic support from the organization (financing, technical and human resources) (Glouberman and Minitzbey, 2001; Whitten and Adams 2003).

Meyer and Goes (1988) study the decision to adopt medical innovations, and attribute 40% of the variance in adoption success to organizational variables such as attitudes, perceptions and especially the climate created by organizational leadership. Doktor et al., (2005) notes that most of today’s healthcare delivery organizations are a product of the pre-information technology age, and quality results from clear rules, high formalization, high authority, and intolerance for ambiguity. They argue that healthcare organizations which have a strategy to use telemedicine technology need to re-address their organizational designs. This will include a major paradigm shift among clinicians, changes in work processes and job descriptions, and organisational restructuring within
health services. Moreover, effectively integrating telemedicine into clinical practice requires major modifications in the structure of traditional clinical practice; technical obstacles, organizational uncertainties, and policy barriers must be overcome on the part of health organizations (Aas, 2001; Leonard-Barton and Deschamps, 1988). This author also argues that institutionalizing telemedicine goes well beyond technology transfer, involving re-thinking how care is delivered, how staff roles will be impacted, what training needs they will have, and how IT resources will reflect such changes.

2.5.3.2 Environmental Factors

In its most general sense, technology adoption can be understood to be the result of organizational decision-making. However, we consider technology adoption to consist of a series of consecutive stages that ultimately lead to technology use or rejection. Prednia and Allen (1995) mention that most previous telemedicine research concentrates on technology development and clinical applications. Some studies examine issues related to the adoption of telemedicine technology at both individual and organizational levels (Hu, 2003).

Adoption of telemedicine in organizations is driven by many factors. For example, Sheng et al. (1999) comment that the adoption of telemedicine technology by healthcare organizations may result from compromises between physicians and management. Specifically, the effect of individual, organizational and contextual variables can impact the project (Kimberly and Evanisko, 1991). Tornatzky and Fleischer (1990) suggest that innovation adoption by organizations can be determined by the combination of organizational, technological and environmental contexts. An organization can influence its internal conditions, that is, its readiness with respect to a particular technology adoption; a technology that is difficult to use is not likely to be well received by physicians (Croteau and Vieru, 2002; Hu et al., 1999). On the other hand, the external environment in which an organization operates has fairly limited influence. Healthcare organizations are designed to provide services to those in need; consequently, such organizations need to explore and evaluate alternatives when existing delivery arrangements cannot meet service demands, as measured by service volume or quality.
Adoption at the institutional level is influenced by each institution’s structure; especially relevant is the degree to which that structure is authoritarian, with the ability to mandate technology use in the organization. For example, the wide adoption of telemedicine in prison programs in USA is well received by the authorities (Grigsby et al., 2002). Even if institutional structure and authority support the diffusion of telemedicine, certain variables at the individual level in the institution can become barriers to the adoption and diffusion of telemedicine, for example, people’s attitudes and perceptions toward technology, their comfort and experience level, and their willingness to use it. Management issues and user acceptance of information systems have been discussed in the medical informatics literature since the early 1980s. Early on, authors discussed the issue of change management (Olivia, 1998); other researchers addressed: work flow (Browne et al., 2004); clinicians' levels of expertise (Smith et al., 2005); values and professional norms (Scott, 2001); the institutional setting (Bond, 1993); communication patterns (Taylor, 2003); organizational culture and status relationships (Daktor et al., 2005); congruence with existing organizational business models and strategic partners (Aas, 2001); and compatibility with clinical-patient encounter and consultation patterns (Kuntalp and Akar, 2004). Some researchers discuss the interrelationships among key components of an organization, such as structure, strategy, management, worker skills, and technology (Al-Gahtani, 2003); others are concerned with the compatibility of goals, professional values, and cultures of different groups (including developers, clinicians, administrators and patients) within an organization (Ash, 1997). More recently, Walker and Whetton (2002) and Robinson et al. (2003) use diffusion of innovation theory to address organizational, social, and other contextual issues. Schubart and Einbinder (2000) base their study on diffusion of innovation theory, and provide a brief review of other similar research.

Organizational readiness is an important factor for decision makers, because it reflects potential service volume, thereby determining the extent to which innovations can be translated into reality (Parasuraman, 2000). Physician readiness and acceptance, however, is the primary challenge for telemedicine projects (Kifle et al., 2006c). Awareness of the stakeholders and educational programs are both required to alleviate the acceptance problem (Walker and Whetton, 2002). Kaplan (1987) classifies barriers to
telemedicine implementation into four categories: (1) insufficient (i.e., not enough funding, knowledge, or advanced technology); (2) inherent in the medical environment (i.e., the fragmentation of healthcare institutions into separate departments and organizations, and the difficulty of organizing and standardizing medical knowledge); (3) project management-related (i.e., associated with on-going difficulties of coordinating teams of clinicians and professionals from other disciplines); and (4) user resistance (especially regarding apparent physician resistance to medical informatics applications). All these barriers have to do with people, environmental, organizational and social issues.

2.5.4 Individual Level

2.5.4.1 Individual Acceptance of Telemedicine

Telemedicine researchers often focus on bandwidth, medical equipment, software and connectivity (Nelson et al., 2001). As Whitten, et al., (2000a) note, “we know a good deal about bandwidth and resolution, but little about human dimensions that make practice possible” (p. 112). The IS research community has done several studies that explain user acceptance of technology (Agarwal and Prasad, 1998; Davis et al., 1989; Gefen and Straub, 1997, 2000; Karahanna, et al., 1999; Lederer et al., 2000; Lee et al., 2004; Mathieson et al., 2001; More and Benbasat, 1991; McCoy, 2002; Myers and Tan, 2002; Straub et al., 1997; Venkatesh and Davis, 2000; Venkatesh and Brown, 2001; Venkatesh et al., 2003). Some articles explain new technology acceptance in Africa (Al-Gahtani, 2001, 2003; de Vreede et al., 1999; Kamel and Assem, 2002; Kamel and Hassan, 2003). Further, a few studies assess the impact of telemedicine on the actual or potential users of this particular technology (Chau and Hu, 2001, 2002a and 2002b; Croteau and Vieru, 2002; Dixon and Stewart, 2000; Han, 2005; Hu et al., 1999; Jayasuriya, 1998; Kifle et al., 2005).

In these theoretical models of user acceptance of technology, the Technology Acceptance Model (TAM) focuses on perception of technology relative to perceived ease of use and its effects on usefulness and attitudes (Davis et al., 1998). Davis (1989) defines Perceived Usefulness (PU) as “the degree to which a person believes that using a particular system would enhance his or her performance” (p.320). Adams et al. (1992) and Straub et al. (1997) report that user acceptance of an IT system
is driven to a large extent by perceived usefulness. Perceived Ease of Use (PEU) is defined as “the degree to which a person believes that using a particular system would be free of effort” (Davis 1989, p.320). Goodwin (1987) argues that the effective functionality of system, i.e. perceived usefulness, depends on its usability. The acceptance of the IT system under investigation is affected by external variables, such as user characteristics (Benbasat et al., 1986; Chen, 2002). Generally, TAM is used to address why users accept or reject an IT system, and how user acceptance is influenced by system characteristics across user perceptions and their attitudes towards the system. This enables managers and system developers to improve user perceptions and their attitude towards a given IT system (Gefen and Keli, 1998).

The Theory of Planned Behavior (TPB) focuses on conditions where individuals do not have complete control over their behavior. In other words, the building blocks of the TPB model are salient beliefs used to ascertain attitudes, subject norms, and behavioral control, consecutively determining intentions and behaviors (Ajaza, 1985, 1989). The Theory of Reasoned Action (TRA) from psychology (Fishbein and Ajzen, 1975, p.396), according to which external stimuli influence a person’s attitude towards a behavior indirectly by influencing his or her salient beliefs about the consequences of performing the behavior, is a well-accepted intention model for predicting and explaining behavior. Both TPB and TRA have been linked two key beliefs (perceived usefulness and perceived ease of use).

Innovation Diffusion Theory (IDT) represents another approach to technology acceptance and use. Rogers (1983) defines innovation as “an idea, practice, or object that is perceived as new by an individual”, and diffusion as “the process by which an innovation is communicated through certain channels over time among the number of social systems”. Further, Rogers defines relative advantage as “the degree to which a new technology is perceived as offering improvement over the existing one”; compatibility as “its consistency with existing social norms, past experiences and work style”; complexity “as the degree to which the new technology is easy to use and learn”; trialability as “the possibility to experiment with an innovation prior to actually using it”; and observability as “the extent to which a new technology’s outcomes are clear”.
In a more recent study, Venkatesh et al. (2003) proposed a unified mode, The Unified Theory of Acceptance and Use of Technology or UTAUT, whose well-validated constructs combine eight models in IS adoption research. The model is formulated with four constructs of intentions and usage: performance expectancy, “the degree to which an individual believes that using the system will help him or her to attain gains in job performance” (p. 447); effort expectancy, “the degree of ease associated with the use of the system” (p. 450); social influence, “the degree to which an individual perceives that it is important others believes that he or she should use the new system” (p. 451); and facilitating conditions, “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system” (p. 453). In addition, there are four moderators of key relationships: gender, age, experience, and voluntariness of use.

Within the healthcare sector (telemedicine), a few studies examine user acceptance of technology, such as TAM or its extended models to investigate physician technology acceptance, for example (Allen et al., 1995; Chau and Hu 2001, 2002a, 2002b; Croteau and Vieru, 2002; Hebert, 1994; Henry and Stone, 1994; Hu et al., 1999; Kifle, et al., 2005b; Yarbrough, et al., 2005). Hu et al. (1999), using data from Hong Kong physicians to examine the acceptance of telemedicine technology, find that perceived usefulness is a significant determinant of attitude and intention, while ease of use is not. A subsequent study by Chau and Hu (2001, 2002a and 2002b), using a similar sample (Hu et al., 1999) article, utilized three models (TAM, TPB and an integrated model derived from TAM and TPB) to evaluate technology use and acceptance decisions based on the technology’s compatibility. The outcomes indicate that TAM is an appropriate model to explain individual physicians’ technology acceptance decisions.

Kifle et al. (2005b) proposes a model that combines Technology Acceptance Model (TAM) originally proposed by Davis (1989), Diffusion Innovation Theory (IDT) by Rogers (1976), and Theory of Planned Behavior (TPB) by Ajzen (1991), and addresses factors influencing Ethiopian physicians’ intentions to adopt telemedicine. In their study, TAM was modified to indicate additional constructs, namely Image and perceived voluntariness of use, taken from the Innovations Diffusion Theory (Rogers, 1983), in addition to situation support and perceived effort and persistence. Their
findings show that perceived compatibility is positively related to perceptions of the ease of use of telemedicine technology.
Chapter 3: Research Method, Model and Hypotheses

In this chapter I discuss the methodological foundations for the research, and demonstrate the research approach. I focus on a quantitative positivist research approach adopted for the study. I then discuss the proposed model which is based on the literature review, and finally I present specific hypotheses.

3.1 Research Methods in Information Systems

A research method is a strategy of inquiry that moves from the individual researcher’s underlying philosophical assumptions to his or her research design, data collection techniques, data analysis techniques and result interpretation (Chen and Hirscheim, 2004; Chua, 1986; Gallers and Land, 1987; Jarvenpaa et al., 1985; Klein and Myers, 1999; McGrath, 1982). Generally, scientific research is based on some basic assumptions about the nature of physical and social reality, or “ontology”, related to valid knowledge about the phenomena, or “epistemology” underlying the research, which influence what are considered acceptable methods for obtaining the knowledge, or “methodology” (Galliers, 1985; Hamilton and Ives, 1992). Methodological assumptions indicate which research method and techniques are considered appropriate for gathering valid empirical evidence. Simon (1980) notes, that the academic study of information systems relies very much on the methods used to answer research questions and test research hypotheses, and on the careful application of these methods. However, scientific methods cannot themselves be used to validate principles; practices are only accepted as received wisdom by a field of profession through philosophical disputation (Falconer and Mackay, 1999; Iivari et al., 1998, Marcoulides and Saunders, 2006)

In scientific research, deduction and induction are two principal strategies for making discoveries; these two approaches are more complementary than opposed. Deductive research proves conclusions with rigor, based on well-established theory and recognized facts. Theory testing in itself does not involve complete knowledge; but testing a hypothesis proposes a relationship between two or more variables (independent and dependent). Deductive arguments can give certainty, but that certainty only applies to the logical relationships involved (Hempel, 1965). To test the empirical validity of a
theory, usually IS researchers employ deductive logic to make generalizations (Mingers, 2001, 2003, 2004; Punsch, 2005). Inductive arguments attempt to show that their conclusions are likely or based on local observation, going from specific to the general, where data is used to build theories.

Social science research types can be classified as descriptive (often the primary focus of the first research about some issue), exploratory (to find out what is going on here and investigate social phenomena without explicit expectations), explanatory (seeking to identify the causes and effects of social phenomena, and to predict how one phenomenon will change or vary in response to variation in some other phenomenon), and evaluative (seeking to determine the effects of social policies, programs, or other types of intervention) (Newman and Benz, 1998; Palvia et al., 2004).

Based upon epistemological assumptions, qualitative and quantitative methodologies are two principal research orientations. The first and foremost difference between them is that quantitative research deals with numbers, whereas qualitative research involves interviews and documents. Another difference between these two research strategies is that quantitative research has a formal, strict approach to research design, whereas qualitative research is more flexible, and the research stance may possibly change (Robson, 1998). Quantitative methods are most often used when the motives for research are explanation or description, whereas qualitative methods on the other hand are mostly used when the motive is exploration (Schutt, 1999). Specifically, quantitative analysis can be achieved by empirical hypothesis and research questions (Lucas 1978, 1991). Another distinguishing factor between the two approaches is that quantitative research is more directed at theory verification or testing, while qualitative research is more concerned with theory generation or building (Newman and Benz, 1998). Therefore, the selection of a research methodology in IS research is incumbent on the individual researcher identifying problems to answer his/her specific research question (Robson, 1998). Hence, the real question is whether the research method is appropriate to answer the research questions being asked by the researcher. I believe that for this study selecting proper strategic methods and properly reporting the results is very important, increasing the reliability, validity, and generalizability of the findings and the philosophical position of the research.
I have followed Hemple’s (1965) quantitative research tradition, based on deductive reasoning in IS (See Figure 3.1). This method includes a research question about the social world which you seek to answer through collecting and analyzing firsthand, verifiable, empirical data. Logically interrelated sets of propositions about empirical reality are called theories. Deductive, nomological explanation is used to create theories and testable hypotheses for empirical research (Hemple and Paul, 1948). A hypothesis is a specific expectation deduced from a more general theory. After formulating hypotheses, you collect data with which to test them. Finally, the empirical results should confirm the theory which started with premises and leads to empirical generalization.

Figure 3.1 Deductive Research Approach

3.1.1 Philosophical Basis for IS Research

Philosophical debate on how to conduct Information Science research (positivism versus interpretivism) has been the focus of much recent attention (Lee 1999; McGrath, 1982; Mingers, 2001; Orlikowski and Baroudi, 1991; Weber, 2004). The major emphasis of such debates lies in the epistemology of research. Epistemological assumptions concern the criteria by which valid knowledge about a phenomenon may be constructed and evaluated. For example, epistemological assumptions of a positivist researcher include the notions that reality is objective and observable, and that a theory is true only if it is repeatedly not falsified by empirical events (Westland, 2004). Positivists believe that a well-designed test of a theoretically based hypothesis can move us closer to understanding the actual social process and provide internal and external validity in the measure of universal constructs (Crotty, 1998; Guo and Sheffield, 2006; Mingers, 2001).
Crossan (2003) in drawing from the work Outhwaite (1987) noted that there are three generations of positivist philosophy. The first generation is associated with early traditional positivism, breaking away from religious interpretations, and establishing human beings as the main protagonists in the development and accumulation of scientific knowledge. The second generation, logical positivism, was primarily concerned with the logical analysis of scientific knowledge, the analysis of scientific thought, and the provable results of technical research on formal logic and the theory of probability. Logical positivism has two fundamental principles: (a) the verifiability principle and its consequence; and (b) the logical structure of scientific theories and the meaning of probability. The third generation of positivist philosophy, associated with Carl Hempel (1965), developed during the post-war period. He focused on the need for reasoning that moves away from theoretical ideas to a logical conclusion through deductive thinking (Crossan, 2003).

Most IS research has been underpinned by a positive philosophy (Mingers, 2003). Chen and Hirschheim (2004) note that positivist philosophy still dominates more than 80 percent of published empirical IS research from 1991 to 2001. Quantitative data is characteristic of the positivist paradigm, as qualitative data is traditionally related to the interpretive paradigm (Weber, 2004). Interpretive researchers are criticized for inconclusive results, whereas positivist researchers are criticized for oversimplifying complex adoption phenomena (Walsham, 1995). According to Smith, “Positivist approaches to the social sciences…assume things can be studied as hard facts and the relationship between these facts can be established as scientific laws the same way as natural objects” (Smith, 1998) (Cited in Crossan, 2003, p.4). (The general elements of positivist philosophy are methodological (research should be quantitative), causal (causal explanations and fundamental laws that explain human behavior), and operational (concepts are to be measured quantitatively) (Bond, 1993; Easterby-Smith et al., 2002; Hughes, 1994). Furthermore, positivist researchers generally attempt to test theory in order to increase the predictive understanding of phenomena (Orlikowski and Baroudi, 1991). Positivist epistemology is described by Robson (1998), “to establish universal laws based on quantitative empirical findings”. He also believes that knowledge may be obtained based on collecting and analyzing numeric data.
The central principles of positivist philosophy are both ontological (the world is objective and exists independent of human observation) and epistemological (the empirical testability of theories, verified or falsified, by the researcher explains the physical and social worlds through universal laws or principles, and deductions made from the laws can then be used to explain events) (Orlikowski and Baroudi, 1991).

Positivist philosophy may also be methodological; it has enforced standards of quality, and seeks to build a tradition of cumulative knowledge (Jarvenpaa, 1985).

### 3.1.2 Quantitative Research

The information system discipline combines computer science and management to study the application of IT in organizations and society (Hirschheim and Klein, 2003 Keen, 1980; Kraemer et al., 1992; Markus, 1983; Mumford and Weir, 1979; Vessey et al., 2002). The study of IS research may be considered “multidisciplinary” (Land, 1993; Banville and Landry, 1989), but others believe that IS is “fully emerged as a discipline in its own right” (Baskerville and Myers 2002); “emerging as a scientific field is evidenced by the building of a solid research tradition” (King and He, 2005). Information system is also emerging as an important reference discipline (King and He, 2005; Vassey and Glass, 2000). Therefore, based on existing different epistemological assumptions, information system research utilizes both quantitative and qualitative methods (Myers and Avison, 2002; Robson, 1998); quantitative research methods are preferred in cases where the research findings will apply to more than one population, thereby increasing the possibility of generalizing the research findings (Hoepfl, 1997). Conclusions obtained from quantitative studies are considered to be more reliable and more valid statistically (Gay and Airasian, 2000).

Quantitative methods originated from the natural sciences, and later have been applied to social sciences through survey methods. Quantitative research must be replicable, so that function can be confirmed or disconfirmed, resulting in knowledge useful for explaining, predicting, and controlling effects and outcomes. Gary and Airasian (2000) identify four features of quantitative research: (1) implementing hypothesis studies and research procedures prior to conducting the study; (2) maintaining control over contextual factors that might interfere with the data collection; (3) using adequate
samples of participants to provide statistically meaningful data; and (4) employing data analysis relying on statistical procedures (Gary and Airasian, 2000).

Certain types of research, such as causal-comparative or experimental research, are conducted using quantitative research. The choice of quantitative approach may depend on: (1) the philosophical paradigm and goal of the research; (2) the nature of the phenomenon of interest; (3) the level and nature of research questions; and (4) practical considerations related to the research environment and the efficient use of resources (Proctor, 1998). Finally, quantitative research is based on positivistic thought (as opposed to post-positivist or interpretivist approaches) that describes and explores phenomena in depth from a qualitative perspective (Polit et al., 2001). Creswell summarizes quantitative research approaches as, “An inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analyzed with statistical procedures, in order to determine whether the predictive generalizations of the theory hold true.” (Creswell, 1994, p. 2).

3.1.3 Measurement

DeVelis (1991) notes that measurement consists of evaluating numbers so they reflect the different degrees of the attribute being assessed. Measurement is a “process of tinking abstract concepts to empirical indicants” (Carmins and Zeller, 1979). Understanding phenomena is a problem of measurement, and requires an accurate set of instruments to capture the essence of the phenomena. In general, people as ‘objects’ are not measured, but their attributes are assessed (Anderson and Gerbing, 1988, 1991). Nunnally and Bernstein (1994) argue that some attributes are so abstract that they may not be amenable to measurement. Hence, an assessment of the measurability of interest must be made prior to attempting to measure it.

In general, measurement must be repeatable – the measure must perform similarly under similar testing conditions, and the methodology measure itself must be standardized – to produce quantifiable numeric results. Thus, the two concepts of repeatability and standardization are primary measurement properties, crucial in order to capture the essence of the phenomenon. Other considerations include reliability and validity, which also enhance communication, and whether the results lend themselves to
generalization. In addition, two other types of measurement are conducted: confirmatory or exploratory. Confirmatory research studies seek to test (confirm) a pre-specified relationship, while exploratory studies define possible relationships in only the most general form, and then allow multivariate techniques to estimate a relationship(s) (Hair et al., 2003).

In general, measurement is the most important characteristic of quantitative research (Anderson and Gerbing, 1982; Straub, 1979; Straub et al., 1995). Latent constructs are not directly observable or quantifiable, but they are variable; for variable latent theoretical constructs to be quantifiable requires analysis of multiple items (DeVellis, 1991; Nunnally and Bernstein, 1994). Therefore, measures of latent constructs should be based on a theoretical framework and/or have theoretical underpinnings. Cronbach and Meehl note that construct validity involves at least three steps: (1) theorizing, i.e. specifying a set of theoretical constructs and their relations; (2) developing methods to measure the constructs of the theory; and (3) empirically testing how well manifest (observable) indicators (items) measure the constructs in the theory, and testing the hypothesized relations among the constructs of the theory.

3.1.4 Choice of Statistical (Data) Analysis Techniques

Structural Equation Modeling (SEM) is a statistical analytical procedure that encompasses aspects of confirmatory factor analysis, path analysis and regression. Generally, SEM is deployed to test theorized models. SEM is usually viewed more as a confirmatory than an exploratory procedure; thus it is better suited to theory testing than theory development. The model in SEM has two basic components: the measurement model, which defines hypothetical latent variables in terms of observed measured variables; and the structural model, which defines relations among the latent variables (Chin, 197,1998a, 1998b; Fornell and Bookstein, 1982).

Partial Least Squares (PLS), is a multivariate statistical approach and analysis technique that can be used to determine whether a certain model is valid (Straub, 1989). This technique is widely used in major Information Science (IS) journals such as MIS Quarterly, Information and Management (IM) and Information System Research (ISR) (Gefen et al., 2000).
There are two general approaches to structural equation modeling: (1) the LISREL approach of covariance-based SEM; and (2) the Partial Least Squares (PLS) approach of variance-based SEM. Chin and Newsted (1999) summarize the differences between the various SEM techniques (see Table 3.1). This comparison highlights the fact that PLS can be used to determine the relationship between multiple variables that cannot be measured directly (Chin, 2001). PLS also works with theoretical models and/or reflective and formative measures (Chin, 1998a; Fornell and Bookstein, 1982). It should be further noticed that PLS has functions that help to resample the model, such as jackknife and bootstrap. PLS is a powerful method of analysis because of the minimal demand on measurement scale sample size and residual distributions (Barclay et al., 1995) (see Table 3.1 for detail).

Table 3.1: Comparison between SEM Techniques, Source: (Chin and Newsted, 1999)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>PLS</th>
<th>LISREL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective</td>
<td>Prediction Oriented</td>
<td>Parameter Estimated</td>
</tr>
<tr>
<td>Approach</td>
<td>Variance based</td>
<td>Covariance Based</td>
</tr>
<tr>
<td>Assumptions</td>
<td>Prediction Specification (non-parametric)</td>
<td>Typically Multivariate Normal Distribution and Independent Observation (Parametric)</td>
</tr>
<tr>
<td>Parameter Estimates</td>
<td>Consistent as Indicators and Sample Size Increase (i.e., Consistency at large)</td>
<td>Consistent</td>
</tr>
<tr>
<td>Latent Variable Scores</td>
<td>Explicitly Estimated</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>Epistemic Relationship between a Latent Variable and its Measures</td>
<td>Can be Modeled in either Formative or Reflective Mode</td>
<td>Typically only with Reflective Indicators</td>
</tr>
<tr>
<td>Implications</td>
<td>Optimal for Prediction Accuracy</td>
<td>Optimal for Parameter Accuracy</td>
</tr>
<tr>
<td>Model Complexity</td>
<td>Large Complexity (e.g., 100 Constructs and 1,000 indicators)</td>
<td>Small to Moderate Complexity (e.g., less than 100 indicators)</td>
</tr>
<tr>
<td>Sample Size</td>
<td>Power Analysis Based on Portion of the Model with the Largest Number of Predictors. Minimal recommendations range from 30 to 100 cases.</td>
<td>Ideally Based on Power Analysis of Specific Model – Minimal Recommendations Range from 200 to 800 cases.</td>
</tr>
</tbody>
</table>
PLS parameters are obtained from three categories: The first category is weight estimates, used to create latent variable scores. The second reflects path estimates, connecting latent variables, and between latent variables and their respective block of indicators (i.e. loading). The third category pertains to means and location parameters (i.e. regression constants for indicators and latent variables) (Falk and Miller, 1992).

PLS modeling consists of three sets of relations. First, the Inner Relations Model uses an iterative estimation technique to define the relationship between different latent constructs. Second, the Outer Relations Model employs indicators that combine to create a linear model for the latent variable score. Third, the Weight Relations Model defines the estimated latent constructs as weighted aggregates of the observed variables.

PLS is built upon both a measurement model and a structural model (Gefen et al., 2000). The measurement model is called the outer model, and the structural model the inner model (see Falk and Miller, 1992 for a complete discussion). At the Measurement Model Level, PLS estimates item loadings and residual covariance having to do with measurement and data collection. The measurement model specifies how the instrument is to be developed with high reliability and low measurement error. At the Structural Model Level, PLS estimates coefficients and correlation among the latent variables, together with the Average Variance Extracted (AVE) for each of the latent constructs, and individual $R^2$ for predicted constructs. In general, the structural model specifies how well some variables predict other variables. As prediction involves relationships, it may be viewed as a regression or path model.

3.1.5 Choice of Quantitative Research Methodology

Our research aim is to determine what factors influence the transfer of telemedicine technology, and how national infrastructure and culture influence the social and value outcomes of telemedicine. Generally, the choice of a research methodology depends on the topic area, the research question, the research background and the intended audience (Palvia et al., 2003, 2004). I have adopted a quantitative positivist research (QPR) approach as the underpinning philosophy and methodology to guide the empirical studies of my research. As Straub et al. (2004) notes, QPR is “a set of methods and techniques that allows IS researchers to answer research questions about the
interaction of humans and computers”. He also observes that QPR relies on two foundations: first, “quantitative data gathering or data exploration”; and second, positivist philosophy dealing “with problem solving and the testing of the theories derived to test these understandings”.

The principles determining how QPR is conducted with rigor are essential for evaluating the quality of research in the IS field. Straub, et al. (2004) points out that validation renders IS QPR methods more meaningful. However, following the appropriate validation procedures is still a major concern for IS researchers (Boudreal et al., 2001; Gefen et al., 2000; Straub, 1989). In general, QPR rigor consists of three sets of validities: instrument validation, such as content validity, construct validity, and reliability; internal validity; and statistical conclusion validity, which should also be considered to claim generalizability, a key feature of QPR. I present recommended guidelines for QPR research, with a focus on those that I adopted in my research (Straub et al., 2004; Han, 2005). See Table 3.2 for details.

**Table 3.2:** Guidelines for QPR research (adapted from Straub et al., 2004).

<table>
<thead>
<tr>
<th>Validity</th>
<th>Definitions</th>
<th>Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Instrument validity</strong></td>
<td>Constructs are probably real and reliable; the instrument is probably measuring the right content.</td>
<td>Literature review; expert panels or judges (Straub, 1989; Smith et al., 1996; Lewis et al., 1995; Storeg et al., 2000)</td>
</tr>
<tr>
<td><strong>Content Validity</strong></td>
<td>An issue of representation from the “content universe”. The degree to which the score or scale being used represents the concept about which generalizations are to be made. (Nunnally, 1978)</td>
<td></td>
</tr>
<tr>
<td><strong>Construct Validity</strong></td>
<td>An issue of operationalization or measurement between constructs. Measures chosen by researcher “fit” together in such a way as to capture the essence of the construct. (Straub et al., 2004)</td>
<td>Convergent and Discriminant validity (Cronbach, 1971; Kerlinger, 1964; Straub, 1990; Igbariu &amp; Barpudi, 1993)</td>
</tr>
</tbody>
</table>
### Validity

<table>
<thead>
<tr>
<th></th>
<th>Definitions</th>
<th>Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminant Validity</td>
<td>The measurement items posited to reflect the construct differ from those that are not believed to make up the construct.</td>
<td>PLS weight, CFA Loading &gt; 0.707 (Loch et al., 2003; Gefen et al., 2000, 2003) Items that do not load properly are dropped.</td>
</tr>
<tr>
<td>Convergent validity</td>
<td>Measurement items reflect one “latent” construct, which shows significant high correlations with one another in comparison with the convergence of those items relevant to other constructs.</td>
<td>CFA item loading should be above .707 (Venkatraman and Ramanujam, 1987; Straub 1990; Gefen, 2000)</td>
</tr>
<tr>
<td>Reliability</td>
<td>An issue of measurement within a construct; a statement about measurement accuracy.</td>
<td>Cronbach’s alpha &gt; 0.707 (SPSS or PLS)</td>
</tr>
</tbody>
</table>

2. **Internal validity**

Inferences regarding cause-effect or causal relationship are approximately true, and only relevant to the specific study in question.

3. **Statistical conclusion validity**

The degree to which we reach conclusions about relationships in our data is reasonable; the statistical inferences made are approximately true.

In my research I have rigorously followed these guidelines, which are generally applicable for IS research to consider when using QPR and PLS applications. Following such guidelines is an essential condition for research to “be scientific”. Furthermore, the rigorous adoption and use of these validation guidelines in the research practice builds a more accurate condition to claim generalizability of the research results.

### 3.2 Research Model

The literature review of telemedicine transfer (social and value) outcomes presented in chapter two indicates that both technical and non-technical issues should be addressed to answer the research questions. Thus, the theoretical model for this study is based on the national and cultural level model in the developing world, and particular objectives (telemedicine). The study addresses at the national aspect variables such as policies, infrastructure, and health environment; the cultural aspect addresses telemedicine transfer implementation, culture-specific beliefs and values, and technology culturation. I encapsulate these factors in two proposed research models (Fig. 3.2 for the
national infrastructure model, and Fig 3.3 for the cultural model). In general, our proposed model (see Figure 3.1) attempts to answer two research questions:

1. What aspects of national infrastructure influence the transfer of telemedicine outcomes in SSA?
2. What cultural and implementation factors influence the transfer of telemedicine outcomes in SSA?

In order to answer these two research questions with the background of a proper theoretical framework, and to explain which factors are especially strongly related to telemedicine (social and value) outcomes in Sub-Saharan African countries, I develop an overall model of telemedicine outcomes. In particular, the research model is drawn from various research streams: telemedicine, ICT diffusion (organizational, environmental), ICTs in developing countries (policies and infrastructure) and culture (power distance, uncertainty avoidance and technology culturation).

3.3 Overall Model of Telemedicine Outcomes

The field of telemedicine continues to evolve and mature; considerable attention for measuring telemedicine outcomes focuses on technical properties, such as data transmission, bandwidth, data quality (resolution), software, connectivity and reliability. Regarding non-technical issues, reliable research results on cost, access, quality, effectiveness and other impacts of telemedicine remain limited (Heinzelmann et al., 2003; McDonald et al., 1998; Scott and Neuberger, 1996; Wootton, 2003). Most research cites the economic need to contain the seemingly uncontrollable growth of healthcare expenditures; the need for better resource allocation is an important driving force for telemedicine transfer outcomes. The social desire for locally adjusted access to health care, regardless of geographic conditions, is an additional significant factor for telemedicine transfer outcomes. However, barriers related to lack of training and inappropriate system design (Kaplan, 2000; McCarthy et al., 2000), cost and quality (Casey et al., 1998; Donabedian, 1996), and policy issues such as privacy and security
concerns and acceptance of IT (Fujimoto et al., 2000; Jennett et al., 2003; Klecun-Dabrowska, 2002), have delayed the adoption of telemedicine.

In measuring factors that influence the transfer of telemedicine outcomes, I have identified several issues that are relevant and have been accepted as significant research problems in the research community (Ten et al., 2005; Kifle et al., 2006a, 2006b, 2006c). These include the potential for addressing social and economic benefits of telemedicine, as well as technological and socio cultural influences on patients, physicians and healthcare providers at the national level. I also identify national infrastructural and cultural factors IS and allied disciplines that focus on developing nations (Avgerou and Walsham, 2000; Checchi et al., 2002; Musa, et al., 2005a; Okoli, 2003; Straub et al., 2001; Straub, 2003), as a basis for extensive empirical testing for my research questions.

The hypotheses for testing my research model have eleven independent variables that directly affect telemedicine outcomes. On the national level, I have general ICT policies, e-health policies, data security policies, the ICT infrastructure, and the healthcare environment (health infrastructure and telemedicine readiness). On the cultural level, I have telemedicine transfer implementation (decision-making factors and implementation effectiveness), culture-specific beliefs and values (power distance and uncertainty avoidance), and technology culturation. Table 3.3 depicts an overview of the variables used in this study. The overall research model for this study is shown in Figure 3.1.
### Table 3.3: Relationship between Hypothesized Variables

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypothesis</th>
<th>Variables</th>
<th>Hypothesized Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RQ1:</strong> What aspects of the national infrastructure influence the transfer of telemedicine outcomes in SSA?</td>
<td>H$_{1a}$</td>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Value Outcomes</td>
</tr>
<tr>
<td></td>
<td>H$_{2a}$</td>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Social Outcomes</td>
</tr>
<tr>
<td></td>
<td>H$_{3a}$</td>
<td>Telemedicine Social Outcomes</td>
<td>Telemedicine Value Outcomes</td>
</tr>
<tr>
<td></td>
<td>H$_{4a}$</td>
<td>ICT Policies</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{4b}$</td>
<td>ICT Policies</td>
<td>ICT infrastructures</td>
</tr>
<tr>
<td></td>
<td>H$_{5a}$</td>
<td>e-Health Policies</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{5b}$</td>
<td>e-Health Policies</td>
<td>ICT infrastructures</td>
</tr>
<tr>
<td></td>
<td>H$_{6a}$</td>
<td>Data Security</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{6b}$</td>
<td>Data Security</td>
<td>ICT infrastructures</td>
</tr>
<tr>
<td></td>
<td>H$_{7}$</td>
<td>ICT infrastructures</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{8}$</td>
<td>Telemedicine Readiness</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{9a}$</td>
<td>Healthcare Infrastructure</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{9b}$</td>
<td>Healthcare Infrastructure</td>
<td>Telemedicine Social Outcomes</td>
</tr>
<tr>
<td><strong>RQ2:</strong> What cultural and implementation factors influence the transfer of telemedicine outcomes in SSA?</td>
<td>H$_{1b}$</td>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Value Outcomes</td>
</tr>
<tr>
<td></td>
<td>H$_{2b}$</td>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Social Outcomes</td>
</tr>
<tr>
<td></td>
<td>H$_{3b}$</td>
<td>Telemedicine Social Outcomes</td>
<td>Telemedicine Value Outcomes</td>
</tr>
<tr>
<td></td>
<td>H$_{10a}$</td>
<td>Power Distance</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{10b}$</td>
<td>Power Distance</td>
<td>Implementation Effectiveness</td>
</tr>
<tr>
<td></td>
<td>H$_{10c}$</td>
<td>Power Distance</td>
<td>Decision Making Factors</td>
</tr>
<tr>
<td></td>
<td>H$_{11a}$</td>
<td>Uncertainty Avoidance</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{11b}$</td>
<td>Uncertainty Avoidance</td>
<td>Implementation Effectiveness</td>
</tr>
<tr>
<td></td>
<td>H$_{11c}$</td>
<td>Uncertainty Avoidance</td>
<td>Decision Making factors</td>
</tr>
<tr>
<td></td>
<td>H$_{12a}$</td>
<td>Technology Culturation</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{12b}$</td>
<td>Technology Culturation</td>
<td>Implementation Effectiveness</td>
</tr>
<tr>
<td></td>
<td>H$_{12c}$</td>
<td>Technology Culturation</td>
<td>Decision Making factors</td>
</tr>
<tr>
<td></td>
<td>H$_{13}$</td>
<td>Implementation Effectiveness</td>
<td>Telemedicine Capabilities</td>
</tr>
<tr>
<td></td>
<td>H$_{14}$</td>
<td>Decision Making Factors</td>
<td>Telemedicine Capabilities</td>
</tr>
</tbody>
</table>
Figure 3.2: Overall Model of Telemedicine Outcomes
3.4 National Infrastructural Model of Telemedicine Outcomes

The model proposed here has three predictor constructs that I postulate to influence telemedicine outcomes on the national level. National ICT polices have three dimensions: (1) general ICT policies (the government’s objective to prioritize ICTs for national development) (Courtright, 2004; Chechi et al., 2002; Gurbaxani, et al., 1990; Rigby, 1999; Straub, et al., 2001; UNCSTD, 1997; Wild and McCube 1996); (2) e-health policies (the government’s attitude and commitment to improve healthcare development by using ICT) (Anderson, 2000; Fujimoto et al., 2000; Jennett and Siedlecki, 2001; Jennett et al., 2004; Scott et al., 2002; Vargneses and Scotte, 2004; WHO, 2000); and (3) data security policies (the government’s awareness and support of setup standards and procedures for telemedicine communication improvement) (Blobel, 2000; Gilbert, 1997; Janczewski and Shi, 2002; Kumekawa, 1997; Sandberg, 1995; Stanberry, 2000; Tulu, 2003; Wachter, 2000).

ICT infrastructure, a telecommunication infrastructure with Internet connections (bandwidth), impacts telemedicine outcomes unidimensionally according to availability, security and affordability (Datta and Mbarika, 2004; Iakovidis, 2000; Mbarika et al., 2001; Meso and Duncan, 2000; Puskin and Sanders, 1995 Tulu et al., 2005). Also, national policies (ICT, data security, e-health) have a direct effect on ICT infrastructure. Thus, ICT Infrastructure is a construct that is both independent and dependent.

Finally, we have the health environment (Bashshur, et al., 2005) with two dimensions, one that impacts the practice of health in general, and the other that influences telemedicine in particular. These factors include the effectiveness and readiness of government in the healthcare institutions dimension (AaS, 2001; Ash, 1997; Bashshur et al., 2005; Hu et al., 2000; Kifle, et al., 2005a). Figure 3.2 displays the national-level model, with all the postulated paths labeled with the specific hypotheses listed in section 3.5.
Figure 3.3: National Infrastructural Model of Telemedicine Outcomes
3.5 Cultural Model of Telemedicine Outcomes

The significance of cultural factors is a critical issue in developing countries (Loch et al., 2003; Meso et al., 2005). Straub et al. (2002) shows that culture influences the transfer of IT technology and future use of other IT systems. The research model I propose has three predictor constructs that I postulate impact telemedicine outcomes at the cultural level.

Telemedicine transfer implementation influences the effectiveness of the process of adopting telemedicine tools and practices (Ash, 1997; Hu et al., 1999; Kuhu and Guise 2001; Kwon and Zmud, 1987; Lucas, 1978; Mitchell 2000; Reid, 1996; Rigby, 2002; Rogers, 1983; Scott, 2004).

At the cultural level, there are two specific factors (Straub et al., 2001; Myer and Tan, 2002): culture-specific beliefs and values and specific patterns of thinking, including the impacts on telemedicine outcomes of power distance (Hofstede, 2000), the degree of inequality among people, and uncertainty avoidance (Hofstede, 2000), the degree to which people prefer structured over unstructured situations.

Technology culturation is the influence of technologically advanced cultures on an individual’s attitude to technology, and the degree to which people are exposed to more technological advanced countries (Checchi et al., 2002; Loch et al., 2000; Straub et al., 2001, 2002).

In addition to their direct impacts on telemedicine outcomes, I propose that cultural factors interact with telemedicine transfer implementation to yield a composite influence. Figure 3.4 displays the cultural model, with all the postulated paths labeled with the specific hypotheses that are presented in the following section.
In addition to the theoretically based items for testing the model, I ask a number of demographic questions to better understand the respondents. I ask the respondents to define the nature of their organization (public, private, nongovernmental, or other), indicate their knowledge of telemedicine, Internet and computers, their specialty (radiology, dermatology, pathology, or other), and how long they have been
working related to ICT/health in Sub-Saharan Africa. I also ask about their gender, age, country, and educational qualifications.

3.6 Research Hypotheses of Telemedicine Outcomes in Sub-Saharan Africa

The social and value outcomes of telemedicine dimensions deal with the issue of uneven geographic distribution of healthcare resources, healthcare facilities, and human resources. Generally the level of healthcare facilities and specialist skills is not the same as in developed countries. I note issues of inadequate access to healthcare, and rising health costs as a consequence of the high level of disease burden. Telemedicine systems are one method to improve health status and reduce costs in developing countries. The potential of telemedicine systems can be expected to improve access to healthcare, and the efficiency with which it is delivered. Even if the benefits of telemedicine are substantial, the practice of telemedicine is still not considered as part of healthcare in most SSA countries, as the literature illustrates. However, it is hoped that telemedicine can address four major concerns of researchers and practitioners: First, healthcare access is made possible for remote (isolated), confined patients, and improved by lowering geographical barriers. Second, human resource development is promoted, and recruitment and retention of physicians in rural areas is encouraged. Third, in terms of the issue of quality of care, telemedicine will provide clinicians better, timely information about the patient. Therefore, through the Internet, the healthcare staff will receive information that may be vital to patient care. Also, telemedicine will reduce misdiagnoses of patients, and increase the local physicians’ professional experience. Fourth, from the economic perspective, we can see a reduction in the cost of patient care and healthcare providers. Thus, from the literature we hypothesize:

H₁: Telemedicine capabilities are positively related to value outcomes of telemedicine.

H₂: Telemedicine capabilities are positively related to social outcomes of telemedicine.

H₃: Social outcomes of telemedicine are positively related to value outcomes of telemedicine.
The next section presents two sets of hypotheses that will be tested in order to answer the two research questions, as well as the two models (Figures 3.2 and 3.3). The first set of hypotheses considers the effects of national infrastructure, while the second set looks at the effects of culture. The two models also include telemedicine capability and telemedicine transfer outcome hypotheses.

3.6.1 National Infrastructural Hypotheses of Telemedicine Outcomes

National ICT Policies (ICT, e-Health, and data security)

The literature of telemedicine or e-health policy is new and relatively sparse, so most of the studies I draw upon focused on ICTs in general. Various examine the effects of ICT policy on the development of ICT infrastructure (Gurbaxani, et al., 1990a, 1990b; Raman and Yap, 1996; Checchi, et al., 2002). These studies generally indicate that policies favoring the development of ICTs help the growth of national ICT infrastructure. For policy issues specifically related to e-health or telemedicine, I investigate particular policies that determine the rate and direction of development for healthcare initiatives (Docteur and Oxley, 2004; Fujimoto 2000; Hämäläinen and Hyppönen, 2006; Jennett et al., 2004; Scott et al., 2002). In terms of policy issues related to data security and standards, I consider policies concerning the physical safety of information, including protection against accident loss and unauthorized alteration (Whitten, 2002; Anderson, 2000). Thus, from the literature we hypothesize:

\[ H_{4a}: \] Policies that favor the development of ICTs in general (not necessarily with a specific focus on healthcare) are positively related to telemedicine capabilities.

\[ H_{4b}: \] Policies that favor the development of ICTs in general (not necessarily with a specific focus on healthcare) are positively related to the level of ICT infrastructure.

\[ H_{5a}: \] Policies specifically tailored to promote the application of ICTs in healthcare (as opposed to general ICT policies) are positively related to telemedicine capabilities.

\[ H_{5b}: \] Policies specifically tailored to promote the applications of ICTs in healthcare (as opposed to general ICT policies) are positively related to the level of ICT infrastructure.
H$_{6a}$: Policies specifically tailored to ensure data security and standards are positively related to telemedicine capabilities.

H$_{6b}$: Policies specifically tailored to ensure data security and standards are positively related to the level of ICT infrastructure.

**ICT Infrastructure**

Several factors can affect the use of national ICT infrastructure in developing countries. Odedra *et al.* (1993) summarizes that infrastructural elements remain inadequate in SSA countries, such as reliable power supply, a well-functioning telephone network, foreign currency, and computer-literate personnel. Infrastructural problems are further complicated not only by availability, but also by application (Avgerou and Walsham, 2000; Mbarika, 2004). However, to measure ICT infrastructure, I examine studies that focus on a variety of technical properties, such as data transmission speed, bandwidth, availability, reliability or maintenance. Among the considerable amount of literature on IT-health, the two most widely cited elements of ICT infrastructure on telemedicine outcomes issues are bandwidth and Internet impact. Broader bandwidth allows for more data to be transmitted more quickly, and enables greater resolution that expands the technical capacity of telemedicine. The Internet has also become a medium for transmission of data for teleconsultation and communication by healthcare providers (Iakovidis, 2000; Meso and Duncan 2000; Puskin and Sanders, 1995; Tulu *et al.*, 2005). Based on these studies, I select items from a rich body of literature that has developed instruments to measure different aspects of ICT infrastructure at the national level, which carefully incorporate local considerations. Thus, I hypothesize:

H$_7$: More reliable and readily accessible ICT infrastructure is positively related to telemedicine capabilities.

**Health Environment**

Study of the healthcare environment includes examining healthcare institutions, structural and workflow changes, organizational transformation, telemedicine readiness, and the healthcare infrastructure affected by the introduction of telemedicine.
The appropriate design of an organization depends upon the strategic intent of that organization and the environment in which it operates (Ash, 1997; AaS, 2001; Hu, et al., 2000). Societal needs, such as the provision of adequate care in sparsely populated rural areas, must also be considered. Telemedicine allows organizations to access, in a timely way, skills and knowledge beyond that which is currently available. Regarding this dimension, I borrow from studies specifically focused on healthcare infrastructure and telemedicine readiness issues in the context of developing countries. Thus, I hypothesize:

H₈: Greater readiness for telemedicine is positively related to telemedicine capabilities.

H₉a: The quality of healthcare infrastructure is positively related to telemedicine capabilities.

H₉b: The quality of healthcare infrastructure is positively related to social outcomes of telemedicine.

Through analysis at the national level, I hypothesize that ICT policies (general ICT, e-health, and data security), ICT infrastructure, and institutional and healthcare environments all have a positive relation to telemedicine outcomes (see Table 3.3). ICT policies (general ICT, e-health, and data security) also directly increase ICT Infrastructure. Table 3.4 summarizes the hypotheses of the national model.

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypothesis</th>
<th>Specific Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1: What aspects of the national infrastructure influence the transfer of telemedicine outcomes in SSA?</td>
<td>H₁a</td>
<td>Telemedicine capabilities are positively related to value outcomes of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>H₂a</td>
<td>Telemedicine capabilities are positively related to social outcomes of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>H₃a</td>
<td>Social outcomes of telemedicine are positively related to value outcomes of telemedicine</td>
</tr>
<tr>
<td></td>
<td>H₄a</td>
<td>Policies that favor the development of ICTs in general (not necessarily with a specific focus on healthcare) are positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td></td>
<td>H₄b</td>
<td>Policies that favor the development of ICTs in general (not necessarily with a specific focus on healthcare) are positively related to the level of ICT infrastructure.</td>
</tr>
</tbody>
</table>
3.6.2 Cultural Hypotheses of Telemedicine Outcomes

**Telemedicine Transfer Implementation**

The implementation context refers to factors where the environment supports and encourages the use of telemedicine technology. I focus especially on considerations identified as particularly pertinent to developing countries. The support of top management is empirically proven to be perhaps the most universally recognized success factor for ICT projects (Moore and Bendates, 1991). Other important success factors for ICT implementation are items encouraged by management, such as financial and technical support (Leonard-Barton, 1988), user satisfaction (Hu and Chau, 1999), and system usage (Davis et al., 1989). User training in system operation is another key factor for developing countries; training may be especially important in light of the generally low literacy levels in such regions. Moore (1991) notes that 30% of IT innovation failures were caused by non-technical organizational factors. Other factors (Aas, 1999) including organizational readiness, commitment of managers, and logical support from organizations, are important to the success of a telemedicine implementation. For this study, I focus particularly on criteria identified as pertinent to telemedicine in developing countries, such as efficiency, cost, technology, and social factors. Thus, I hypothesize:

<table>
<thead>
<tr>
<th>Hypothesis (H)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₅a</td>
<td>Policies specifically tailored to promote the application of ICTs in healthcare (as opposed to general ICT policies) are positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td>H₅b</td>
<td>Policies specifically tailored to promote the applications of ICTs in healthcare (as opposed to general ICT policies) are positively related to the level of ICT infrastructure.</td>
</tr>
<tr>
<td>H₆a</td>
<td>Policies specifically tailored to ensure data security and standards are positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td>H₆b</td>
<td>Policies specifically tailored to ensure data security and standards are positively related to the level of ICT infrastructure.</td>
</tr>
<tr>
<td>H₇</td>
<td>More reliable and readily accessible ICT infrastructure is positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td>H₈</td>
<td>Greater readiness for telemedicine is positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td>H₉a</td>
<td>The quality of healthcare infrastructure is positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td>H₉b</td>
<td>The quality of healthcare infrastructure is positively related to social outcomes of telemedicine.</td>
</tr>
</tbody>
</table>

86
$H_{13}$: Implementation effectiveness is positively related to telemedicine capabilities.

$H_{14}$: Rational decision-making factors are positively related to telemedicine capabilities.

**Culture-Specific Beliefs & Values and Culturation**

The effect of culture on information technology has been studied by many researchers (Hofstede, 1984; Loch *et al.*, 2003; McCoy and Mbarika, 2003a; Okoli and Mbarika, 2003b; Straub *et al.*, 1997, 2001; Walsham, 2000). Numerous cultural factors might be associated with telemedicine usage patterns in various nations (Choe, 2004; Doktor *et al.*, 2005; Kaplan, 2000; Shore, 2006; Tan *et al.*, 1998). This study, however, focuses primarily on culture-specific beliefs and technology culturation in two cultural sub-constructs. Despite the importance of culture, the effect of cultural factors on telemedicine research has not received appropriate attention, because most research emphasizes technologies used and the effectiveness of the program. In the surveyed IS literature, technology culturation is uniquely described by Straub (Straub *et al.*, 2002).

Power distance is the degree of inequality among people. Straub *et al.* (1997) notes that countries characterized by higher power distance exhibit low technological adoption, whereas people with low power distance cultural orientation are likely to be more willing to take on new responsibilities.

Uncertainty avoidance is the general feeling of being threatened by uncertain or unknown situations. Bagchi *et al.* (2003) note that telecommunication products such as e-mail, telephones and fax machines can reduce uncertainty in communication. Louis (1980) recommends that a reduction of environmental uncertainty be achieved through effective use of IS (telemedicine).

Technology culturation is a result of on-going exposure to technology, which in turn, enhances an individual’s familiarization with the technology. Loch *et al.*, (2003) notes that there is direct effect of technological culturation on usage of ICTS, especially emerging technology, primarily by traveling in the technologically-advanced countries and later return to their countries with the knowledge of the emerging technology.
In my study focusing on understanding cultural factors, I draw upon studies particularly focused on Power Distance, Uncertainty Avoidance and Technology Culturation (Hofstede, 1984; Straub et al., 2001; Loch et al., 2003). Thus I hypothesize:

H\textsubscript{10a}: Power distance between senior healthcare practitioners and subordinates is negatively related to telemedicine capabilities.

H\textsubscript{10b}: Power distance between senior healthcare practitioners and subordinates dampens the positive relation of implementation effectiveness, thus reducing the capabilities of telemedicine.

H\textsubscript{10c}: Power distance between senior healthcare practitioners and subordinates dampens the positive relation of rational decision-making, thus reducing the capabilities of telemedicine.

H\textsubscript{11a}: Avoidance of uncertainty in telemedicine decisions is negatively related to telemedicine capabilities.

H\textsubscript{11b}: Uncertainty avoidance in telemedicine decisions dampens the positive relation of implementation effectiveness, thus reducing the capabilities of telemedicine.

H\textsubscript{11c}: Uncertainty avoidance in telemedicine decisions dampens the positive relation of rational decision-making, thus reducing the capabilities of telemedicine.

H\textsubscript{12a}: Exposure to technologically advanced cultures is positively related to telemedicine capabilities.

H\textsubscript{12b}: Exposure to technologically advanced cultures enhances the positive relation of implementation effectiveness, thus further increasing the capabilities of telemedicine.

H\textsubscript{12c}: Exposure to technologically advanced cultures enhances the positive relation of rational decision-making, thus further increasing the capabilities of telemedicine.

At the cultural level of analysis, I hypothesize that telemedicine transfer implementation and technology culturation are positively related to telemedicine outcomes, while power distance and uncertainty avoidance have a negative impact on telemedicine outcomes (see Table 3.3). The three sub-constructs (power distance, uncertainty avoidance, and technology culturation) also have a moderating influence on
telemedicine transfer implementation. Table 3.5 summarizes the hypotheses in our cultural model.

**Table 3.5: Hypotheses – Culture Level**

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Hypothesis</th>
<th>Specific Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( H_{1b} ):</td>
<td>Telemedicine capabilities are positively related to value outcomes of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{2b} ):</td>
<td>Telemedicine capabilities are positively related to social outcomes of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{3b} ):</td>
<td>Social outcomes of telemedicine are positively related to value outcomes of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{10a} ):</td>
<td>Power distance between senior healthcare practitioners and subordinates is negatively related to telemedicine capabilities.</td>
</tr>
<tr>
<td></td>
<td>( H_{10b} ):</td>
<td>Power distance between senior healthcare practitioners and subordinates dampens the positive relation of implementation effectiveness, thus reducing the capabilities of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{10c} ):</td>
<td>Power distance between senior healthcare practitioners and subordinates dampens the positive relation of rational decision-making, thus reducing the capabilities of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{11a} ):</td>
<td>Avoidance of uncertainty in telemedicine decisions is negatively related to telemedicine capabilities.</td>
</tr>
<tr>
<td></td>
<td>( H_{11b} ):</td>
<td>Uncertainty avoidance in telemedicine decisions dampens the positive relation of implementation effectiveness, thus reducing the capabilities of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{11c} ):</td>
<td>Uncertainty avoidance in telemedicine decisions dampens the positive relation of rational decision-making, thus reducing the capabilities of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{12a} ):</td>
<td>Exposure to technologically advanced cultures is positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td></td>
<td>( H_{12b} ):</td>
<td>Exposure to technologically advanced cultures enhances the positive relation of implementation effectiveness, thus further increasing the capabilities of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{12c} ):</td>
<td>Exposure to technologically advanced cultures enhances the positive relation of rational decision-making, thus further increasing the capabilities of telemedicine.</td>
</tr>
<tr>
<td></td>
<td>( H_{13} ):</td>
<td>Implementation effectiveness is positively related to telemedicine capabilities.</td>
</tr>
<tr>
<td></td>
<td>( H_{14} ):</td>
<td>Rational decision-making factors are positively related to telemedicine capabilities.</td>
</tr>
</tbody>
</table>
Chapter 4: Pre-Test and Pilot Test

In this chapter I focus on the pre-test and pilot test, and make a recommendation for the main study. The pilot study survey methodology is discussed. The process for developing the detailed questionnaires is then presented, followed by a discussion of the data collection procedure employed. Finally, the last section describes a pilot study that prepared me for conducting the main study and survey instruments, indicating the sources from the literature for the items I chose to include.

4.1 Background for Instrument Creation

ICT infrastructure in particular (the Internet) is consistently demonstrated to be an important factor for successful telemedicine adoption. However, in SSA countries the limitation and availability of Internet and bandwidth is a major concern. Moreover, the bandwidth and the technology approach vary widely depend on the clinical telemedicine application. such as teleradiology, telepathology, teledermatology, teleophthalmology and telecardiology using store-and-forward technologies through the telecommunication infrastructure are often minimal. This is despite the fact that the maturity level of image-dependent telemedicine clinical specialties (classified by research evidence, standards and protocols, and mainstream professional acceptance) is high, due to: (1) heavy dependence on imaging rather than direct patient contact; (2) explicit standards for quality assurance, such as Digital Imaging and Communication in Medicine (DICOM); (3) considerable scientific evidence demonstrating clinical effectiveness; and (4) wide-spread acceptance by mainstream medicine (Bashshur, 2003).

As mentioned in chapter one, the scope of this study is restricted to image-dependent clinical telemedicine applications. I further restrict the scope of this study to consultation, second opinion, and education of physicians in telemedicine practices. My focus is on the store-and-forward principle, in which a message is composed, saved, and then relayed to the recipient in such a way that delivery and receipt are not necessarily time-related. Table 4.1 lists the definitions I use in the questionnaire (in both the pilot and main studies): telemedicine, image-dependent telemedicine applications, Internet, ICT or IT, and SSA.
Table 4.1: Important Definitions for this Study

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sub-Saharan Africa (SSA)</strong></td>
<td>For this survey, SSA refers to all African countries excluding North Africa (Morocco, Algeria, Tunisia, Libya, and Egypt) and South Africa.</td>
</tr>
<tr>
<td><strong>Telemedicine</strong></td>
<td>The use of medical information exchanged from one site to another via electronic communication for the health and education of patients or health care providers, for the purpose of improving patient care.</td>
</tr>
<tr>
<td><strong>Image-based Telemedicine Applications</strong></td>
<td>Diagnosis is achieved by visually examining perceived features from images (such as teleradiology, telepathology, teledermatology, teleophthalmology, telecardiology).</td>
</tr>
<tr>
<td><strong>Internet</strong></td>
<td>E-mail, the World Wide Web (WWW), FTP, chat, instant messaging, Voice over IP, and other services provided over the Internet.</td>
</tr>
<tr>
<td><strong>ICT or IT</strong></td>
<td>Information and Communication Technologies (ICTs) or Information Technologies (IT) includes all telephone, computer and network-based technologies: telephone, wireless, wired, satellites, the Internet and so on.</td>
</tr>
</tbody>
</table>

4.1.1 Instrument Creation

With these qualifications made explicit, I developed questions from the relevant literature, which I now explain. (See Table 4.7 for the items in the study and the survey instruments, indicating the literature sources for the items I chose).

Initially, I considered diffusion of innovation theory as a lens to conceptualize the diffusion process, and to establish a set of national factors (technology, policies, organization, environment and culture) that would be expected to influence the transfer process. Then, I looked at the telemedicine, telehealth and e-health literature, to develop a basis for understanding the technology transfer environment. Finally, I discussed theoretical perspectives and empirical findings from national ICT, e-health, and data security policies, ICT and health infrastructure, organization, and culture literature, and related them to the way transfer is influenced by policy, infrastructure, organization and cultural intervention. I found a significant number of IS publications in healthcare.
(See section 2.5); however, few publications specifically discuss technology transfer in healthcare, and very limited literature focuses on SSA countries. This paucity clearly indicates a significant need and opportunity for further research and publication focused on this region.

4.2 Pre-test, Pilot Study Procedures

To verify the factors identified in the literature review as pertinent to telemedicine in SSA, I investigated a key informant approach to data collection. Specifically, I conducted a quantitative survey of relevant experts (physicians) and decision-makers; I also used a pre-test to investigate whether the respondents have any difficulties with the questionnaires.

The development of the survey instrument proceeded according to IS research methods recommendations (Straub et al., 2004), including: First, I reviewed relevant prior research to identify appropriate measurements, and discussed the measurements with a focus group consisting of three researchers from different specialty areas. Second, I revised my questionnaires to fit the SSA context, and sought feedback from SSA physicians to ensure that each respondent understood the questions. Third, that same focus group also examined the preliminary questions developed through my interactions with SSA physicians, and evaluated the validity of their content. Based on group feedback, several minor modifications, including word choice, were made to enhance each question’s appropriateness to the healthcare environment. Fourth, after designing a first draft of the survey and receiving feedback, I sent it out for content and face validation to external researchers with domain expertise. One of the researchers is an expert on cultural issues that impact ICTs; two others have specific expertise in ICTs for healthcare. Further, as Cronbach (1971), Lawther, (1986), and Straub, (1989) recommend, I prepared a high-level questionnaire for a group of 24 people, twelve ICT/healthcare practitioners and twelve physician/telemedicine experts, to get feedback for content validation from these key informants.

I am confident that the method and means of determining content validity provided high-quality feedback (see Appendix IV for the items in the high-level survey,
and Appendix V for the results). Based on all the feedback from both practitioners and scholars, I came up with a 90-item survey instrument covering all my constructs. With nine demographic questions, I had a total of 99 questions in the pilot instrument. I also included solicitations for qualitative comments at the end of each survey section. A 7-point Likert scale was used for all question items, with “AAA” being equivalent to “strongly agree”, and “DDD” being equivalent to “strongly disagree”.

Telemedicine diffusion in Sub-Saharan African countries is for the most part in the early stages of development, and actual technology use is growing rapidly. Thus, use of continuum methods is suitable for my study of the current factors that influence the transfer of telemedicine, in spite of the overall limited technology use. At the same time, continuum methods enable the identification of potential factors impacting transfer of telemedicine barriers.

4.3 Result of Pilot Test

The objectives of the pilot study were to assess the reliability of the instrument in terms of the research questions. Furthermore, a pilot survey “…can help not only define your subject, but also give you some preliminary warnings…on problem areas, such as questions which are sensitive…or which elicit vague responses…” (Kane 1985, p. 73). Generally, a pilot test is strongly recommended to qualitatively assess reliability and construct validity of instruments (Straub, 1998). For the pilot study I used only postal mail, with initial questions being sent out to respondents in Ethiopia. To facilitate the collection of data, a letter signed by the university and the Ethiopian National Telemedicine Committee was sent out to all participating institutions, asking for the identification of focal persons from these institutions or from appropriate departments. The research was conducted in 17 institutions: five governmental, two private, three non-government organizations (NGOs), three international organizations, and four hospitals. All physicians who took part in the pilot test were excluded from the subsequent formal study.
4.3.1 Sample

I selected the target population of this study in consultation with the Ethiopian National Telemedicine Committee, Addis Ababa Medical Faculty, and the participating international organizations. I attempted to create a sample that would represent hospitals at different levels (tertiary, secondary, primary, and clinic) as well as different types (government, private, police, and army). I included experts from government, non-governmental, and international organizations. The final sample included health practitioners, telemedicine stakeholders, IT/health professionals, government policy makers, non-governmental organization officials, and academicians involved with telemedicine in SSA.

From the list of 17 organizations, I identified 82 professionals as potential participants. I called or arranged on site face-to-face meetings for pre-contact with all sampled professionals in my pilot list; during those meetings I was able to confirm each individual’s willingness to participate in the survey. I believe that those who voluntarily responded are more likely to have strong opinions than those who did not participate in the survey. The validation process enabled me to identify 69 willing participants for the survey, with 51 completed responses; the survey had an effective response rate of 73.9%. At this stage, most questionnaires were delivered personally. Some questionnaires were completed immediately by participants; some were collected later by enumerators; in a few cases, completed responses were returned by e-mail. Data collection was done on site, face-to-face, from December, 17, 2003 to February 27, 2004; this step was followed by data entry and analysis.

4.3.2 Data Collection Methods

Questionnaires were sent to the senior administrator and/or the medical director of each organization. I collected data using a self-administrated questionnaire survey. Then, before distributing the questionnaires, each organization’s management was informed of my intent by means of an introductory letter that briefly stated the study’s purpose and its significance. The target list had a balanced representation of tertiary and secondary, civilian and military, as well as teaching and non-teaching
hospitals. I made up to three telephone calls to management in each of these target organizations, encouraging completion of the survey. In addition, institute faculties called on their personal management and physician contacts to request that they complete the questionnaires.

4.3.3 Responses

17 institutions were surveyed in our pilot study; this target response level was sufficient to meet the pilot study objectives for the final study. The actual number of survey responses was 51, with 73.9% response rate. Thirty-six responses were from health sector specialists (physicians), and 15 were from IS (health) specialists. I was aware, however, that the results of the pilot study needed to be interpreted carefully, since the sample size was only marginally sufficient (Chin, 1998b; Hair et al., 1998). All the same, I hope that such statistical analysis would indicate which items were problematic, and might suggest changes and modifications for the main study; from the respondent’s detailed qualitative comments in their responses, I revised the final instruments.

4.3.4 Data analysis

First, I conducted some descriptive analysis to understand the data I had collected, and tested for some common statistical assumptions. (See Table 4.2 for Demography Results)
Table 4.2: Demography Results

<table>
<thead>
<tr>
<th>Gender</th>
<th>No.</th>
<th>%</th>
<th>Highest Education Level</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>7</td>
<td>14</td>
<td>Bachelor’s</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Male</td>
<td>44</td>
<td>86</td>
<td>Master’s</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>51</td>
<td></td>
<td>Doctorate/MD</td>
<td>36</td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>%</th>
<th>Primary Speciality</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>11</td>
<td>22</td>
<td>IS</td>
<td>15</td>
<td>29</td>
</tr>
<tr>
<td>35-44</td>
<td>16</td>
<td>31</td>
<td>Medicine</td>
<td>36</td>
<td>71</td>
</tr>
<tr>
<td>45-54</td>
<td>14</td>
<td>27</td>
<td>Medicine</td>
<td>36</td>
<td>71</td>
</tr>
<tr>
<td>55-64</td>
<td>9</td>
<td>18</td>
<td>Total</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>65+</td>
<td>1</td>
<td>2</td>
<td>Total</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty</th>
<th>No.</th>
<th>%</th>
<th>Organization</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermatology</td>
<td>4</td>
<td>11</td>
<td>Hospital Teaching</td>
<td>12</td>
<td>33</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>6</td>
<td>17</td>
<td>Hospital Non-Teaching</td>
<td>16</td>
<td>45</td>
</tr>
<tr>
<td>Orthopedics</td>
<td>4</td>
<td>11</td>
<td>Private Clinic</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Pathology</td>
<td>6</td>
<td>17</td>
<td>Others</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Radiology</td>
<td>6</td>
<td>17</td>
<td>Total</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Ear, Nose &amp; Throat (ENT)</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doctors (Ministry of Health)</td>
<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiology</td>
<td>1</td>
<td>3</td>
<td>Not at all knowledgeable</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Neurology</td>
<td>1</td>
<td>3</td>
<td>Somewhat knowledgeable</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Pediatrics</td>
<td>1</td>
<td>3</td>
<td>Knowledgeable</td>
<td>28</td>
<td>55</td>
</tr>
<tr>
<td>General Practice</td>
<td>2</td>
<td>5</td>
<td>Very knowledgeable</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td></td>
<td>Total</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>

4.4 Assessment of Measurement Model

The study must first assess the reliability analysis, and then the measurement model, consisting of the relationships between the constructs, and the indicators (i.e. items) used to measure them. This implies examining the convergent and discriminant validity of the research instrument, to evaluate the strength of the measurements used to test the proposed model.

Using SPSS 10, I conducted reliability analysis to produce Cronbach’s Alpha for each construct dimension, to determine which items to eliminate or revise. I conducted analysis for discriminant validity using Partial Least Squares (PLS 3.0), a second-generation multivariate technique that allows for the testing of the psychometric
properties of the scales used to measure a variable, as well as the strength and direction of the relationships among variables (Cassel et al., 1999). Specifically, I analyzed convergent and discriminant validity, including the AVE analysis (Straub et al., 2004; Gefen et al., 2000). Testing construct relationships was not a major concern at this stage, because the objective of a pilot test is to test the reliability and construct validity of an instrument (Straub, 1989).

4.4.1 Reliability

Reliability was tested using Cronbach’s Alpha values. As summarized in Table 4.3, all the internal consistencies similar to Cronbach’s alpha values were above 0.707, the acceptable cut-off point (Fornell and Larcker, 1981; Nunnally, 1978). In our case, most values were in a range above 0.90, considered acceptable and strong except for the construct ICT penetration in health (alpha = 0.69)

Table 4.3: Cronbach’s Alpha

<table>
<thead>
<tr>
<th>Constructs</th>
<th>No of Cases</th>
<th>Reliability Coefficients</th>
<th>Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Outcomes</td>
<td>51</td>
<td>4</td>
<td>0.90</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>51</td>
<td>4</td>
<td>0.93</td>
</tr>
<tr>
<td>Culture-Specific Beliefs/Values</td>
<td>51</td>
<td>10</td>
<td>0.94</td>
</tr>
<tr>
<td>Policies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td>51</td>
<td>5</td>
<td>0.82</td>
</tr>
<tr>
<td>e-Health</td>
<td>51</td>
<td>5</td>
<td>0.93</td>
</tr>
<tr>
<td>Data Security</td>
<td>51</td>
<td>6</td>
<td>0.80</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>51</td>
<td>9</td>
<td>0.87</td>
</tr>
<tr>
<td>Telemedicine Implementation Factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT Penetration in Health</td>
<td>51</td>
<td>5</td>
<td>0.69</td>
</tr>
<tr>
<td>Telemedicine Support &amp; Involvement</td>
<td>51</td>
<td>5</td>
<td>0.93</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>51</td>
<td>4</td>
<td>0.91</td>
</tr>
<tr>
<td>Telemedicine Policy</td>
<td>51</td>
<td>10</td>
<td>0.86</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td>51</td>
<td>6</td>
<td>0.91</td>
</tr>
<tr>
<td>Organization Readiness</td>
<td>51</td>
<td>15</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Note: Cronbach’s alpha values > 0.707 are significant (Nunnally, 1978).

4.4.2 Convergent validity

Convergent validity assesses the degree to which items that should be related to a construct are, in reality, related. To do so, the composite reliability coefficient is used, the value of which is determined by the respective loading of the items. The
criterion established by Nunnally (1967) pertaining to the reliability of constructs is that any construct having a composite reliability value equal to or greater than 0.707 should be kept. The results of the pilot test verified that for all constructs in the model, indicating that highly interrelated (Straub, 1989, p. 160). As summarized in Table 4.4, all values were above 0.85, except for construct organization readiness (convergent reliability = 0.75).

Table 4.4: Convergent Reliability

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Item</th>
<th>Convergent Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Outcomes</td>
<td>SC</td>
<td>0.92</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>CU</td>
<td>0.95</td>
</tr>
<tr>
<td>Culture-Specific Beliefs/Values</td>
<td>CS</td>
<td>0.95</td>
</tr>
<tr>
<td>Policies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT</td>
<td>IP</td>
<td>0.88</td>
</tr>
<tr>
<td>e-Health</td>
<td>HP</td>
<td>0.95</td>
</tr>
<tr>
<td>Data Security</td>
<td>SP</td>
<td>0.89</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>II</td>
<td>0.91</td>
</tr>
<tr>
<td>Telemedicine Implementation Factors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ICT Penetration in Health</td>
<td>PI</td>
<td>0.93</td>
</tr>
<tr>
<td>Telemedicine Support &amp; Involvement</td>
<td>TI</td>
<td>0.87</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>IE</td>
<td>0.93</td>
</tr>
<tr>
<td>Telemedicine Policy</td>
<td>TP</td>
<td>0.89</td>
</tr>
<tr>
<td>Decision-Making Factors</td>
<td>DM</td>
<td>0.96</td>
</tr>
<tr>
<td>Organization Readiness</td>
<td>RE</td>
<td>0.75</td>
</tr>
</tbody>
</table>

Note: Convergent Reliability validity values > 0.707 are significant (Nunnally, 1967).

4.4.3 Discriminant Validity

Discriminant validity reflects the degree to which each construct is unique. First, items associated with a construct correlate more highly with each other than with other constructs in the model. Second, the square root of the Average Variance Extracted (AVE) calculated for each construct is compared to the correlation between each construct and other constructs. All the values of AVE (i.e., the diagonals) are higher than the correlations between constructs (i.e. the rest of the matrix, off-diagonals) (Fornell and Larcker, 1981). Table 4.5 indicates that all the constructs in the model demonstrate discriminate validity.
Table 4.5: Discriminant Validity

<table>
<thead>
<tr>
<th></th>
<th>IP</th>
<th>SP</th>
<th>HP</th>
<th>II</th>
<th>CS</th>
<th>CU</th>
<th>IE</th>
<th>TP</th>
<th>PI</th>
<th>TI</th>
<th>DM</th>
<th>RE</th>
<th>SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>0.700</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>0.033</td>
<td>0.720</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HP</td>
<td>0.014</td>
<td>0.281</td>
<td>0.780</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>0.028</td>
<td>0.058</td>
<td>0.017</td>
<td>0.720</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS</td>
<td>0.055</td>
<td>0.026</td>
<td>0.035</td>
<td>0.005</td>
<td>0.760</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CU</td>
<td>0.032</td>
<td>0.063</td>
<td>0.045</td>
<td>0.035</td>
<td>0.653</td>
<td>0.820</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>0.010</td>
<td>0.298</td>
<td>0.812</td>
<td>0.006</td>
<td>0.047</td>
<td>0.064</td>
<td>0.770</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP</td>
<td>0.531</td>
<td>0.017</td>
<td>0.083</td>
<td>0.011</td>
<td>0.081</td>
<td>0.033</td>
<td>0.094</td>
<td>0.660</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PI</td>
<td>0.025</td>
<td>0.004</td>
<td>0.085</td>
<td>0.003</td>
<td>0.353</td>
<td>0.291</td>
<td>0.124</td>
<td>0.030</td>
<td>0.760</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TI</td>
<td>0.106</td>
<td>0.056</td>
<td>0.025</td>
<td>0.018</td>
<td>0.637</td>
<td>0.415</td>
<td>0.026</td>
<td>0.034</td>
<td>0.204</td>
<td>0.810</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DM</td>
<td>0.003</td>
<td>0.029</td>
<td>0.013</td>
<td>0.016</td>
<td>0.669</td>
<td>0.682</td>
<td>0.033</td>
<td>0.000</td>
<td>0.283</td>
<td>0.309</td>
<td>0.780</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE</td>
<td>0.004</td>
<td>0.006</td>
<td>0.054</td>
<td>0.005</td>
<td>0.057</td>
<td>0.027</td>
<td>0.070</td>
<td>0.021</td>
<td>0.148</td>
<td>0.008</td>
<td>0.026</td>
<td>0.590</td>
<td></td>
</tr>
<tr>
<td>SC</td>
<td>0.399</td>
<td>0.030</td>
<td>0.018</td>
<td>0.014</td>
<td>0.180</td>
<td>0.240</td>
<td>0.037</td>
<td>0.361</td>
<td>0.049</td>
<td>0.189</td>
<td>0.085</td>
<td>0.056</td>
<td>0.780</td>
</tr>
</tbody>
</table>

Diagonal elements are the square roots of average variance extracted (AVE); the other matrix entries represent the correlations between constructs.

4.5 Recommended Changes After Pilot Tests

Table 4.6 summarizes the results of my analysis. I evaluated instrument validity, including content, construct, discriminant, convergent and reliability analysis, for each construct and dimension to determine which items to eliminate or revise. Items with convergent and discriminant validity loading equal to or greater than 0.50 were kept for inclusion in the scale (Anderson and Gerbing, 1982, 1988, 1991). The composite reliability value and Cronbach’s alpha that met the threshold 0.707 were also kept. After this analysis, I took the following measures to thoroughly revise the instrument for the main survey: (1) I dropped or modified items that loaded poorly on their respective factors, based on reliability and composite reliability analysis. (See Tables 4.3, 4.4 and 4.6 for comparison); (2) many respondents gave detailed qualitative comments in their responses, which I carefully examined to guide my revisions; and (3) I re-consulted three of the domain experts who had initially assisted in developing the pilot instrument; they advised me as to which items to revise, drop, or add to the final instrument.
Table 4.6: Comparison – Pilot and Final Survey

<table>
<thead>
<tr>
<th>Telemedicine Survey</th>
<th>Pilot</th>
<th>Final</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT Policies</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>e-Health Policies</td>
<td>5</td>
<td>3</td>
<td>-2 ♦</td>
</tr>
<tr>
<td>Data Security Policies</td>
<td>6</td>
<td>3</td>
<td>-3 ♦</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>10</td>
<td>11</td>
<td>+1 ♦</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>4</td>
<td>5</td>
<td>+1 ♦</td>
</tr>
<tr>
<td>Decision-Making Factors</td>
<td>6</td>
<td>4</td>
<td>-2 ♦</td>
</tr>
<tr>
<td>Culture–Specific Beliefs &amp; Values</td>
<td>10</td>
<td>7</td>
<td>-3 ♦</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Telemedicine Outcomes (Social and Value)</td>
<td>4</td>
<td>8</td>
<td>+4 ♦</td>
</tr>
<tr>
<td>Organizational Readiness</td>
<td>15</td>
<td>-</td>
<td>-15 X</td>
</tr>
<tr>
<td>ICT Penetration in Health</td>
<td>5</td>
<td>-</td>
<td>-5 X</td>
</tr>
<tr>
<td>Support and Involvement</td>
<td>5</td>
<td>-</td>
<td>-5 X</td>
</tr>
<tr>
<td>Telemedicine Policy</td>
<td>10</td>
<td>-</td>
<td>-10 X</td>
</tr>
<tr>
<td>Telemedicine Capabilities</td>
<td>-</td>
<td>7</td>
<td>+7 +</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>-</td>
<td>3</td>
<td>+3 +</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>-</td>
<td>10</td>
<td>+10 +</td>
</tr>
<tr>
<td></td>
<td>90</td>
<td>71</td>
<td>-19</td>
</tr>
</tbody>
</table>

♦ = A blank means there were no changes between pilot & Final instruments.
+ = Item not in pilot added to final instrument
X = Item in pilot deleted from final instrument

After these revisions, I developed an instrument with 71 questions addressing my theoretical constructs. With ten demographic questions, there were 81 total questions, not including the qualitative requests for comments. Appendix VI of the thesis presents this final instrument. Two practitioners and two domain experts further reviewed a modified version of the questionnaire. The two practitioners were from SSA, actual users of visually-based clinical telemedicine applications. The two domain experts were from IS (SSA and culture) and IT (health).
## Table 4.7: Items in study instrument, with sources from theory

<table>
<thead>
<tr>
<th>Construct</th>
<th>Code</th>
<th>Wording in Instrument</th>
<th>Source of Theory and Items</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>I. Dependent Variables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Technology | TOT | | |
| | TOTN | Image-based telemedicine currently uses store-and-forward technologies such as email over than real-time interactive video |
| | TOTN | Image-based telemedicine currently uses standard telephone services as network service (that is, Plain Old Telephone Service [POTS] and/or Integrated Services Digital Network [ISDN]). |

| Procedure | TOP | | |
| | TOPD | There is enough demand for image-based telemedicine consultation service. |
| | TOPC | There are well-defined procedures for clinical protocol and preparation of a case (image acquisition, storage in an appropriate format, aggregation with clinical data and transmission) during image-based telemedicine consultations. |

<p>| Improvement | TOI | | |
| | TOIC | Image-based telemedicine consultations are currently being used |</p>
<table>
<thead>
<tr>
<th>Construct</th>
<th>Code</th>
<th>Wording in Instrument</th>
<th>Source of Theory and Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOII</td>
<td></td>
<td><strong>to change</strong> diagnoses, treatments and ongoing regimes that result in clinical improvement, quality of care and significant effects on the clinical process of care</td>
<td></td>
</tr>
<tr>
<td>TOIL</td>
<td></td>
<td>Image-based telemedicine is currently being <strong>used to influence</strong> the health care process by allowing the primary health care center physician to participate more actively in treatment.</td>
<td></td>
</tr>
<tr>
<td>TOII</td>
<td></td>
<td><strong>Image-based telemedicine is currently being used as a learning tool</strong> to increase the level of expertise of doctors and other medical professionals.</td>
<td></td>
</tr>
<tr>
<td>Social Outcomes</td>
<td>SCPA</td>
<td>Telemedicine will <strong>increase patient access</strong> to care for underserved citizens.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCPW</td>
<td>Telemedicine will <strong>reduce patient waiting time</strong> and result in more <strong>timely advice and intervention</strong>.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCFU</td>
<td>Telemedicine will <strong>improve follow-up</strong> care of patients.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCDR</td>
<td>Telemedicine will <strong>decrease unnecessary referrals</strong> to tertiary care.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SCIC</td>
<td>Telemedicine will <strong>improve collaboration</strong> among health care professionals.</td>
<td></td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
<td>Source of Theory and Items</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>-----------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Value Outcomes</td>
<td>VA</td>
<td>Please indicate how much you agree or disagree that image-based telemedicine applications in your country will prove <strong>valuable</strong> in the following ways.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VAIR</td>
<td>Telemedicine service will <strong>increase revenues</strong> of health centers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VASC</td>
<td>Telemedicine service will <strong>save costs</strong> for patients and health care providers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VART</td>
<td>Telemedicine service will <strong>reduce the time and effort</strong> of health care professionals.</td>
<td></td>
</tr>
</tbody>
</table>

### II. Independent Variables

#### ICT Policies

<table>
<thead>
<tr>
<th></th>
<th>Some policies <strong>influence</strong> information and communication technologies (ICTs) by encouraging or setting a trend, whereas others <strong>regulate</strong> ICTs by implementing and enforcing definite laws. Some policies target the <strong>supply</strong> of ICTs by focusing on organizations that create and provide ICTs, whereas others target the <strong>demand</strong> for ICTs by focusing on people and organizations that use them.</th>
<th>Checchi, et al 2002; Dutta, 1997, 2001; Gurbaxani <em>et al.</em>, 1990b; Hakken 1991; IDRC 1998; King <em>et al.</em>, 1994; Kraemer, <em>et al.</em>, 1992; Raman and Yap 1996; Tractinsky and Jarvenpaa 1995; Wild and McCube 1996)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General ICT Policies</strong></td>
<td><strong>IC</strong></td>
<td>Some policies <strong>influence</strong> information and communication technologies (ICTs) by encouraging or setting a trend, whereas others <strong>regulate</strong> ICTs by implementing and enforcing definite laws. Some policies target the <strong>supply</strong> of ICTs by focusing on organizations that create and provide ICTs, whereas others target the <strong>demand</strong> for ICTs by focusing on people and organizations that use them.</td>
</tr>
<tr>
<td></td>
<td><strong>ICIS</strong></td>
<td>The government <strong>influences the supply</strong> of ICTs (for example: by funding ICT research and innovation; providing educational and training services; and subsidizing ICT development).</td>
</tr>
<tr>
<td></td>
<td><strong>ICID</strong></td>
<td>The government <strong>influences the demand</strong> of ICTs (for example: by providing skill training; subsidizing the cost of purchasing ICTS; and providing programs for ICT awareness and promotion).</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>ICRS</td>
<td></td>
<td>The government regulates the supply of ICTs (for example: by requiring computer education; removing economic barriers to ICT trade and innovation; and establishing standards and requirements for research and development in ICTs).</td>
</tr>
<tr>
<td>ICRD</td>
<td></td>
<td>The government regulates the demand of ICTs (for example: by requiring that specific ICT-related standards, products or processes be used by government or private agencies).</td>
</tr>
<tr>
<td>ICPL</td>
<td></td>
<td>Privatization and liberalization: The government gives ownership and control of telecommunications provision to private enterprises, and private enterprises can freely compete in the mobile phone, ICT and ISP markets.</td>
</tr>
<tr>
<td>ICPD</td>
<td></td>
<td>The government promotes the development of ICTs (for example: number of projects to be implemented in the policies; number of laws adopted by the government regarding ICTs or intellectual property; mobilizing financial resources).</td>
</tr>
<tr>
<td>E-Health Policies</td>
<td>EHP</td>
<td>E-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally and worldwide by using information and communication technology. How much do you agree or disagree with the following statements about e-health policy (Telemedicine), concerning ICTs in your country</td>
</tr>
<tr>
<td>EHP</td>
<td></td>
<td>E-health promotion: The government generally supports and actively promotes the practice of ICT for health.</td>
</tr>
<tr>
<td>EHPA</td>
<td></td>
<td>Awareness of e-health: The government generally creates</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>EHPR</td>
<td>SPS</td>
<td><strong>Research and development</strong>: The government actively supports ICT related projects (equipment, training, capital expenditures, etc) in the health sector by word and action.</td>
</tr>
<tr>
<td>Data Security &amp; Standard Policies</td>
<td>SPS</td>
<td><strong>Computer Security</strong> relates to the physical safety of information, including protection against accidental loss as well as against unauthorized alteration. <strong>Privacy</strong> relates to the quality or condition of being secluded from the view of others and free from unsanctioned intrusion. <strong>Confidentiality</strong> relates to ensuring that persons with a specific clinical responsibility that see patient information are bound to secrecy. How much do you agree or disagree with the following statements about <strong>security and standards policy</strong>, concerning ICTs in your country?</td>
</tr>
<tr>
<td>SPSE</td>
<td></td>
<td>The government <strong>ensures</strong> the setup of data security standards and procedures (for example, they support the necessary hardware and software, try to prevent systems and data failures and effective recovery of the system, and attain a satisfactory level of system and data integrity and quality).</td>
</tr>
<tr>
<td>SPSS</td>
<td></td>
<td>The government <strong>ensures</strong> standardization of interconnectivity, interoperability and quality of information of computer networks.</td>
</tr>
<tr>
<td>SPSP</td>
<td></td>
<td>The government <strong>provides</strong> legal protection for data security concerns (for example, laws are in place and enforced that guard against misuse, negligence, and failure to adhere to the prevention and recovery standards and procedures set at national/sectoral/institutional levels).</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>-----------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>II</td>
<td>ICT infrastructure is a physical system of telecommunications pathways and connections that transmit voice, video, and data, and encompassing a web of telecommunications, information, and computing technologies. How much do you agree or disagree with the following statements about the current state of infrastructure for information and communication technologies in the context of image based telemedicine applications in urban as well as rural areas in your country?</td>
</tr>
<tr>
<td></td>
<td>IITB</td>
<td>There is an adequate number of national and international trunk/backbone (long distance) phone and data circuits.</td>
</tr>
<tr>
<td></td>
<td>IIWS</td>
<td>There is an adequate number of ICT workers skilled in developing and maintaining ICTs, training others how to use ICTs, and managing ICT infrastructures.</td>
</tr>
<tr>
<td></td>
<td>IIWN</td>
<td>There is an adequate number of wireless networks, such as VSAT, satellite and microwave links.</td>
</tr>
<tr>
<td></td>
<td>IIEU</td>
<td>There is steady supply of electric power, whether by national grids or backup electrical generators in urban areas.</td>
</tr>
<tr>
<td></td>
<td>IIER</td>
<td>There is steady supply of electric power, whether by national grids or backup electrical generators in rural areas.</td>
</tr>
<tr>
<td></td>
<td>IIPU</td>
<td>Urban health institutions have adequate access to phone services, whether land telephone lines or mobile/cellular phones.</td>
</tr>
<tr>
<td></td>
<td>IIPR</td>
<td>Rural health institutions have adequate access to phone services, whether land telephone lines or mobile/cellular phones.</td>
</tr>
<tr>
<td></td>
<td>IIIU</td>
<td>Urban health institutions have adequate access to the internet, whether from home, work, internet cafes, telecenters, or other locations.</td>
</tr>
<tr>
<td></td>
<td>IIIIR</td>
<td>Rural health institutions have adequate access to the internet,</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>------------------</td>
<td>------</td>
<td>----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>whether from home, work, internet cafes, telecenters, or other locations.</td>
</tr>
<tr>
<td>IIAU</td>
<td></td>
<td>Computers, networks and internet access are <strong>affordable</strong> for most health sector institutions in <strong>urban</strong> areas.</td>
</tr>
<tr>
<td>IIAR</td>
<td></td>
<td>Computers, networks and internet access are <strong>affordable</strong> for most health sector institutions in <strong>rural</strong> areas.</td>
</tr>
<tr>
<td>Health Environment</td>
<td></td>
<td>The strongest form of readiness for organization is a combination of &quot;real need&quot; and expresses dissatisfaction with current conditions so that member of the community is willing to adopt new practice (telemedicine) to create change. How much do you agree or disagree with the following statement in your country.</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>RE</td>
<td>How much do you agree or disagree with the following statement about organization readiness in your country.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Structural change:</strong> Health institutions generally support and actively promote the structural changes involved when introducing telemedicine (strong leadership, investment in training and experimenting with telemedicine technology)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Workflow change:</strong> Health institutions are generally aware of the concept and benefits of telemedicine and are willing to allocate new responsibilities to health professionals, technical and administrative personnel.</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>---------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>REOT</td>
<td></td>
<td><strong>Organizational transformation:</strong> Health institutions are willing to change the type of services and focuses as a result of introducing telemedicine.</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>HI</td>
<td>How much do you agree or disagree with the following statement about the health infrastructure in urban as well as rural area in your country.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HIWU</td>
<td>Urban citizens have adequate access to primary healthcare, water and sanitation.</td>
</tr>
<tr>
<td></td>
<td>HIWR</td>
<td>Rural citizens have adequate access to primary healthcare, water and sanitation.</td>
</tr>
<tr>
<td></td>
<td>HIBU</td>
<td>Urban health institutions have adequate budget allocation for healthcare.</td>
</tr>
<tr>
<td></td>
<td>HIBR</td>
<td>Rural health institutions have adequate budget allocation for healthcare.</td>
</tr>
<tr>
<td></td>
<td>HIFU</td>
<td>Urban health institutions have adequate facilities (hospitals, health centers, private clinics, pharmacies, etc).</td>
</tr>
<tr>
<td></td>
<td>HIFR</td>
<td>Rural health institutions have adequate facilities (health centers, health stations, private clinics, rural drug vendors, pharmacies, etc).</td>
</tr>
<tr>
<td></td>
<td>HIDU</td>
<td>Urban health facilities have essential drugs and medical supplies.</td>
</tr>
<tr>
<td></td>
<td>HIDR</td>
<td>Rural health facilities have essential drugs and medical supplies.</td>
</tr>
<tr>
<td></td>
<td>HIHU</td>
<td>Urban health institutions have adequate human resources (physicians, health officers, nurses, etc).</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Rational Decision Making</td>
<td>DM</td>
<td>Several core questions are generally relevant to any priority-setting exercise such as, access, cost, plan etc... Most of these considerations assume a societal or policy-level perspective. Please indicate how much you agree or disagree with these statements about the priority-setting to select image-based telemedicine application in your country.</td>
</tr>
<tr>
<td>DMIE</td>
<td>DMIE</td>
<td><strong>Impacts of efficiency:</strong> Telemedicine implementation decisions are made based on the significance and prevalence of the problems to be addressed, timely availability of needed information, and seriousness of medical conditions.</td>
</tr>
<tr>
<td>DMIC</td>
<td>DMIC</td>
<td><strong>Impact of cost savings:</strong> Telemedicine implementation decisions are made based on the potential of cost savings.</td>
</tr>
<tr>
<td>DMIT</td>
<td>DMIT</td>
<td><strong>Impact of technology:</strong> Telemedicine implementation decisions are made based on the level and availability of technical infrastructure such as bandwidth, high cost, inadequate access, basic phone lines, internet service providers, quality, and delivery outcomes.</td>
</tr>
<tr>
<td>DMIS</td>
<td>DMIS</td>
<td><strong>Impact of social factors:</strong> Telemedicine is decided based on the needs of the patient and practitioner (for example limited access to healthcare, need to travel long distances for specialized services, and isolation of practitioners).</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>------------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Implementation</td>
<td>AB</td>
<td>The degree to which a person believes that using a particular system would enhance his or her performances. To what extent do you agree or disagree with the following statements about the usefulness of telemedicine in Sub-Saharan Africa</td>
</tr>
<tr>
<td>Effectiveness</td>
<td>ABMS</td>
<td><strong>Management support</strong>: Top managers support the project by word and action.</td>
</tr>
<tr>
<td></td>
<td>ABDP</td>
<td><strong>System Development Personnel</strong>: The system development team is skilled in the pertinent technologies.</td>
</tr>
<tr>
<td></td>
<td>ABUI</td>
<td><strong>User involvement</strong>: Healthcare professionals, administrators, patients, and other stakeholders are closely involved in the design and development of the system.</td>
</tr>
<tr>
<td></td>
<td>ABUC</td>
<td><strong>User competency</strong>: Healthcare professionals are computer literate and are adequately trained in using the system.</td>
</tr>
<tr>
<td></td>
<td>ABIC</td>
<td><strong>Internal champion</strong>: There is at least one person who purposefully champions the project by encouraging and advocating it.</td>
</tr>
<tr>
<td></td>
<td>CU</td>
<td>Technology Culturation is represents a person's exposure to a relatively technology-intense culture such as Europe or USA. Please indicate how much you agree or disagree with the following statements about the amount and nature of travel of physicians and managers for conferences, workshops, exhibitions, etc – ICTs or telemedicine.</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>CUPP</td>
<td></td>
<td>Most have traveled to a technologically-advanced country for <strong>personal purposes</strong>.</td>
</tr>
<tr>
<td>CUDC</td>
<td></td>
<td>Most have attended computer-related conferences <strong>either within Sub-Saharan Africa or in other developing countries</strong>.</td>
</tr>
<tr>
<td>CUTA</td>
<td></td>
<td>Most have attended computer-related conferences in a <strong>technologically-advanced country</strong>.</td>
</tr>
<tr>
<td><strong>Culture-Specific Beliefs &amp; Values</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Uncertainty Avoidance</strong></td>
<td>UA</td>
<td></td>
</tr>
<tr>
<td>UARI</td>
<td></td>
<td>Health practitioners generally feel that it is important to have job requirements and instructions spelled out in detail so they always know what they are expected to do.</td>
</tr>
<tr>
<td>UATI</td>
<td></td>
<td>Health practitioners generally do not trust ICTs.</td>
</tr>
<tr>
<td>UAPI</td>
<td></td>
<td>Health practitioners typically prefer to adopt ICTs only if they</td>
</tr>
<tr>
<td>Construct</td>
<td>Code</td>
<td>Wording in Instrument</td>
</tr>
<tr>
<td>-----------</td>
<td>------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>have been proven to be effective.</td>
</tr>
<tr>
<td>UAHI</td>
<td></td>
<td>Health practitioners are usually hesitant to attempt new ICTs applications.</td>
</tr>
<tr>
<td>Power Distance</td>
<td>PD</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDAP</td>
<td>Senior health practitioners in health institutions frequently use their authority and power when dealing with subordinates.</td>
</tr>
<tr>
<td></td>
<td>PDDI</td>
<td>Senior health practitioners in health institutions do not usually delegate important tasks to subordinates.</td>
</tr>
<tr>
<td></td>
<td>PDDS</td>
<td>Subordinates are usually afraid to express disagreement with their superiors.</td>
</tr>
</tbody>
</table>
Chapter 5: Main Study Procedure and Report

This chapter focuses on the research approach and methodology used to conduct the main study in order to answer the two research questions. I follow the scientific method to generate, collect and interpret the results. Specifically, I discuss the results of testing the measurement model, the structural model, and the hypotheses. Then, I present the step I took to ensure the validity of the study.

5.1 Questionnaire Design

The aim of this study is to investigate the effects of national infrastructures and culture on telemedicine outcomes, both social and value adding. A survey-based methodology was employed, using previously validated scales. Data were collected through a web survey, as well as through the standard postal method. In constructing the instrument, I followed generally accepted guidelines for building survey instruments (Gefene et al., 2000; Straub et al. 2004). I also followed and used standard questions in my survey research, based on the following assumptions: (1) the meanings of the questions are shared by a majority of respondents; (2) respondents understand the phenomenon under investigation in roughly equivalent ways; and (3) the responses are given in a manner which allows the researcher to interpret and compare them (Dlamini, 2000; Sudman and Bradburn, 1982).

To minimize errors in survey data, I followed three steps (see sub-section 4.2): *First*, I designed the instrument to avoid problems that commonly affect reliability (Fowler, 1984). *Second*, I addressed the issue of survey bias that might be introduced by the wording of questions relating directly to the notion of construct validity (Paulhus, 1991). *Finally*, I wanted to avoid problems with the survey data (improper sampling procedures and nonsampling errors are typically attributable to poorly designed survey instruments, vague, inconsistent or misleading administration procedures, or respondent reactions to the research process itself) (Sudman and Bradburn, 1982).

Moreover, I carefully designed the questionnaires to ensure that the formats of World Wide Web, electronic document and paper were equivalent. I followed Dillman’s (2000) guidelines for designing effective mail and Internet surveys. I also
followed the accepted length of a questionnaire, according to the recommendation of Heberlein and Baumgratner (1978) and Terry et al. (1979): the length should be no more than 8 to 10 pages, and I drew attention to the importance of making the task of completion look easy. For both paper and electronic documents I used a word processor to create a six-page printable survey (see Appendix VI). For World Wide Web administration, I designed my documents using Microsoft FrontPage (see Appendix VII).

The questionnaire was divided into seven parts (this, however, was not known by the respondents), each containing a series of related questions. The first section dealt with the outcomes of telemedicine, second national policies, third national ICT infrastructures, fourth health environments, fifth telemedicine transfer implementation, sixth culture, and seventh some demography items and content details. All questions were structured using an ordinal scale. Open-ended questions were also included, to record factors not anticipated and to provide further explanation. The Web questionnaire was similar in structure to the postal questionnaire, except that HTML form tools were used to enforce consistency in the Web questionnaire.

In general, postal questionnaires are widely accepted as a low-cost way of collecting data, providing the response rate is adequate. However, low response rates are often cited as a disadvantage (Dillman, 2000). In this study, part of the questionnaire was sent out by regular mail, together with a personally addressed covering letter explaining the nature of the research. Recipients were advised that the result of the research would be e-mailed in due course. In order to obtain more respondents, recipients were asked to pass on a copy of the questionnaire, together with an explanatory page, to other colleagues. I specified a date to complete the questionnaires, within two weeks of receiving them (Dillman, 2000). I believe recipients were thereby encouraged to respond quickly. A reminder was sent out after the due date, extending the deadline.

As an alternative to mail surveys, Internet-based surveys are able to access a large population, and respondents reply more quickly by e-mail than by post (Ilieva et al., 2002; Meha and Sivadas, 1995). The Internet-based questionnaire was designed as an HTML form under the Department of Computer and Systems Sciences (DSV), Stockholm University (SU)/Royal Institute of Technology (KTH) Website, and the URL
included in the call for participation. The website was tested to ensure readability and that the web page would load correctly and without extensive delay.

5.2 Instrument

In addition to demographic information (e.g. name, title, gender, age, nationality, specialty, organization, length of time using computers and the Internet, and telemedicine knowledge), the survey contains four dependent variables related to telemedicine’s social and value outcomes (ICT infrastructure, telemedicine capabilities, telemedicine social and value outcomes), and twelve independent variables: ICT, e-health and data security policies, ICT infrastructure, healthcare infrastructure, telemedicine readiness, rational decision-making factors, implementation effectiveness, technology culturation, uncertainty avoidance, power distance, and telemedicine capabilities.

5.3 Philosophical Basis for the Study

I adopted rigorous reporting procedures as used in previous studies (March and Smith, 1995; Cronbach and Meehl, 1995). I worked through step-by-step methods of structural equation modeling (Anderson and Gerbing, 1998; Chin, 1998a; Gefen et al., 2000) (i.e. literature review, model construction, instrument construction, data collection, model testing, and result interpretation). I also followed the recommendation of (Straub et al., 2004; Marcoulides and Saunders, 2006) for IS quantitative positivist research, to include instrument, internal, and statistical conclusion validity. Indeed my findings of telemedicine transfer outcome research are intended to inform and improve the transfer and use of telemedicine in SSA regions. Therefore clear reporting of the findings help a better understanding for the researchers as well as for practitioners. Hence, I believe that my selecting a quantitative positivist research philosophy is appropriate for achieving the objectives.

5.3.1 Data collection procedures

The study was conducted in Sub-Saharan Africa from the first week of December 2004 to the end of April 2005. The subjects for the present study were physicians or telemedicine experts. Each participant was mailed a letter inviting them to take part in the
study (Appendix VIII). The purpose of the study and confidentiality of the data collected were explained in the cover letter. The participants were instructed that the study was being conducted to explore their perceptions, and that participation was voluntary. They were provided the telephone number, fax, e-mail and postal address for contacting the researcher, to make inquiries or to obtain the results of the study. The survey consisted of two major parts. The first part included questions related to demographics of the respondents; the second part, question items for the constructs in the research model. In the introduction of the survey questionnaire, the respondents were asked their specialty, knowledge of ICT in health care, and the country in SSA that they are most familiar with. To assist the respondents in understanding the survey, I provided important definitions for the survey. The questionnaire was posted on a university web survey host site. The data collection period lasted about fourteen weeks. The respondents were asked to submit their names and addresses at the end of the survey, if they were willing to receive the results.

Some participants who chose to respond *via* the online method, experiencing difficulty accessing the Website or needing clarification on a particular questionnaire item, sent e-mail messages to the researcher. All email questions were responded to within a 24-hour period. Those choosing the mail method of response had to refer back to the cover letter presenting the address to which the questionnaire was to be returned, as well as listing telephone, fax, and e-mail contact information for the researcher. Participation was by informed consent, by direct logging on the study Website and submitting responses, or sending the study by e-mail, fax or mail.

5.3.2 Survey Administration

To administer the survey, I followed a rigorous approach to ensure that the study would validly address the two research questions. In addition, the researcher carefully followed rigorous procedures (Diallman, 2000, Gefen *et al.*, 2002; Straub *et al.*, 2004) to develop an instrument that was appropriate for the objectives of this study, and that demonstrates strong psychometric properties; see Figure 5.1 for detail. Hence, I administered the questionnaires using both electronic (World Wide Web, WWW) and paper formats, and distributed the questionnaires to respondents *via* the WWW, postal
mail, and/or e-mail. The respondents could return their responses via the WWW, fax, postal mail, or an e-mail attachment. I used this multiple media approach for receiving responses (1) to give flexibility to respondents; (2) to improve the accuracy and ease of data entry (especially in the case of Web responses); and (3) to increase the possible speed of responses (other than that of postal mail).

Following Dillman’s (2000) administration methodology, one week after sending a pre-contact e-mail (see Appendix VIII), I sent another e-mail with the link to the actual Web-based survey. Two weeks later, I e-mailed a reminder to the respondents (see Appendix IX); to this reminder, I attached an electronic Rich Text Format (RTF) version of the survey. Finally, two weeks later, I sent all those who had not responded a final reminder. The design of the study was such that main study data collection would necessarily involve respondents in different countries; therefore, a web-based survey was conducted. Web-based surveys, as I have described in an earlier chapter, allow data to be collected much more quickly than paper surveys. Furthermore, data are more accurate because they are downloaded directly from the web into a spreadsheet. This digital coding avoids the human errors common in manual transcription and coding.

Data collected online were automatically placed into software programs (PLS) that began the data analysis procedures. Data collected by mail were hand-entered to a spreadsheet program, and then transferred to PLS analysis software. All data, regardless of method of entry, were checked for accuracy and consistency of entry; spot checks were performed, and range limitations were established to ensure the integrity of the data.

Out of a total 220 responses to my survey, 88.2% was retained (194 responses) and used in the study. The remainder 11.8% of the responses (26 responses) was dropped for two reasons. First, 11 (five from the online group and six from the mail group) out of the 26 responses were dropped because of too many missing data points. Secondly, 15 out of the 26 responses were dropped because they indicated that they had no prior experience or knowledge of telemedicine.

As for the remainder of the data retained and used for this study, there were very few missing values that accounted for only about 0.15% of the total values. Based on prior studies, it is permissible to apply any imputation methods to replace the missing
values (Little and Rubin, 2002; Hair et al., 1998). I therefore applied mean values as well as the bootstrap method to replace the missing values. More specifically, I used mean values for demographic analysis and Cronbach Alpha and PLS bootstrap method for the measurement and structure model (Hair et al., 2003). After replacing the missing values, Kolmogorov-Smirnov statistical tests did show that each indicator of the major constructs was normally distributed.

Figure 5.1: Research Process and Administration
5.3.3 Statistical – Data Analysis Technique

The statistical analysis method chosen for the proposed model and hypotheses testing was PLS (Partial Least Squares) Version 3.0. I particularly choose PLS for my research purpose, as Hulland, (1999) suggested that when the research model is at the early stages of development and has not been tested extensively, it is the appropriate technique. As my literature review indicates, empirical tests of telemedicine’s social and value outcomes are still sparse in the literature; my work is a preliminary effort to test this model. Hence, I believe that PLS is an appropriate technique for this research. I conducted a two-step analysis: first a measurement model, and then testing the hypotheses using a structural model. The measurement model indicates the strength of the measures used to test the proposed model, whereas the structural model and hypotheses are assessed by examining the significance of the path coefficients and the variance accounted for by the antecedent constructs. Moreover PLS produces estimates of $R^2$ which can be used to examine model fit, the same as conventional regression analysis.

5.4 Data Analysis Procedure

Before testing the actual model, I first conducted some descriptive and demographic analysis to understand the data I had collected. I tested for response bias, and for some common statistical assumptions.

In Table 5.1, I report categorized demographic questions. As can be seen, most of the respondents were male, employed at government hospitals. Most responses were from persons between the ages of 35 and 45; most participants also represented image-dependent telemedicine applications, such as radiology. Most physicians had significant computer, Internet and telemedicine knowledge.
### Table 5.1: Demography Result

<table>
<thead>
<tr>
<th>Gender</th>
<th>No.</th>
<th>%</th>
<th>Highest Level of Education</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>25</td>
<td>12.89</td>
<td>MD</td>
<td>142</td>
<td>73.20</td>
</tr>
<tr>
<td>Male</td>
<td>169</td>
<td>87.11</td>
<td>PhD</td>
<td>28</td>
<td>14.43</td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td></td>
<td>Others</td>
<td>24</td>
<td>12.37</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>%</th>
<th>Type of Organization</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-34</td>
<td>43</td>
<td>22.16</td>
<td>Hospital Teaching</td>
<td>81</td>
<td>41.75</td>
</tr>
<tr>
<td>35-44</td>
<td>65</td>
<td>33.51</td>
<td>Hospital Non-Teaching</td>
<td>52</td>
<td>26.80</td>
</tr>
<tr>
<td>45-54</td>
<td>52</td>
<td>26.80</td>
<td>Private Clinic</td>
<td>22</td>
<td>11.34</td>
</tr>
<tr>
<td>55-64</td>
<td>21</td>
<td>10.82</td>
<td>Others</td>
<td>39</td>
<td>20.10</td>
</tr>
<tr>
<td>65+</td>
<td>13</td>
<td>6.70</td>
<td>Total</td>
<td>194</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specialty</th>
<th>No.</th>
<th>%</th>
<th>Telemedicine Knowledge</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiologist</td>
<td>5</td>
<td>2.58</td>
<td>Somewhat Knowledgeable</td>
<td>61</td>
<td>31.44</td>
</tr>
<tr>
<td>Dermatologist</td>
<td>17</td>
<td>8.76</td>
<td>Knowledgeable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General Practitioner</td>
<td>23</td>
<td>11.86</td>
<td>Knowledgeable</td>
<td>84</td>
<td>43.30</td>
</tr>
<tr>
<td>Neurology</td>
<td>4</td>
<td>2.06</td>
<td>Very Knowledgeable</td>
<td>49</td>
<td>25.26</td>
</tr>
<tr>
<td>Ear, Nose, Throat</td>
<td>6</td>
<td>3.09</td>
<td>Total</td>
<td>194</td>
<td></td>
</tr>
<tr>
<td>Ophthalmologist</td>
<td>21</td>
<td>10.82</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedist</td>
<td>19</td>
<td>9.79</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pathologist</td>
<td>23</td>
<td>11.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pediatrician</td>
<td>11</td>
<td>5.67</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiologist</td>
<td>31</td>
<td>15.98</td>
<td>Less than 1 year</td>
<td>12</td>
<td>6.19</td>
</tr>
<tr>
<td>Surgeon</td>
<td>9</td>
<td>4.64</td>
<td>1 to 2 years</td>
<td>51</td>
<td>26.29</td>
</tr>
<tr>
<td>Others</td>
<td>25</td>
<td>12.89</td>
<td>2 to 3 years</td>
<td>64</td>
<td>32.99</td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td></td>
<td>3 to 5 years</td>
<td>41</td>
<td>21.13</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>More than 5 years</td>
<td>26</td>
<td>13.40</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expert's Region</th>
<th>No.</th>
<th>%</th>
<th>Computer Use</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>76</td>
<td>39.18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>45</td>
<td>23.20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other SSA Countries</td>
<td>59</td>
<td>30.41</td>
<td>Less than 1 year</td>
<td>7</td>
<td>3.61</td>
</tr>
<tr>
<td>Outside SSA Region</td>
<td>14</td>
<td>7.22</td>
<td>1 to 2 years</td>
<td>31</td>
<td>15.98</td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td></td>
<td>2 to 3 years</td>
<td>76</td>
<td>39.18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3 to 5 years</td>
<td>51</td>
<td>26.29</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>More than 5 years</td>
<td>29</td>
<td>14.95</td>
</tr>
<tr>
<td>Total</td>
<td>194</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 5.4.1 Characteristics of the Respondents

Two hundred and twenty responses were received. These responses represent physicians from 21 different SSA countries, others who are not located in SSA, and
experts outside the region. The number of responses, along with their geographical dispersion and cultural background, should provide enough variability to test the relationships in the model. Of the 220 responses received, 11 lacked sufficient information to be included. Also, fifteen of the respondents were excluded because of their insufficient knowledge of telemedicine. All responses to my survey were voluntary. All participants were encouraged to complete all the questions in the survey. Of these participants, 194 reported that they had knowledge of telemedicine (49 very knowledgeable, 84 knowledgeable, and 61 somehow knowledgeable).

The respondents were largely specialized in six major image-based telemedicine clinical specialties: radiology (15 percent), pathology (12 percent), ophthalmology (11 percent), orthopedics (10 percent), dermatology (9 percent), and cardiology (9 percent). The remaining 37 percent of the respondents were practicing other clinical specialties. Approximately 84 percent of the respondents were male, and 16 percent were female (A very typical gender gap in the medical profession in most SSA countries). The respondents were primarily medical doctors and healthcare-related specialists. More than 71 percent of the respondents were medical doctors (practitioners), and approximately 29 percent held a PhD in healthcare-related specialties. Forty-two percent of the respondents were from teaching hospitals. The remaining 58 percent were from non-teaching hospitals (25 percent), private clinics (10 percent), and others (23 percent). About 65 percent of the respondents reported that they had used the Internet more than 3 years, and the additional 28 percent reported that they had used the Internet 1 to 2 years. Less than 9 percent of the respondents reported that they had used the Internet less than 1 year. The respondents were primarily from SSA countries. About 38 percent of the respondents were from Ethiopia, 24 percent from Tanzania, and 33 percent from other SSA countries. The remaining five percent of the respondents were from Canada, Europe, and USA with expertise related to telemedicine in SSA countries.

5.4.2 Test for Response Bias

In quantitative positivist research, it is essential to avoid response bias (Krosnick, 1999). Paulhus (1991, p. 17) stated that response set bias refers to the tendency on the part of individuals to respond to attitude statements for reasons other than the
content of the statements. In general, two sources of response set bias are commonly cited: quiescence and social desirability bias. Both types of potential bias should be minimized through rigorous methods (literature review, data collection, analysis, and interpretation) (Palvia et al., 2004). Accordingly, before I actually tested and refined my measurement model and hypotheses, I conducted some exploratory analyses to test questionnaire responses for any possible biases (DeCoster, 2003; Thurstone, 1931). First, I avoided systematic or deliberate biases, such as question wording, scaling and questionnaire length, following generally accepted guidelines such as convening an expert panel, field testing the instrument, standardizing the administration procedures (March and Smith, 1995), and randomly selecting representatives of the population. I also checked for biases associated with whichever medium was used to respond to the survey, such as incomplete forms, data coding or entry errors. Medium biases were avoided because only a small number of respondents used any means other than web survey. Furthermore, the data collection bias was avoided by extending the original data collection period over 5 weeks, and we assured the confidentiality of the respondents by promising not to release their identity, then using the data in aggregate format only. I also used a comments section to allow the respondents to write what was not covered in the survey, and conducted preliminary analysis of the physicians’ responses to the primary dependent variables (ICT infrastructures, telemedicine capabilities, telemedicine’s value and social outcomes) based on their demographic characteristics (specialty, respondent’s region and knowledge of telemedicine), to see if the demographic distribution of respondents affected their answers to these questions. The demographic distribution of respondents in the survey was good enough for our study; however, the total elimination of nonresponse bias is not possible (Mohadjer and Hussain, 2001). From the results, I conclude that no bias attributable to the response medium would significantly skew our research.

5.4.3 Cronbach’s Alpha Reliability

Reliability is the internal consistency of a scale, which assesses the degree to which items are homogeneous. Generally, reliability is concerned with the interrelationship among items in the scale for all who answer the item. The most widely
used internal relationship coefficient is Cronbach’s alpha (Cronbach and Meehl, 1955; Nummaly, 1978); usually constructs with reliability values of 0.707 or greater are accepted. Cronbach’s alpha was analyzed using SPSS version 10. Table 5.2 outlines the scale names and reliabilities of the variables in the main study. Cronbach’s alpha can be written as a function of the number of test items and the average inter-correlation among the items:

$$\alpha = \frac{N \times r}{1 + (N - 1) \times r}$$

where N is equal to the number of items and r-bar is the average inter-item correlation among the items.

### Table 5.2: Cronbach Alpha

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Reliability Coefficients</th>
<th>Cronbach Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>7</td>
<td>0.78</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>5</td>
<td>0.88</td>
</tr>
<tr>
<td>Telemedicine Value</td>
<td>3</td>
<td>0.81</td>
</tr>
<tr>
<td>ICT Policies</td>
<td>6</td>
<td>0.87</td>
</tr>
<tr>
<td>e-Health Policies</td>
<td>3</td>
<td>0.92</td>
</tr>
<tr>
<td>Data Security</td>
<td>3</td>
<td>0.90</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>11</td>
<td>0.91</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>3</td>
<td>0.74</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>10</td>
<td>0.97</td>
</tr>
<tr>
<td>Power Distance</td>
<td>3</td>
<td>0.80</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>4</td>
<td>0.90</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>4</td>
<td>0.80</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>5</td>
<td>0.85</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td>4</td>
<td>0.81</td>
</tr>
</tbody>
</table>

As summarized in Table 5.2, all of the values were above 0.707, the acceptable range (Nunnaly, 1978), and most were above 0.8, a range considered acceptable and strong.

In the following section, I report the analysis of the measurement (outer) model and of the structural (inner) model using PLS.
5.5 Testing and Refining the Measurement (Outer) Model

The test of this research model includes two major stages: the estimation of the measurement model and of the structural model. In the estimation of the measurement model, I evaluated in terms of reliability and validity. Reliability is the extent to which “a particular technique, applied repeatedly to the same object, would yield the same result each time” (Babbie, 1992, p. 129). Validity is defined as “the extent to which measurements indicate what they are intended to measure” (Schutt, 1999, p. 83).

In addition, the measurement model consists of the relationship between the constructs and the indicators (i.e., items) used to measure them. This implies the examination of internal consistency, convergent validity, and discriminate validity of the instrument (Barclay et al., 1995; Boudreau et al., 2001; Fornell and Larcker, 1981; Straub, 1989; Straub et al., 2004). Convergent and discriminate validity, belonging to factor validity, capture some of the goodness of fit of the measurement model. There are, in general, four steps involved in testing and refining the measurement model: confirmatory factor analysis, checking for cross-loadings, reliability measures of the constructs, and discriminant validity (Boudreau et al., 2001; Chin, 1989a; Straub 1989).

5.5.1 Confirmatory Factor Analysis

Factor analysis is a method used to examine a number of measured variables. The main applications of a factor analysis technique are data reduction or structure detection (Thurstone, 1931). In general, both Exploratory (EFA) and Confirmatory Factor Analysis (CFA) are performed by examining the pattern of correlations between the observed measures (DeCoster, 2003). Bagozzi (1983, p. 135) noted that “EFA represents a procedure for the discovery of structure, while at the other extreme, CFA is a techniques for testing hypothesized structure formed a prior basis…in practice the EFA and CFA procedures tend to converge and represent differences in degree in this sense”. EFA is used to determine the number of common factors influencing a set of measures, and the strength of the relationships between each factor and each observed measure (Hair et al., 1998). CFA is used to determine the ability of a predefined factor model to fit an observed set of data. CFA ensures that, in a factor analysis of all the items in the instrument, each item is loaded on the construct to which it is theoretically assigned.
Floyd and Widaman (1995) suggest that EFA analysis is most appropriate in the initial stages of model development, whereas CFA provides a more powerful tool in the second stage of research, when a model has been established (cited in Heubeck and Neill, 2000, p. 4).

Confirmatory Factor Analysis was carried out to assess the measurement. I used PLS to run the overall model theoretically specified in Figure 5.2, using 64 items in Table 5.3. We used the guidelines recommended by Chin (1998a) and Fornell and Larcker (1981), who suggested that only items with loading equal to or greater than 0.707 were very significant. Therefore, the main findings were that item ICPL of ICT policy, IITB, IIFS, IIBN, ITII, and IIU of ICT infrastructure, and items HIWU, HIWR, HIFR, HIDU, HIDR, and HIHR item of health infrastructure did not load adequately (i.e. less than 0.707) and thus need to be investigated further (Gefen et al., 2000). The remaining items which loaded adequately were modified prior to running PLS by removing 15 items that did not load adequately in the initial instrument (see Table 5.3). Then, based on a bootstrap of 200 resamples, the factor loading for the remaining 49 items were adequately loaded and significant (Gefen et al., 2000). Table 5.3 displays the weight and loading for the initial and refined instrument run.

### Table 5.3: Confirmatory Factor Analysis

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Item</th>
<th>Initial Instrument</th>
<th></th>
<th>Refined Instrument</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Weight</td>
<td>Loading</td>
<td>Weight</td>
<td>Loading</td>
</tr>
<tr>
<td>Tele-Medicine Social Outcomes</td>
<td>SCPA</td>
<td>0.229</td>
<td>0.760</td>
<td>0.224</td>
<td>0.757</td>
</tr>
<tr>
<td></td>
<td>SCPW</td>
<td>0.216</td>
<td>0.769</td>
<td>0.217</td>
<td>0.770</td>
</tr>
<tr>
<td></td>
<td>SCFU</td>
<td>0.275</td>
<td>0.896</td>
<td>0.276</td>
<td>0.897</td>
</tr>
<tr>
<td></td>
<td>SCDR</td>
<td>0.255</td>
<td>0.896</td>
<td>0.255</td>
<td>0.897</td>
</tr>
<tr>
<td></td>
<td>SCIC</td>
<td>0.242</td>
<td>0.768</td>
<td>0.242</td>
<td>0.769</td>
</tr>
<tr>
<td>Telemedicine Value Outcomes</td>
<td>VAIR</td>
<td>0.321</td>
<td>0.797</td>
<td>0.319</td>
<td>0.795</td>
</tr>
<tr>
<td></td>
<td>VASC</td>
<td>0.443</td>
<td>0.902</td>
<td>0.431</td>
<td>0.898</td>
</tr>
<tr>
<td></td>
<td>VART</td>
<td>0.411</td>
<td>0.840</td>
<td>0.425</td>
<td>0.846</td>
</tr>
<tr>
<td>Telemedicine Capabilities</td>
<td>TCIQ</td>
<td>0.421</td>
<td>0.762</td>
<td>0.365</td>
<td>0.823</td>
</tr>
<tr>
<td></td>
<td>TCSI</td>
<td>0.416</td>
<td>0.757</td>
<td>0.460</td>
<td>0.857</td>
</tr>
<tr>
<td></td>
<td>TCPR</td>
<td>0.252</td>
<td>0.683</td>
<td>0.280</td>
<td>0.785</td>
</tr>
<tr>
<td></td>
<td>ICID</td>
<td>0.240</td>
<td>0.853</td>
<td>0.259</td>
<td>0.869</td>
</tr>
<tr>
<td></td>
<td>ICIS</td>
<td>0.186</td>
<td>0.833</td>
<td>0.190</td>
<td>0.837</td>
</tr>
<tr>
<td>Constructs</td>
<td>Item</td>
<td></td>
<td>Initial Instrument</td>
<td></td>
<td>Refined Instrument</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------</td>
<td>---</td>
<td>--------------------</td>
<td>---</td>
<td>--------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Weight</td>
<td>Loading</td>
<td>Weight</td>
</tr>
<tr>
<td>ICRD</td>
<td></td>
<td></td>
<td>0.195</td>
<td>0.753</td>
<td>0.239</td>
</tr>
<tr>
<td>ICRPL</td>
<td></td>
<td></td>
<td>0.174</td>
<td>0.696</td>
<td></td>
</tr>
<tr>
<td>ICPD</td>
<td></td>
<td></td>
<td>0.244</td>
<td>0.735</td>
<td>0.295</td>
</tr>
<tr>
<td>E-health Policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHPP</td>
<td></td>
<td></td>
<td>0.350</td>
<td>0.930</td>
<td>0.349</td>
</tr>
<tr>
<td>EFPA</td>
<td></td>
<td></td>
<td>0.354</td>
<td>0.925</td>
<td>0.341</td>
</tr>
<tr>
<td>EHPD</td>
<td></td>
<td></td>
<td>0.373</td>
<td>0.929</td>
<td>0.387</td>
</tr>
<tr>
<td>Data Security Policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPSE</td>
<td></td>
<td></td>
<td>0.370</td>
<td>0.924</td>
<td>0.376</td>
</tr>
<tr>
<td>SPSS</td>
<td></td>
<td></td>
<td>0.367</td>
<td>0.927</td>
<td>0.355</td>
</tr>
<tr>
<td>SPSP</td>
<td></td>
<td></td>
<td>0.358</td>
<td>0.889</td>
<td>0.364</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IITB</td>
<td></td>
<td></td>
<td>0.085</td>
<td>0.639</td>
<td></td>
</tr>
<tr>
<td>IIWS</td>
<td></td>
<td></td>
<td>0.085</td>
<td>0.621</td>
<td></td>
</tr>
<tr>
<td>IIWN</td>
<td></td>
<td></td>
<td>0.091</td>
<td>0.688</td>
<td></td>
</tr>
<tr>
<td>IIEU</td>
<td></td>
<td></td>
<td>0.118</td>
<td>0.674</td>
<td></td>
</tr>
<tr>
<td>IIER</td>
<td></td>
<td></td>
<td>0.161</td>
<td>0.766</td>
<td>0.198</td>
</tr>
<tr>
<td>IIPU</td>
<td></td>
<td></td>
<td>0.156</td>
<td>0.807</td>
<td>0.195</td>
</tr>
<tr>
<td>IIPR</td>
<td></td>
<td></td>
<td>0.192</td>
<td>0.853</td>
<td>0.239</td>
</tr>
<tr>
<td>IIIU</td>
<td></td>
<td></td>
<td>0.120</td>
<td>0.732</td>
<td>0.158</td>
</tr>
<tr>
<td>IIIIR</td>
<td></td>
<td></td>
<td>0.095</td>
<td>0.754</td>
<td>0.129</td>
</tr>
<tr>
<td>IIAU</td>
<td></td>
<td></td>
<td>0.094</td>
<td>0.700</td>
<td>0.126</td>
</tr>
<tr>
<td>IIAI</td>
<td></td>
<td></td>
<td>0.147</td>
<td>0.762</td>
<td>0.197</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RESC</td>
<td></td>
<td></td>
<td>0.387</td>
<td>0.807</td>
<td>0.383</td>
</tr>
<tr>
<td>REWC</td>
<td></td>
<td></td>
<td>0.377</td>
<td>0.809</td>
<td>0.295</td>
</tr>
<tr>
<td>REOT</td>
<td></td>
<td></td>
<td>0.475</td>
<td>0.807</td>
<td>0.555</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HIWU</td>
<td></td>
<td></td>
<td>0.197</td>
<td>0.873</td>
<td>0.163</td>
</tr>
<tr>
<td>HIWR</td>
<td></td>
<td></td>
<td>0.078</td>
<td>0.859</td>
<td>0.099</td>
</tr>
<tr>
<td>HIBU</td>
<td></td>
<td></td>
<td>0.156</td>
<td>0.897</td>
<td>0.150</td>
</tr>
<tr>
<td>HIBR</td>
<td></td>
<td></td>
<td>0.042</td>
<td>0.888</td>
<td>0.071</td>
</tr>
<tr>
<td>HIFU</td>
<td></td>
<td></td>
<td>0.142</td>
<td>0.904</td>
<td>0.134</td>
</tr>
<tr>
<td>HIFR</td>
<td></td>
<td></td>
<td>0.078</td>
<td>0.844</td>
<td>0.099</td>
</tr>
<tr>
<td>HIDU</td>
<td></td>
<td></td>
<td>0.090</td>
<td>0.884</td>
<td>0.103</td>
</tr>
<tr>
<td>HIDR</td>
<td></td>
<td></td>
<td>0.189</td>
<td>0.859</td>
<td>0.157</td>
</tr>
<tr>
<td>HIHU</td>
<td></td>
<td></td>
<td>0.129</td>
<td>0.916</td>
<td>0.113</td>
</tr>
<tr>
<td>HIHR</td>
<td></td>
<td></td>
<td>0.035</td>
<td>0.847</td>
<td>0.049</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DMIE</td>
<td></td>
<td></td>
<td>0.409</td>
<td>0.832</td>
<td>0.464</td>
</tr>
<tr>
<td>DMIC</td>
<td></td>
<td></td>
<td>0.315</td>
<td>0.854</td>
<td>0.294</td>
</tr>
<tr>
<td>DMIT</td>
<td></td>
<td></td>
<td>0.338</td>
<td>0.832</td>
<td>0.320</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IEMS</td>
<td></td>
<td></td>
<td>0.296</td>
<td>0.860</td>
<td>0.299</td>
</tr>
<tr>
<td>IEUI</td>
<td></td>
<td></td>
<td>0.256</td>
<td>0.769</td>
<td>0.280</td>
</tr>
<tr>
<td>IEUC</td>
<td></td>
<td></td>
<td>0.239</td>
<td>0.775</td>
<td>0.227</td>
</tr>
<tr>
<td>IEIC</td>
<td></td>
<td></td>
<td>0.270</td>
<td>0.797</td>
<td>0.245</td>
</tr>
<tr>
<td>IEDP</td>
<td></td>
<td></td>
<td>0.202</td>
<td>0.735</td>
<td>0.213</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUOP</td>
<td></td>
<td></td>
<td>0.286</td>
<td>0.784</td>
<td>0.507</td>
</tr>
<tr>
<td>CUPP</td>
<td></td>
<td></td>
<td>0.410</td>
<td>0.827</td>
<td>0.321</td>
</tr>
<tr>
<td>CUDC</td>
<td></td>
<td></td>
<td>0.386</td>
<td>0.846</td>
<td>0.350</td>
</tr>
<tr>
<td>CUTA</td>
<td></td>
<td></td>
<td>0.165</td>
<td>0.673</td>
<td></td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UARI</td>
<td></td>
<td></td>
<td>0.285</td>
<td>0.868</td>
<td>0.217</td>
</tr>
<tr>
<td>UATI</td>
<td></td>
<td></td>
<td>0.192</td>
<td>0.825</td>
<td>0.250</td>
</tr>
<tr>
<td>UAPI</td>
<td></td>
<td></td>
<td>0.253</td>
<td>0.879</td>
<td>0.184</td>
</tr>
</tbody>
</table>
Initial Instrument  |  Refined Instrument
---|---
**Constructs** |  
UAHI | 0.409 | 0.486 | 0.909 | 0.929 | 0.409 | 0.486 | 0.909 | 0.929 | 0.409 | 0.486 | 0.909 | 0.929 |
PDAP | 0.446 | 0.403 | 0.851 | 0.831 | 0.446 | 0.403 | 0.851 | 0.831 | 0.446 | 0.403 | 0.851 | 0.831 |
PDDI | 0.396 | 0.454 | 0.863 | 0.885 | 0.396 | 0.454 | 0.863 | 0.885 | 0.396 | 0.454 | 0.863 | 0.885 |
PDDS | 0.343 | 0.326 | 0.813 | 0.809 | 0.343 | 0.326 | 0.813 | 0.809 | 0.343 | 0.326 | 0.813 | 0.809 |

**Composite Reliability** |  
0.880 | 0.880 | 0.880 | 0.880

Note: Items in cells, with values < 0.707 did not load adequately (Gefen et al., 2000).

5.5.2 Checking for Cross-Loading

The second step in testing the measurement model was to assess whether any item cross-loaded on a construct other than the one for which it was theoretically specified (Chin, 1998a, 1998b). Cross-loadings indicate items that potentially measure more than one factor; PLS provides information that can be used to estimate cross-loadings. Cross-loadings are not directly computed by PLS; they must be manually constructed, as suggested by Wynne Chin (www.disc-nt.cba.uh.edu/chin/plsfaq.htm).

Therefore, I copied my row data set using Excel software, and standardized all the items, by calculating the means and standard deviations of each indicator. I then subtracted the mean and divided by the standard deviations to create standardized items, used SPSS 10 to generate Pearson’s correlation coefficients for the items against the latent variable scores, and listed the results obtained in Table 5.4. Chin (1998a) recommends that items with values of 0.707 or greater are significant. In my case, forty-nine items were loaded adequately in the initial instrument.

Table 5.4: Cross-Loading of All Items Against Refined Items’ Latent Variable Scores

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Item</th>
<th>IC</th>
<th>EH</th>
<th>SP</th>
<th>II</th>
<th>RE</th>
<th>HI</th>
<th>DM</th>
<th>IE</th>
<th>CU</th>
<th>UA</th>
<th>PD</th>
<th>SC</th>
<th>VA</th>
<th>TC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Distance</td>
<td>UAHI</td>
<td>0.768</td>
<td>0.332</td>
<td>0.225</td>
<td>0.143</td>
<td>0.197</td>
<td>0.119</td>
<td>0.226</td>
<td>0.213</td>
<td>0.105</td>
<td>0.136</td>
<td>0.142</td>
<td>0.209</td>
<td>0.252</td>
<td>0.384</td>
</tr>
<tr>
<td></td>
<td>ICID</td>
<td>0.853</td>
<td>0.338</td>
<td>0.308</td>
<td>0.195</td>
<td>0.232</td>
<td>0.086</td>
<td>0.254</td>
<td>0.256</td>
<td>0.145</td>
<td>0.146</td>
<td>0.073</td>
<td>0.227</td>
<td>0.259</td>
<td>0.327</td>
</tr>
<tr>
<td></td>
<td>ICRS</td>
<td>0.833</td>
<td>0.326</td>
<td>0.266</td>
<td>0.166</td>
<td>0.264</td>
<td>0.142</td>
<td>0.199</td>
<td>0.151</td>
<td>0.144</td>
<td>0.111</td>
<td>0.096</td>
<td>0.214</td>
<td>0.219</td>
<td>0.245</td>
</tr>
<tr>
<td></td>
<td>ICRD</td>
<td>0.753</td>
<td>0.351</td>
<td>0.307</td>
<td>0.207</td>
<td>0.189</td>
<td>0.132</td>
<td>0.270</td>
<td>0.213</td>
<td>0.227</td>
<td>0.086</td>
<td>0.101</td>
<td>0.201</td>
<td>0.239</td>
<td>0.235</td>
</tr>
<tr>
<td></td>
<td>ICPL</td>
<td>0.695</td>
<td>0.315</td>
<td>0.268</td>
<td>0.203</td>
<td>0.239</td>
<td>0.168</td>
<td>0.166</td>
<td>0.087</td>
<td>0.258</td>
<td>0.111</td>
<td>0.054</td>
<td>0.179</td>
<td>0.240</td>
<td>0.198</td>
</tr>
<tr>
<td></td>
<td>ICPR</td>
<td>0.735</td>
<td>0.497</td>
<td>0.444</td>
<td>0.231</td>
<td>0.332</td>
<td>0.111</td>
<td>0.307</td>
<td>0.309</td>
<td>0.238</td>
<td>0.229</td>
<td>0.092</td>
<td>0.292</td>
<td>0.327</td>
<td>0.312</td>
</tr>
<tr>
<td></td>
<td>EHP</td>
<td>0.425</td>
<td>0.930</td>
<td>0.473</td>
<td>0.362</td>
<td>0.300</td>
<td>0.115</td>
<td>0.424</td>
<td>0.427</td>
<td>0.281</td>
<td>0.017</td>
<td>-0.020</td>
<td>0.204</td>
<td>0.222</td>
<td>0.326</td>
</tr>
<tr>
<td></td>
<td>EFPA</td>
<td>0.426</td>
<td>0.925</td>
<td>0.494</td>
<td>0.406</td>
<td>0.391</td>
<td>0.104</td>
<td>0.382</td>
<td>0.406</td>
<td>0.256</td>
<td>0.052</td>
<td>0.013</td>
<td>0.150</td>
<td>0.163</td>
<td>0.277</td>
</tr>
<tr>
<td></td>
<td>EHP</td>
<td>0.457</td>
<td>0.929</td>
<td>0.568</td>
<td>0.420</td>
<td>0.420</td>
<td>0.147</td>
<td>0.401</td>
<td>0.483</td>
<td>0.332</td>
<td>0.083</td>
<td>0.005</td>
<td>0.162</td>
<td>0.229</td>
<td>0.303</td>
</tr>
<tr>
<td></td>
<td>SPSE</td>
<td>0.356</td>
<td>0.541</td>
<td>0.924</td>
<td>0.296</td>
<td>0.403</td>
<td>0.035</td>
<td>0.293</td>
<td>0.415</td>
<td>0.296</td>
<td>0.039</td>
<td>0.093</td>
<td>0.088</td>
<td>0.207</td>
<td>0.329</td>
</tr>
<tr>
<td></td>
<td>SPSS</td>
<td>0.353</td>
<td>0.516</td>
<td>0.926</td>
<td>0.331</td>
<td>0.400</td>
<td>0.088</td>
<td>0.308</td>
<td>0.381</td>
<td>0.305</td>
<td>0.051</td>
<td>0.096</td>
<td>0.168</td>
<td>0.315</td>
<td>0.288</td>
</tr>
<tr>
<td></td>
<td>SPSP</td>
<td>0.374</td>
<td>0.456</td>
<td>0.888</td>
<td>0.324</td>
<td>0.316</td>
<td>0.108</td>
<td>0.188</td>
<td>0.335</td>
<td>0.224</td>
<td>0.017</td>
<td>0.117</td>
<td>0.065</td>
<td>0.260</td>
<td>0.278</td>
</tr>
</tbody>
</table>
IITB
IIWS
IIWN
IIEU
IIER
IIPU
IIPR
IIIU
IIIR
IIAU
IIAR
RESC
REWC
REOT
HIWU
HIWR
HIBU
HIBR
HIFU
HIFR
HIDU
HIDR
HIHU
HIHR
DMIE
DMIC
DMIT
DMIS
IEMS
IEUI
IEUC
IEIC
IEDP
CUOP
CUPP
CUDC
CUTA
UARI
UATI
UAPI
UAHI
PDAP
PDDI
PDDS
SCPA
SCPW
SCFU

IC
0.140
0.164
0.156
0.218
0.252
0.234
0.291
0.149
0.032
0.075
0.127
0.263
0.236
0.259
0.157
0.125
0.122
0.116
0.091
0.093
0.089
0.197
0.188
0.136
0.263
0.266
0.259
0.188
0.271
0.365
0.158
0.178
0.078
0.086
0.207
0.279
0.110
0.144
0.166
0.160
0.167
0.086
0.107
0.122
0.197
0.179
0.296

EH
0.190
0.193
0.210
0.254
0.391
0.368
0.448
0.324
0.235
0.267
0.357
0.302
0.258
0.393
0.120
0.110
0.148
0.104
0.110
0.062
0.050
0.182
0.077
0.086
0.329
0.418
0.363
0.259
0.437
0.447
0.320
0.333
0.313
0.177
0.191
0.370
0.251
0.054
0.016
0.032
0.070
-0.019
0.007
0.014
0.132
0.148
0.178

SP
0.138
0.196
0.157
0.187
0.275
0.321
0.366
0.231
0.217
0.177
0.357
0.305
0.364
0.324
0.072
0.031
0.073
0.044
0.059
0.056
0.016
0.169
0.045
0.071
0.202
0.263
0.237
0.254
0.462
0.358
0.261
0.305
0.202
0.207
0.247
0.268
0.232
0.004
0.063
-0.002
0.066
0.047
0.156
0.084
0.141
0.087
0.145

II
0.639
0.621
0.688
0.674
0.766
0.807
0.853
0.732
0.754
0.700
0.762
0.369
0.354
0.430
0.144
0.101
0.059
0.044
0.047
0.000
0.040
0.101
0.021
0.104
0.156
0.291
0.199
0.235
0.284
0.308
0.306
0.281
0.335
0.221
0.209
0.402
0.392
0.060
0.147
0.169
0.228
0.117
0.140
0.119
0.094
0.129
0.083

RE
0.256
0.281
0.300
0.306
0.293
0.349
0.475
0.353
0.341
0.375
0.465
0.807
0.809
0.807
0.078
0.121
0.085
0.098
0.093
0.128
0.031
0.263
0.113
0.147
0.173
0.377
0.223
0.271
0.420
0.383
0.372
0.369
0.361
0.238
0.211
0.386
0.273
0.127
0.142
0.123
0.156
0.115
0.093
0.092
0.141
0.156
0.145

HI
-0.029
-0.065
0.018
0.079
0.165
0.056
0.112
0.003
0.070
-0.038
0.133
0.189
0.068
0.082
0.872
0.858
0.897
0.888
0.904
0.844
0.884
0.859
0.916
0.847
0.188
0.039
0.024
-0.002
0.076
0.116
0.119
0.013
0.006
0.023
0.074
0.082
0.111
-0.021
-0.022
-0.032
-0.005
-0.040
-0.017
0.126
-0.031
-0.010
0.063

128

DM
0.193
0.158
0.105
0.167
0.118
0.257
0.237
0.232
0.146
0.271
0.216
0.239
0.217
0.289
0.119
0.037
0.114
0.107
0.075
0.079
0.025
0.117
0.050
0.027
0.832
0.854
0.832
0.639
0.474
0.439
0.305
0.477
0.438
0.197
0.155
0.237
0.166
0.075
-0.014
0.063
0.006
0.143
0.036
0.090
0.175
0.187
0.276

IE
0.275
0.263
0.228
0.265
0.274
0.279
0.349
0.247
0.257
0.294
0.310
0.387
0.346
0.429
0.104
0.023
0.066
0.061
0.069
0.057
0.010
0.178
0.005
0.021
0.440
0.466
0.432
0.408
0.860
0.769
0.775
0.797
0.735
0.316
0.333
0.427
0.346
0.150
0.121
0.194
0.209
0.201
0.220
0.156
0.305
0.245
0.214

CU
0.339
0.431
0.340
0.309
0.259
0.267
0.334
0.152
0.134
0.145
0.294
0.353
0.268
0.235
0.050
0.081
0.092
0.058
0.057
0.049
0.052
0.172
0.015
0.079
0.193
0.220
0.178
0.177
0.279
0.343
0.350
0.409
0.414
0.784
0.827
0.846
0.673
0.124
0.187
0.244
0.229
0.197
0.218
0.157
0.200
0.166
0.231

UA
0.159
0.073
0.035
0.124
0.117
0.135
0.156
0.157
0.129
0.204
0.160
0.102
0.100
0.171
0.018
-0.005
-0.011
-0.037
-0.099
-0.001
-0.014
-0.030
0.000
0.032
-0.027
0.059
0.018
0.137
0.106
0.142
0.169
0.241
0.136
0.123
0.173
0.187
0.293
0.868
0.825
0.879
0.909
0.203
0.215
0.164
0.168
0.183
0.123

PD
0.027
0.033
-0.016
0.065
0.139
0.152
0.194
0.043
0.152
0.091
0.174
0.138
0.080
0.075
0.050
-0.064
-0.006
0.007
0.014
-0.010
0.079
0.028
-0.008
0.047
0.076
0.015
0.176
0.079
0.147
0.045
0.238
0.207
0.311
0.122
0.212
0.228
0.113
0.125
0.230
0.191
0.254
0.851
0.863
0.813
0.100
0.064
-0.018

SC
0.188
0.066
0.152
0.173
-0.025
0.098
0.008
0.018
-0.090
-0.003
0.045
0.075
0.088
0.140
-0.015
0.005
-0.025
-0.060
0.015
-0.003
-0.048
0.036
0.009
-0.024
0.218
0.252
0.190
0.251
0.295
0.258
0.154
0.211
0.150
0.174
0.282
0.123
0.117
0.142
0.143
0.215
0.180
-0.022
0.083
-0.010
0.760
0.769
0.896

VA
0.100
0.067
0.083
0.217
0.090
0.041
0.105
-0.011
-0.029
-0.038
0.088
0.111
0.116
0.102
0.098
0.046
0.047
0.074
0.071
0.040
0.062
0.152
0.096
0.066
0.261
0.266
0.096
0.191
0.284
0.190
0.150
0.212
0.129
0.156
0.273
0.093
0.130
0.118
0.146
0.113
0.138
-0.008
0.064
0.104
0.356
0.380
0.437

TC
0.127
0.052
0.112
0.198
0.159
0.123
0.194
0.031
0.048
0.006
0.057
0.162
0.158
0.199
0.180
0.071
0.142
0.039
0.129
0.071
0.082
0.172
0.118
0.032
0.413
0.317
0.341
0.173
0.441
0.382
0.357
0.402
0.301
0.158
0.227
0.213
0.091
0.117
0.079
0.104
0.168
0.242
0.214
0.186
0.289
0.148
0.321


5.5.3 Composite Reliability

To assess the internal consistency for the indicators of each construct, the composite reliability was calculated. In comparison to Cronbach’s alpha, composite reliability does not assume that all items are equally weighted (Chin, 1998a); minimum composite reliability scores greater than 0.707 are considered acceptable. All constructs in this research model exhibited very good internal consistency. Composite reliability of the telemedicine social, e-health policies, data security policy, ICT infrastructure, healthcare infrastructure and uncertainty avoidance constructs values were above 0.90, indicating that the measurement model demonstrates high internal consistency. Table 5.3 presents the composite reliabilities for each refined construct. As recommended by Barclay et al. (1995) and procedures outlined by Fornell and Larcker (1981), composite reliability was calculated as follows:

$$P_c = \frac{\left(\sum \lambda_i\right)^2 Var F}{\sum \lambda_i Var F + \Sigma \theta_i}$$

where $\lambda_i$, $F$ and $\theta_i$ are the factor loading factor variance and unique/error variance respectively. If $F$ is set at 1, then $\theta_i$ is the $1$-square of $\lambda_i$.

Note: Items in cells, with values < 0.707 are not significant (Chin, 1998a).
5.5.4 Average Variance Extracted

As another measure of reliability (in addition to composite reliability), to assess convergent validity, I examine the Average Variance Extracted (AVE) (Fornell and Lacker, 1981). AVE values should be greater than 0.50, which means that “half” or more of the variance of the indicators should be accounted for (Chin, 1998a, p. 321; Fornell and Larcker, 1981, p. 46). The AVE attempts “to measure the amount of variances that a latent variable (construct) component captures from its indicators relative to the amount due to measurement error” (Chin, 1998a, p. 321). All AVEs for the latent constructs in this study were very good, as Table 5.5 displays. Hence, I was confident that my operationalizations were reliable measures of the theoretical constructs. As recommended by Barclay et al. (1995), the AVE was calculated as follows:

\[
AVE = \frac{\sum \lambda_i^2}{\sum \lambda_i^2 + \sum_{i=1}^{n} Var(\xi_i)}
\]

where \( Var(\xi_i) = 1 - \lambda_i^2 \) and \( \lambda_i \) = the component loading of each item to latent construct.

Table 5.5: Average Variance Extracted

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Average Variance Extracted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>0.690</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>0.673</td>
</tr>
<tr>
<td>Telemedicine Value</td>
<td>0.710</td>
</tr>
<tr>
<td>ICT Policies</td>
<td>0.635</td>
</tr>
<tr>
<td>e-Health Policies</td>
<td>0.861</td>
</tr>
<tr>
<td>Data Security and Standards</td>
<td>0.834</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>0.640</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>0.774</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>0.643</td>
</tr>
<tr>
<td>Power Distance</td>
<td>0.710</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>0.751</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>0.688</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>0.621</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td>0.713</td>
</tr>
</tbody>
</table>

Note: Average Variance Extracted validity values > 0.50 (Fornell and Lacker, 1981)
5.5.5 Convergent Validity

Convergent validity verifies whether each item really measures what it was theoretically supposed to measure. Convergent validity is defined as “the extent to which multiple attempts to measure the same construct are in agreement” (Campbell and Fiske, 1959). It is achieved by keeping constructs with reliability values higher than 0.707 (Fornell and Larker, 1981). Reliability value is measured with the rank correlation coefficients (rho) coefficient, the value of which is determined by the respective loading of items. The criterion established by Nunnally (1967, 1978) pertaining to the reliability of the construct is that any construct having a rho value equal to or greater than 0.707 should be kept. This criterion was maintained. The rho or composite reliability values are presented in Table 5.6; all items have loadings greater than 0.707. In summary, the results show that all constructs demonstrate strong convergent validity.

Table 5.6: Convergent Reliability

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>0.870</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>0.911</td>
</tr>
<tr>
<td>Telemedicine Value</td>
<td>0.884</td>
</tr>
<tr>
<td>ICT Policies</td>
<td>0.897</td>
</tr>
<tr>
<td>e-Health Policies</td>
<td>0.938</td>
</tr>
<tr>
<td>Data Security and Standards</td>
<td>0.949</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>0.926</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>0.972</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>0.843</td>
</tr>
<tr>
<td>Power Distance</td>
<td>0.862</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>0.923</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>0.880</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>0.882</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td>0.891</td>
</tr>
</tbody>
</table>

Note: Convergent Reliability validity values > 0.707 are significant (Nunnally, 1967).

5.5.6 Discriminant Validity

The fourth step in ensuring the reliability of the measurement model involved testing for discriminant validity, which refers to the degree to which each construct is unique or measures different concepts (Campbell and Fiske 1959; Gefen et al., 2000).
Discriminant validity is assessed in terms of the correlations between the latent factor scores of each construct in the model; this set of correlations is called the (phi) matrix. The test compares these correlations with the square root of the average variance extracted (AVE) for each construct pair (Fornell and Larcker, 1981; Fornell and Bookstien, 1983).

The variance shared between measures of two different constructs should be lower than the AVE by the items measuring each construct (Chin, 1998a). Table 5.7 displays the result matrix of latent construct correlations with the square root of AVEs in the leading diagonal. It is evident from Table 5.7 that 14 non-diagonal entries were found not to exceed the diagonals of specific constructs, and thus no single violation exists of the conditions for discriminant validity (Chin 1998a, p. 327).

Table 5.7: Matrix of Latent Construct

<table>
<thead>
<tr>
<th></th>
<th>AVE</th>
<th>IC</th>
<th>EH</th>
<th>SP</th>
<th>II</th>
<th>HI</th>
<th>RE</th>
<th>IE</th>
<th>DH</th>
<th>PD</th>
<th>UA</th>
<th>CU</th>
<th>SO</th>
<th>VA</th>
<th>TC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC</td>
<td>0.635</td>
<td>0.797</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EH</td>
<td>0.861</td>
<td>0.473</td>
<td>0.928</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td>0.834</td>
<td>0.398</td>
<td>0.553</td>
<td>0.913</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>0.640</td>
<td>0.219</td>
<td>0.442</td>
<td>0.361</td>
<td>0.800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HI</td>
<td>0.643</td>
<td>0.141</td>
<td>0.128</td>
<td>0.079</td>
<td>0.098</td>
<td>0.802</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE</td>
<td>0.774</td>
<td>0.310</td>
<td>0.411</td>
<td>0.404</td>
<td>0.484</td>
<td>0.134</td>
<td>0.880</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE</td>
<td>0.621</td>
<td>0.301</td>
<td>0.477</td>
<td>0.415</td>
<td>0.363</td>
<td>0.080</td>
<td>0.489</td>
<td>0.788</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DH</td>
<td>0.713</td>
<td>0.318</td>
<td>0.428</td>
<td>0.269</td>
<td>0.239</td>
<td>0.113</td>
<td>0.295</td>
<td>0.525</td>
<td>0.844</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PD</td>
<td>0.710</td>
<td>0.129</td>
<td>0.000</td>
<td>0.117</td>
<td>0.176</td>
<td>0.015</td>
<td>0.117</td>
<td>0.229</td>
<td>0.099</td>
<td>0.843</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UA</td>
<td>0.751</td>
<td>0.188</td>
<td>0.056</td>
<td>0.048</td>
<td>0.196</td>
<td>-0.018</td>
<td>0.166</td>
<td>0.197</td>
<td>0.004</td>
<td>0.244</td>
<td>0.867</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CU</td>
<td>0.686</td>
<td>0.218</td>
<td>0.294</td>
<td>0.290</td>
<td>0.258</td>
<td>0.071</td>
<td>0.328</td>
<td>0.429</td>
<td>0.224</td>
<td>0.229</td>
<td>0.197</td>
<td>0.828</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO</td>
<td>0.673</td>
<td>0.292</td>
<td>0.185</td>
<td>0.116</td>
<td>0.016</td>
<td>-0.007</td>
<td>0.133</td>
<td>0.278</td>
<td>0.258</td>
<td>0.025</td>
<td>0.194</td>
<td>0.241</td>
<td>0.820</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VA</td>
<td>0.710</td>
<td>0.334</td>
<td>0.221</td>
<td>0.285</td>
<td>0.058</td>
<td>0.092</td>
<td>0.133</td>
<td>0.252</td>
<td>0.252</td>
<td>0.059</td>
<td>0.151</td>
<td>0.218</td>
<td>0.489</td>
<td>0.843</td>
<td></td>
</tr>
<tr>
<td>TC</td>
<td>0.690</td>
<td>0.342</td>
<td>0.298</td>
<td>0.308</td>
<td>0.083</td>
<td>0.199</td>
<td>0.168</td>
<td>0.434</td>
<td>0.400</td>
<td>0.234</td>
<td>0.097</td>
<td>0.223</td>
<td>0.283</td>
<td>0.349</td>
<td>0.831</td>
</tr>
</tbody>
</table>

Diagonals represent the average variance extracted (AVE), while the other matrix entries represent shared variance.

In summary, all the constructs demonstrate adequate reliability and validity, indicating that the measurement model is acceptable. The convergent validity of the study survey measures was adequate. Average variance extracted and individual item reliabilities of the constructs appear to be satisfactory, and composite reliability of all
scales exceeded 0.8. Once I am confident with respect to the measurement model assessment (reliability and validity), I can evaluate the structural model.

5.6 Assessment of the Structural (Inner) Model and Hypotheses

After successfully passing the statistical analysis and test of measurement model, the data were subjected to path analysis. This section presents the result of the structural model testing hypotheses and PLS results that were obtained while testing the model. PLS yields two main kinds of information that indicate how well the structural model predicates the hypothesized relationships (Gefen, 2002).

First, PLS provides the squared multiple correlation (R²) for each endogenous construct in the model, a measure of the percentage of a construct’s variation that the model explains. R² is similar to regression, used to measure the percentage of a construct’s variation that the model explains (Chin, 1998a). Falk and Miller (1992) provide the following formula for testing the R² value (F):

\[
F = \frac{R^2/m}{(1-R^2)/(N-m-1)}
\]

where N is the number of cases, m is the number of items in the construct, and F is distributed as an F distribution with m and (N-m-1) degrees of freedom.

The R² value represents the amount of variance explained by the independent variables, thereby providing insight into the model’s predictive power (Chin, 1998a; Fornell and Bookstien, 1982; Fornell and Larkner, 1981).

The second measure of the structural model provided by PLS is the path coefficient, indicating the strength of relationship between two constructs (dependent and independent variables). Dependent and independent variables need to be significant and directionally consistent with expectations. To calculate the significance of these coefficients, I ran a bootstrap procedure with 200 resamples (Li and Maddala, 1997). This procedure provides an estimate of the standard error for each salience in all latent variables, and serves to assess the contribution of each data point to the latent variable structure. The estimates of the standard errors are usually stable after 100 resamplings.
(Chin, 1998a, p.320). Chin (1998a) suggests, “the standardized path should be about 0.20 and ideally above 0.30 in order to be considered meaningful”. The coefficients of paths should be significant at the 0.05 level.

5.6.1 Results: Overall Model of Telemedicine Factors

Results of the assessment of the structural model are presented in Figure 5.2. Table 5.8 also provides a summary of all the results obtained for overall models.

Table 5.8: Path Coefficients and $R^2$ for the Overall Model

<table>
<thead>
<tr>
<th>Predictor Constructs</th>
<th>Predicted Constructs</th>
<th>Hyp.</th>
<th>Path</th>
<th>t</th>
<th>P (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Value</td>
<td>H1</td>
<td>**0.449</td>
<td>4.794</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>Telemedicine Value</td>
<td>H2</td>
<td>**0.228</td>
<td>2.735</td>
<td>0.007</td>
</tr>
<tr>
<td>ICT Policies</td>
<td>Telemedicine Capabilities</td>
<td>H3</td>
<td>**0.544</td>
<td>5.645</td>
<td>0.000</td>
</tr>
<tr>
<td>e-Health Policies</td>
<td>Telemedicine Capabilities</td>
<td>H4a</td>
<td>**0.254</td>
<td>3.111</td>
<td>0.002</td>
</tr>
<tr>
<td>Data Security</td>
<td>Telemedicine Capabilities</td>
<td>H4b</td>
<td>-0.018</td>
<td>0.270</td>
<td>0.787</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>Telemedicine Capabilities</td>
<td>H4b</td>
<td>**0.435</td>
<td>5.393</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>Telemedicine Capabilities</td>
<td>H5a</td>
<td>0.026</td>
<td>0.318</td>
<td>0.751</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>Telemedicine Capabilities</td>
<td>H5b</td>
<td>**0.435</td>
<td>5.393</td>
<td>0.000</td>
</tr>
<tr>
<td>Power Distance</td>
<td>Telemedicine Capabilities</td>
<td>H6a</td>
<td>**0.232</td>
<td>2.505</td>
<td>0.013</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>Telemedicine Capabilities</td>
<td>H6b</td>
<td>**0.272</td>
<td>2.748</td>
<td>0.007</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>Telemedicine Capabilities</td>
<td>H7</td>
<td>**0.252</td>
<td>3.136</td>
<td>0.002</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>Telemedicine Capabilities</td>
<td>H8</td>
<td>*0.202</td>
<td>2.231</td>
<td>0.027</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td>Telemedicine Capabilities</td>
<td>H9a</td>
<td>**0.246</td>
<td>2.809</td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Social</td>
<td>H9b</td>
<td>-0.078</td>
<td>1.447</td>
<td>0.655</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Capabilities</td>
<td>H10</td>
<td>*0.248</td>
<td>2.277</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Capabilities</td>
<td>H11</td>
<td>0.088</td>
<td>0.228</td>
<td>0.820</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Capabilities</td>
<td>H12</td>
<td>0.090</td>
<td>0.133</td>
<td>0.894</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Capabilities</td>
<td>H13</td>
<td>**0.370</td>
<td>2.881</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Capabilities</td>
<td>H14</td>
<td>*0.295</td>
<td>2.219</td>
<td>0.028</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$R^2$</th>
<th>$F$</th>
<th>P (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT infrastructure</td>
<td>0.315</td>
<td>17.291</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Capabilities</td>
<td>0.437</td>
<td>49.418</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>0.353</td>
<td>25.779</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Value</td>
<td>0.222</td>
<td>27.251</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* $P<0.050$; ** $P<0.010$; *** $P<0.001$

The overall model result shows that an adequate percentage of variance ($R^2$) is explained for all dependent constructs in the study ($R^2 = 31.5\%$ for ICT infrastructure,
43.7 % for telemedicine capabilities, 35.3 % for telemedicine social outcomes, and 22.2 % for telemedicine value outcomes).

Hypothesis H<sub>1</sub>, referring to the relationship between telemedicine capabilities and telemedicine value outcomes, documents a significant impact on telemedicine value outcomes  \( t = 4.794; \ p = 0.000 \). This suggests that telemedicine capability has a strong relation to telemedicine value, implying that a well-defined procedure, infrastructure and image based consultation service would exert a positive influence on clinical improvement, and reduce the time and effort of healthcare services and its societal cost.

Hypothesis H<sub>2</sub>, referring to the relationship between telemedicine capabilities and telemedicine social outcomes, documents a significant impact on telemedicine social outcomes \( t= 2.735; \ p = 0.007 \). This suggests that telemedicine capability has strong relation to telemedicine social outcomes, implying that increasing services and improving collaboration among physicians would exert a positive influence on the level of healthcare services, and improve patient access to healthcare services for underserved citizens.

Hypothesis H<sub>3</sub>, referring to the relationship between telemedicine social outcomes and telemedicine value outcomes, documents significant influence on telemedicine value outcomes \( t = 0.544; \ p = 0.000 \). This suggests that telemedicine social outcomes are strongly related to telemedicine value, implying that increased patient access, improved follow-up care of patients, and enhanced collaboration among healthcare professionals would exert a positive influence on saving costs to patient and healthcare providers, and reducing the time and effort of healthcare services.

Hypothesis H<sub>4a</sub>, referring to the relationship between general ICT policy and telemedicine capabilities, documents a significant impact on telemedicine capabilities \( t = 3.111; \ p = 0.002 \). This suggests that ICT policies have strong relation to telemedicine capabilities, implying that governmental promotion, influence and encouragement of the development, implement of ICT would exert a positive influence on increased clinical improvement, quality of care and improved collaboration among physicians.

Hypothesis H<sub>4b</sub>, referring to the relationship between national ICT policy and ICT infrastructure, is not supported \( t = 0.270; \ p = 0.787 \). This relationship does not seem to hold in SSA. This suggests that ICT policy does not have a significant effect on ICT
infrastructure, implying that a good national ICT policy is not directly related to telemedicine capabilities.

Hypothesis H$_{5a}$, referring to the relationship between e-health policy and telemedicine capabilities, is not significant ($t = 0.318; p = 0.751$). This relationship indicates e-health policy does not have a significant effect on telemedicine capabilities. This indicates that e-health policy is not a significant influencing factor in telemedicine capabilities, implying that improvement in quality does not necessarily relate with e-health policy.

Hypothesis H$_{5b}$, referring to the relationship between e-health policy and ICT infrastructure, documents significant influence on ICT infrastructure ($t = 5.393; p = 0.000$). This suggests that e-health policy has strong relationship to ICT infrastructure, implying that a good e-health policy would exert a positive influence on the use of telemedicine.

Hypothesis H$_{6a}$, referring to the relationship between data security policy and telemedicine capabilities, documents significant impact on telemedicine capabilities ($t = 2.505; p = 0.013$). This suggests that data security policy has strong relation to telemedicine capabilities, implying that governmental support, providing and enforcing standards and procedures to prevent system and data failure, would exert a positive influence on increasing clinical improvement, quality of care and improved collaboration among physicians at national and international levels.

Hypothesis H$_{6b}$, referring to the relationship between data security and ICT infrastructure, is significant ($t = 2.748; p = 0.007$). This suggests that data security and standards have a positive impact on ICT infrastructures, implying that a national policy should be tailored to ensure the security and standards increasing the development of ICT infrastructures.

Hypothesis H$_{7}$, referring to the influence of national ICT Infrastructure on telemedicine capabilities, supports telemedicine capabilities ($t = 3.136; p = 0.002$). This suggests that an ICT infrastructure is positively related to telemedicine capabilities, implying that the level and availability of ICT infrastructure are important for the development of telemedicine.
Hypothesis $H_8$, referring to the impact of national telemedicine readiness on telemedicine capabilities, is supported ($t = 2.231; p = 0.027$). The results show that strong leadership, investment in training, willingness to change, and awareness of the concept and benefit of telemedicine have a significant influence on telemedicine capabilities, implying that telemedicine readiness improves access to healthcare and saves costs, exerting a positive influence on telemedicine outcomes.

Hypothesis $H_9a$, referring to the impact of national healthcare infrastructure on telemedicine capabilities, documents significant influence supporting telemedicine capabilities ($t = 2.809; p = 0.005$). This suggests that adequate access, budget, facilities and human resources are not yet well developed, and thus a greater incentive to change the healthcare system.

Hypothesis $H_{9b}$, referring to the relationship between healthcare infrastructure and telemedicine social outcomes, is not supported ($t = 1.447; p = 0.655$). This result proves that healthcare infrastructure is not directly related to social outcomes; perhaps it has indirect effects. One possible reason for the lack of direct effect could be that healthcare infrastructure is directly related to telemedicine capabilities.

Hypothesis $H_{10a}$, referring to the relationship between power distance affecting managers and subordinates on telemedicine capabilities, is supported ($t = 2.277; p = 0.024$).

Hypothesis $H_{11a}$, referring to the influence of uncertainty avoidance in telemedicine capabilities, is not supported ($t = 0.228; p = 0.820$). This implies that uncertainty creates a source of resistance to adopting clinical telemedicine applications. Moreover, physician’s attitudes to adopting telemedicine, and the level of diffusion, have strong impact on telemedicine capabilities.

Hypothesis $H_{12a}$, referring to the impact of technology-intense cultures from advanced nations (technology culturation) on telemedicine’s capabilities, is not supported ($t = 0.133; p = 0.894$). This result shows that traveling to a technologically advanced country itself cannot improve quality of care of visually-based clinical applications in SSA countries.

Hypothesis $H_{13}$, referring to the relationship between implementation effectiveness and telemedicine capabilities, reveals a significant influence and support for
telemedicine capabilities ($t = 2.881; p = 0.004$). This suggests that implementation effectiveness has strong relation to telemedicine capabilities, implying that top management support, involvement of physicians and champions, would exert a positive influence on clinical improvement and increased quality of care.

Hypothesis $H_{14}$, referring to rational decision-making factors’ influence on telemedicine capabilities, demonstrates significant influence and support for telemedicine capabilities ($t=2.219; p = 0.028$). This suggests that rational decision-making factors are strongly related to telemedicine capabilities, implying that decisions made based on the significance of medical problems, cost saving, increasing access, availability of technical infrastructure, and considering social factors, would exert a positive influence on telemedicine outcomes.

In the overall model testing, I did not test the interaction hypotheses ($H_{10b}$, $H_{10c}$, $H_{11b}$, $H_{11c}$, $H_{12b}$ and $H_{11c}$); I tested these interactions between telemedicine transfer implementation factors (implementation effectiveness and decision making factors) and the cultural factors (power distance, uncertainty avoidance and technology culturation) in the culture model.
Figure 5.2 Overall Model with Significant and Insignificant Paths
5.6.2 Results from the National Infrastructure Model of Telemedicine Factors

I also conducted a PLS analysis to compare the National Infrastructure model results with the overall model. Table 5.9 provides a summary of results (the coefficients for all hypothesized paths in the model), and displays $R^2$ for each endogenous construct. Figure 5.3 displays the structural path diagram with the coefficient of paths.

Table 5.9: Path Coefficients and $R^2$ for a National Infrastructure Model

<table>
<thead>
<tr>
<th>Predictor Constructs</th>
<th>Predicted Constructs</th>
<th>Hyp.</th>
<th>Path</th>
<th>t</th>
<th>P (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Value</td>
<td>H1a</td>
<td>***0.435</td>
<td>5.425</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>Telemedicine Social</td>
<td>H2a</td>
<td>**0.230</td>
<td>2.891</td>
<td>0.004</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>Telemedicine Value</td>
<td>H3a</td>
<td>***0.543</td>
<td>6.117</td>
<td>0.000</td>
</tr>
<tr>
<td>ICT Policies</td>
<td>Telemedicine Capabilities</td>
<td>H4a</td>
<td>**0.314</td>
<td>3.710</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>ICT Infrastructure</td>
<td>H4b</td>
<td>-0.018</td>
<td>0.257</td>
<td>0.797</td>
</tr>
<tr>
<td>e-Health Policies</td>
<td>Telemedicine Capabilities</td>
<td>H5a</td>
<td>*0.220</td>
<td>2.295</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>ICT Infrastructure</td>
<td>H5b</td>
<td>**0.435</td>
<td>5.896</td>
<td>0.000</td>
</tr>
<tr>
<td>Data Security</td>
<td>Telemedicine Capabilities</td>
<td>H6a</td>
<td>**0.286</td>
<td>3.196</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>ICT Infrastructure</td>
<td>H6b</td>
<td>**0.272</td>
<td>3.653</td>
<td>0.000</td>
</tr>
<tr>
<td>ICT Infrastructure</td>
<td>Telemedicine Capabilities</td>
<td>H7</td>
<td>*0.208</td>
<td>2.491</td>
<td>0.014</td>
</tr>
<tr>
<td>Telemedicine Readiness</td>
<td>Telemedicine Capabilities</td>
<td>H8</td>
<td>*0.220</td>
<td>2.328</td>
<td>0.021</td>
</tr>
<tr>
<td>Health Infrastructure</td>
<td>Telemedicine Capabilities</td>
<td>H9a</td>
<td>***0.249</td>
<td>3.688</td>
<td>0.000</td>
</tr>
</tbody>
</table>

The exogenous factors explain 31.5% of the variation in ICT infrastructure, as well as 35.3% of the variation in telemedicine social outcomes. These variations compared to overall model were the same 31.5% for the ICT infrastructure and 35.3% for telemedicine social outcomes. However, the exogenous factors explained 29.2% of telemedicine capabilities, compared to 43.7% for the overall model; and 22.6% of the variation in telemedicine value, compared to 22.2% for the overall model. These differences motivate and explain by the absence of cultural factors. In the national infrastructure model, all $R^2$ values were statistically significant.
Figure 5.3: National Infrastructure Model with Significant and Insignificant Paths
The respondents believe that telemedicine capabilities are significantly influential in telemedicine value outcomes (H\textsubscript{1a}), with a path coefficient of 0.435 (t = 5.425; p = 0.000). Physicians also perceive telemedicine capabilities as significantly influential in telemedicine social outcomes (H\textsubscript{2a}), with a path coefficient of 0.230 (t = 2.891; p = 0.004).

Telemedicine social outcomes significantly influence telemedicine value (H\textsubscript{3a}), with a path coefficient of 0.543 (t = 6.117; p = 0.000).

General ICT policies are significantly influential on telemedicine capabilities (H\textsubscript{4a}), with a path coefficient of 0.314 (t = 3.710; p = 0.000). However, there is no apparent influence on general ICT policies (Hypothesis H\textsubscript{4b}) (t = 0.257; p = 0.797).

The physicians perceive that the impact of e-health policies is significantly influenced by telemedicine capabilities (H\textsubscript{5a}), with a path coefficient of 0.220 (t = 2.295; p = 0.023). E-health policy is significantly influential in ICT infrastructure (H\textsubscript{5b}), with a path coefficient of 0.435 (t = 5.896; p = 0.000).

The physicians perceive that the influence of data security policies is significantly influenced by telemedicine capabilities (Hypotheses H\textsubscript{6a}) (t = 3.196; p = 0.002), with a path coefficient of 0.286. Also, data security policies are significantly influential in ICT infrastructure (H\textsubscript{6b}), with a path coefficient of 0.272 (t = 3.653; p = 0.000).

The ICT infrastructure is significantly influenced by telemedicine capabilities (H\textsubscript{7}), with a path coefficient of 0.208 (t = 2.491; p = 0.014).

The respondents believe that telemedicine readiness significantly influences telemedicine capabilities (Hypotheses H\textsubscript{8}), with a path coefficient of 0.220 (t = 2.328; p = 0.021).

The healthcare infrastructure is significantly influenced by telemedicine capabilities (H\textsubscript{9a}), with a path coefficient of 0.249 (t = 3.688; p = 0.000). However, health infrastructure is not seen as directly related to telemedicine social outcomes.

### 5.6.3 Results on the Cultural Model of Telemedicine Factors

This study also investigated comparative analyses of the cultural model, namely uncertainty avoidance, power distance, and technology culturation, and their interaction with implementation effectiveness and decision making factors. Telemedicine
transfer implications, culture-specific beliefs and values, and technology culturation hypotheses involve finding a direct path between two constructs; but I hypothesized interactions between telemedicine transfer implementation factors and the cultural factors of Power Distance (the degree of which among individuals is called ‘hierarchy’), Uncertainty Avoidance (the degree to which individuals lack tolerance for ambiguous situations), and technology culturation (the degree of a person’s exposure to a relatively technology-intense culture). To test these hypotheses, I applied the methodology that Chin et al., (1996) presented for testing interactions using PLS. First, I normalized each variable in the culture model: telemedicine capabilities (TC), telemedicine outcomes (telemedicine-social (SC) and telemedicine-value (VA)); telemedicine transfer implementation factors (implementation effectiveness (IE) and decision-making factors (DMF); Power Distance (PD); Uncertainty Avoidance (AV), and Technology culturation (CU)). Second, I created six new interaction constructs by inter-multiplying the values of each variable in the constructs proposed to interact with each other, resulting in six new constructs: IE*CU (5*3 = 15 variables), IE*PD (5*3 = 15 variables), IE*UA (5*4 = 20 variables), DMF*CU (3*3 = 9 variables), DMF*PD (3*3 = 9 variables), and DMF*UA (3*4 = 12 variables) (IE is Implementation Effectiveness; DMF is Decision Making Factors; PD is Power Distance; UA is Uncertainty Avoidance, and CU is Technology Culturation) (see Figure 5.4). I included these interaction constructs in the cultural model, and conducted PLS analysis.
Table 5.10 displays $R^2$ for the three endogenous telemedicine outcome constructs. The exogenous factors explain 38.3% of the variation in telemedicine capabilities, compared to an average of 43.7% for the overall model; 32.3% of telemedicine social outcomes, compared to an average of 35.3% for the overall model; and 22.3% of telemedicine value outcomes, compared to an average of 22.2% for the overall model. These figures drop, as I explained, because of the absence of the national infrastructure.
factors and the present of the three interaction constructs. Both $R^2$ values are statistically significant ($p < 0.001$). Table 5.10 displays the coefficients for all hypothesized paths in the model and displays $R^2$ for each endogenous constructs.

**Table 5.10:** Path Coefficients and $R^2$ for the Cultural Model

<table>
<thead>
<tr>
<th>Predictor Constructs</th>
<th>Predicted Constructs</th>
<th>Hyp.</th>
<th>Path</th>
<th>t</th>
<th>P (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>Telemedicine Value</td>
<td>H1b</td>
<td>***0.352</td>
<td>3.460</td>
<td>0.001</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>Telemedicine Value</td>
<td>H2b</td>
<td>**0.215</td>
<td>2.606</td>
<td>0.010</td>
</tr>
<tr>
<td>Power Distance</td>
<td>Telemedicine Capabilities</td>
<td>H3b</td>
<td>***0.419</td>
<td>3.977</td>
<td>0.000</td>
</tr>
<tr>
<td>IE x PD</td>
<td>Telemedicine Capabilities</td>
<td>H10a</td>
<td>*0.253</td>
<td>2.304</td>
<td>0.022</td>
</tr>
<tr>
<td>DMF x PD</td>
<td>Telemedicine Capabilities</td>
<td>H10b</td>
<td>*0.286</td>
<td>2.204</td>
<td>0.029</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>Telemedicine Capabilities</td>
<td>H10c</td>
<td>*0.172</td>
<td>2.389</td>
<td>0.018</td>
</tr>
<tr>
<td>IE x UA</td>
<td>Telemedicine Capabilities</td>
<td>H11a</td>
<td>0.065</td>
<td>0.713</td>
<td>0.477</td>
</tr>
<tr>
<td>DMF x UA</td>
<td>Telemedicine Capabilities</td>
<td>H11b</td>
<td>0.031</td>
<td>0.103</td>
<td>0.918</td>
</tr>
<tr>
<td>Technology Culturation</td>
<td>Telemedicine Capabilities</td>
<td>H11c</td>
<td>0.041</td>
<td>0.222</td>
<td>0.824</td>
</tr>
<tr>
<td>IE x CU</td>
<td>Telemedicine Capabilities</td>
<td>H12a</td>
<td>0.132</td>
<td>1.555</td>
<td>0.122</td>
</tr>
<tr>
<td>DMF x CU</td>
<td>Telemedicine Capabilities</td>
<td>H12b</td>
<td>-0.056</td>
<td>1.410</td>
<td>0.160</td>
</tr>
<tr>
<td>Implementation Effectiveness</td>
<td>Telemedicine Capabilities</td>
<td>H12c</td>
<td>-0.088</td>
<td>1.513</td>
<td>0.132</td>
</tr>
<tr>
<td>Decision Making Factors</td>
<td>Telemedicine Capabilities</td>
<td>H13</td>
<td>**0.315</td>
<td>2.739</td>
<td>0.007</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Predicted Constructs</th>
<th>R^2</th>
<th>F</th>
<th>P (F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemedicine Capabilities</td>
<td>0.383</td>
<td>48.834</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Social</td>
<td>0.323</td>
<td>29.543</td>
<td>0.000</td>
</tr>
<tr>
<td>Telemedicine Value</td>
<td>0.223</td>
<td>27.409</td>
<td>0.000</td>
</tr>
</tbody>
</table>

* $P<0.050$; ** $P<0.010$; *** $P<0.001$
Figure 5.5: Modified Cultural Model with Significant and Insignificant Paths
5.6.4 Resulting Hypotheses

This section presents the result of testing my hypotheses, as outlined in the previous section. As I have discussed, my criteria for “supported” is strictly path coefficients $\geq \pm 0.20$ and $P(t) \leq 0.05$. Based on my overall test results from the infrastructure and cultural models, Table 5.11 highlights which hypotheses are significant. In the results section, “not supported” means p-values $> 0.05$, no matter what the value of the path coefficients, or positive results when I hypothesize a negative effect (or vice-versa); “strongly supported” means path coefficient $> 0.3$; “supported” means path coefficient $> 0.2$; “weak support” means path coefficient $> 0.1$.

<table>
<thead>
<tr>
<th>$H_n$</th>
<th>Specific Hypotheses</th>
<th>Independent Variables</th>
<th>Dependent Variables</th>
<th>$O$</th>
<th>$I$</th>
<th>$C$</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_{1a}$</td>
<td>Telemedicine capabilities are positively related to value outcomes of telemedicine.</td>
<td>Telemedicine Capabilities</td>
<td>Value Outcomes</td>
<td>$+$</td>
<td>$+$</td>
<td>$+$</td>
<td>Strongly Supported</td>
</tr>
<tr>
<td>$H_{1b}$</td>
<td>Telemedicine capabilities are positively related to social outcomes of telemedicine.</td>
<td>Telemedicine Capabilities</td>
<td>Social Outcomes</td>
<td>$+$</td>
<td>$+$</td>
<td>$+$</td>
<td>Supported</td>
</tr>
<tr>
<td>$H_{2a}$</td>
<td>Social outcomes of telemedicine are positively related to value outcomes of telemedicine</td>
<td>Social Outcomes</td>
<td>Value Outcomes</td>
<td>$+$</td>
<td>$+$</td>
<td>$+$</td>
<td>Strongly Supported</td>
</tr>
<tr>
<td>$H_{2b}$</td>
<td>Policies that favor the development of ICTs in general (not necessarily with a specific focus on healthcare) are positively related to telemedicine capabilities.</td>
<td>General Policies</td>
<td>ICT Capabilities</td>
<td>$+$</td>
<td>$+$</td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>$H_{3a}$</td>
<td>Policies that favor the development of ICTs in general (not necessarily with a specific focus on healthcare) are positively related to the level of ICT infrastructure.</td>
<td>General Policies</td>
<td>ICT Infrastructure</td>
<td>$X$</td>
<td>$X$</td>
<td></td>
<td>Not Supported</td>
</tr>
<tr>
<td>$H_{3b}$</td>
<td>Policies specifically tailored to promote the application of ICTs in healthcare (as opposed to general ICT policies) are positively related to telemedicine capabilities.</td>
<td>e-Health Policies</td>
<td>Telemedicine Capabilities</td>
<td>$X$</td>
<td>$+$</td>
<td></td>
<td>Inconclusive</td>
</tr>
<tr>
<td>(H_n)</td>
<td>Specific Hypotheses</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>O</td>
<td>I</td>
<td>C</td>
<td>Result</td>
</tr>
<tr>
<td>-------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-------------------------</td>
</tr>
<tr>
<td>(H_{6b})</td>
<td>Policies specifically tailored to promote the applications of ICTs in healthcare (as opposed to general ICT policies) are positively related to the level of ICT infrastructure.</td>
<td>e-Health Policies</td>
<td>ICT Infrastructure</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Strongly Supported</td>
</tr>
<tr>
<td>(H_{6a})</td>
<td>Policies specifically tailored to ensure data security and standards are positively related to telemedicine capabilities.</td>
<td>Data security and Standards</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>(H_{6b})</td>
<td>Policies specifically tailored to ensure data security and standards are positively related to the level of ICT infrastructure.</td>
<td>Data security and Standards</td>
<td>ICT Infrastructure</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>(H_7)</td>
<td>More reliable and readily accessible ICT infrastructure is positively related to telemedicine capabilities.</td>
<td>ICT Infrastructure</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>(H_8)</td>
<td>Greater readiness for telemedicine is positively related to telemedicine capabilities.</td>
<td>Telemedicine Readiness</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>(H_{9a})</td>
<td>The quality of healthcare infrastructure is positively related to telemedicine capabilities.</td>
<td>Health Infrastructure</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Supported</td>
</tr>
<tr>
<td>(H_{9b})</td>
<td>The quality of healthcare infrastructure is positively related to social outcomes of telemedicine.</td>
<td>Health Infrastructure</td>
<td>Social Outcomes</td>
<td>X</td>
<td>X</td>
<td></td>
<td>Not Supported (Indirect Relation)</td>
</tr>
<tr>
<td>(H_{10a})</td>
<td>Power distance between senior healthcare practitioners and subordinates is negatively related to telemedicine capabilities.</td>
<td>Power Distance</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>+</td>
<td></td>
<td>Not Supported (Positive effect)</td>
</tr>
<tr>
<td>(H_{10b})</td>
<td>Power distance between senior healthcare practitioners and subordinates dampens the positive relation of implementation effectiveness, thus reducing the capabilities of telemedicine.</td>
<td>Interaction between Implementation Effectiveness and Power Distance</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td></td>
<td></td>
<td>Not Supported (Positive effect)</td>
</tr>
<tr>
<td>(H_{10c})</td>
<td>Power distance between senior healthcare practitioners and subordinates dampens the positive relation of rational decision-making, thus reducing the capabilities of telemedicine.</td>
<td>Interaction between Decision Making and Power Distance</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td></td>
<td></td>
<td>Not Supported (Positive effect)</td>
</tr>
<tr>
<td>$H_n$</td>
<td>Specific Hypotheses</td>
<td>Independent Variables</td>
<td>Dependent Variables</td>
<td>O</td>
<td>I</td>
<td>C</td>
<td>Result</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>---------------------</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>--------</td>
</tr>
<tr>
<td>$H_{11a}$</td>
<td>Avoidance of uncertainty in telemedicine decisions is negatively related to telemedicine capabilities.</td>
<td>Uncertainty Avoidance</td>
<td>Telemedicine Capabilities</td>
<td>X</td>
<td>X</td>
<td>Not Supported</td>
<td></td>
</tr>
<tr>
<td>$H_{11b}$</td>
<td>Uncertainty avoidance in telemedicine decisions dampens the positive relation of implementation effectiveness, thus reducing the capabilities of telemedicine.</td>
<td>Interaction between Implementation Effectiveness and Uncertainty Avoidance</td>
<td>Telemedicine Capabilities</td>
<td>X</td>
<td>Not Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{11c}$</td>
<td>Uncertainty avoidance in telemedicine decisions dampens the positive relation of rational decision-making, thus reducing the capabilities of telemedicine.</td>
<td>Interaction between Decision Making and Uncertainty Avoidance</td>
<td>Telemedicine Capabilities</td>
<td>X</td>
<td>Not Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{12a}$</td>
<td>Exposure to technologically advanced cultures is positively related to telemedicine capabilities.</td>
<td>Technology Culturation</td>
<td>Telemedicine Capabilities</td>
<td>X</td>
<td>X</td>
<td>Not Supported</td>
<td></td>
</tr>
<tr>
<td>$H_{12b}$</td>
<td>Exposure to technologically advanced cultures enhances the positive relation of implementation effectiveness, thus further increasing the capabilities of telemedicine.</td>
<td>Interaction between Implementation Effectiveness and Technology Culturation</td>
<td>Telemedicine Capabilities</td>
<td>X</td>
<td>Not Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{12c}$</td>
<td>Exposure to technologically advanced cultures enhances the positive relation of rational decision-making, thus further increasing the capabilities of telemedicine.</td>
<td>Interaction between Decision Making and Technology Culturation</td>
<td>Telemedicine Capabilities</td>
<td>X</td>
<td>Not Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{13}$</td>
<td>Implementation effectiveness is positively related to telemedicine capabilities.</td>
<td>Implementation Effectiveness</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>Strongly Supported</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_{14}$</td>
<td>Rational decision-making factors are positively related to telemedicine capabilities.</td>
<td>Decision Making Factors</td>
<td>Telemedicine Capabilities</td>
<td>+</td>
<td>Strongly Supported</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$H =$ Hypotheses; $O =$ Overall Model; $I =$ Infrastructural Model; $C =$ Cultural model; $X =$ Insignificant Result, $p > 0.05$; $+$ = Significant Positive Result
5.7 Validation of the Main Study

I followed (Starub et al., 2004) for evaluating the quality of my research, and the validity of reflected physicians’ perceptions of telemedicine transfer in SSA. Below, I summarize the four steps (pilot study, statistical power, reliability, and internal and external validity), which I followed to validate my research.

5.7.1 Pilot Study

I solicited comments from experts and respondents about how to improve the survey, and with their feedback, I modified the main study questionnaires and the format of the survey to ensure a reliable instrument for the main study. In addition, I conducted some analysis to understand the data, and tested for common statistics and the estimation of the measurement model in terms of reliability and validity (see chapter 4 for details).

5.7.2 Statistical Power

The power of a statistical test is “the probability that the researcher will find a statistically significant relationship, when the relationship is actually there. The power of a statistical test is reduced by (among other things) small sample size, a weak underlying relationship, or measures that are clouded by error (low reliability) (Goodhue et al., 2006; Marcoulides and Saunders, 2006). Generally statistical power is the ability to detect and reject a poor model (Chin, 1998b). As Kaplan (1995) states, “…assessing statistical power must now become a routine part of establishing the statistical validity of an estimate model…” (Kaplan, 1995, p. 117) (cited in (Chin, 1998b)). Statistical power is less carefully attended in IS published research (Baroudi and Orlikowski, 1989). However, I followed the standard guidelines (Chin, 2000) with ten subjects per item for the endogenous construct with the most predictors (that is ICT infrastructure with 11 items; before and after refining the items utilizing a minimum sample of $11 \times 10 = 110$ and $7 \times 10 = 70$, respectively). Thus, with 194 cases I believe that I applied an appropriate sample size for the test of my constructs. Chin (1998, p. 311) observes that, “if one were
to use a regression heuristic of 10 cases per indicator, the sample size requirement would be 10 times (1) the largest number of indicators or (2) the largest number of independent variables impacting a dependent variable, whichever is the greater.” It is important to note that “under this circumstance it may be possible to obtain stable estimates”.

5.7.3 Reliability

I applied existing methodologies following rigorous guidelines in (Gefen et al., 2000; Hair et al., 2003; March and Smith, 1995; Straub et al., 2004) that refer to data collection and evaluating and interpreting the research results. I followed Dillman’s (2000) rigorous guidelines to collect the empirical data. In order to explain the factors influencing the transfer of telemedicine, PLS version 3.0 is considered a suitable statistical technique to test theories and examine model fit. I assessed instrument or construct validity that involves content or face validity, where the measure reflects the content of the concept in question, by having outside experts review the questionnaires; I prepared a high-level questionnaire to elicit comments from key informants, and a pilot study with feedback from respondents. I tested the Discriminant validity (the extent to which the construct correlates with other measures) and confirmed by the square root of the Average Variance Extract (AVE) being greater than their respective correlations with other constructs in the model (Section 5.5.4). Convergent validity (the extent to which a construct is positively correlated with other measures of the same construct), was analyzed by confirmatory factor analysis and cross-loading items (Section 5.5.1 and 5.5.2).

5.7.4 Internal and External Validity

Internal validity involves the relationship between a hypothesized variable and the degree which the finding reflected in reality. The tests of relationship between dependent and independent variables in the study were built on internal validity, presented as face validity, construct validity, instrument reliability and statistical test validity. I believe that most threats to internal validity of my study have been considered.
**External validity** relates to the generalizability of the study’s findings. The sampling was most representative of the target population, and the research findings represent actual values from the target population. However, the conclusions from the study are not directly applicable beyond the target region, SSA, the focus of the theory and the subject of the study.
Chapter 6: Discussion and Conclusion

The main objective of the research has been to examine potential factors that impact transfer of telemedicine technology into sub-Saharan African (SSA) countries. The study hypothesized national ICT infrastructure and cultural factors, and I also examined technical and non-technical telemedicine transfer factors that influence telemedicine (social and value) outcomes through theoretical models. Further, in subsection 5.6.4, I specified the analysis used to test the hypotheses and reported the results of those tests. In this final chapter, I discuss the findings and their implications, followed by interpretation of the results and limitations of this study. Then, I highlight specific research contributions of the study and give recommendations for future research.

6.1 Discussion of Results

This study is a first-of-its-kind in the area of telemedicine transfer within the context of the SSA region. I attempted to combine a large and diverse literature from various streams such as policy, infrastructure and culture as they relate to the information system and telemedicine related literature. Hence, the study emerged with a unified model of telemedicine transfer outcomes in healthcare in general, and specifically the transfer of visually-based clinical applications of telemedicine in SSA, in particular. In summary, this study attempted to address two research questions:

1. What aspects of the national infrastructure influence the transfer of telemedicine outcomes in the SSA?
2. What cultural and implementation factors influence the transfer of telemedicine outcomes in the SSA?

In order to address these research questions, I reviewed the relevant literature (see Chapter 2), and derived a conceptual model and formulated of a series of hypotheses to test the research model (see Chapter 3). Further, I empirically tested the model (see Chapters 4 and 5). In the following section, I interpret the results of the hypothesis testing and draw conclusions.
6.1.1 Impacts of Telemedicine Capabilities on Telemedicine Transfer Outcomes

6.1.1.1 Telemedicine capabilities were positively related to telemedicine value outcomes.

This study provides strong evidence that physicians perceive that image-dependent clinical specialties and the use of store-and-forward technology would increase the telemedicine value outcomes. It is obvious that any decision to introduce telemedicine must ensure that the opportunity costs are less than the benefits accrued from allocated resources. In most cases, the cost effectiveness of telemedicine systems is meager, because telemedicine activity in the SSA region so far has been in the form of pilot projects with subsidized funding from international organizations. However, the results of these pilot projects could be useful for developing countries to evaluate the costs and benefits of telemedicine. They also indicate that visually-based clinical applications are cost effective to improve equity of access to healthcare, and the efficiency by which it is delivered.

It has been suggested that societal costs and efficiencies in use of limited healthcare resources related to technology will define the dimensions of resource allocation decisions. This seems to be particularly true in the SSA context, as countries within the region continue to spend smaller percentages of their gross domestic product on healthcare, compared to other regions of the world. One explanation for this is that the SSA countries tend to have many unforeseen priorities to spend such as natural disasters and civil wars that keep distracting policy makers’ focus on healthcare. This continues to hinder SSA countries from economic benefits accrued through telemedicine, such as patients not having to travel, lies in time saving, fewer unnecessary referrals and improved follow-up care of patients.

The findings indicate that visually-based clinical service using store-and-forward communication infrastructure is promising for financial benefits and reducing costs of healthcare services. Moreover, improvements and reducing costs in ICT and Internet, as well as the development of standards for data acquisition, storage, and transmission during image-based telemedicine consultation, suggest a potential in clinical improvement and quality of clinical services in the SSA region. Thus, it would seem
natural that focusing on simple and economically affordable alternatives to current systems, such as store-and-forward telemedicine using low-cost digital images, holds promise of becoming a reliable and cost-effective means of delivery of specialty consultation from international or urban areas, where there is a relative surplus of specialists, to rural areas where there is acute shortage. Findings from this study indicate that the cost-effective use of telemedicine is possible in the SSA region through recent advances in telemedicine. In particular, the availability of Internet and mobile technology has dramatically increased in the region. Thus according to physicians surveyed, improved accuracy of telemedicine images for visually-based clinical applications, and lower costs of transmission, create the possibility of widespread use of the technology in the region. Additionally, telemedicine increases the pool of possible providers such as nurses and physician assistants, supporting the ability to supply more care while assuring quality through supervision in cost-effective ways. It also allows specialists outside the SSA geographic area to use resources in situations where telemedicine is the only way practical.

6.1.1.2 Telemedicine capabilities are positively related to telemedicine social outcomes.

Academic and practitioner literature show that the geographical separation between healthcare providers and patients is the main reason for the development of telemedicine (Bashshur et al., 2005; Roine et al., 2001; Wootton et al., 2004). There is evidence in the SSA region that major contributions of telemedicine include increasing access to medical care, reducing unnecessary referrals, decreasing the isolation of physicians, following a continuing education course, or accessing medical information from digital libraries. This is particularly significant in countries where healthcare staff and specialists are few, and where distance and quality of infrastructure hinder services. My findings are also consistent with prior research stating that geographic barriers, or inadequate healthcare as a primary factor limiting access to care, may be overcome by telemedicine (Brauchli et al., 2004; Swinfen, R. and Swinfen P., 2002). This implies that telemedicine can help healthcare providers in many ways that might improve governments’ ability to manage and transform scarce resources to meet healthcare needs. It also addresses
issues related to providing healthcare services in remote, rural areas motivated by increasing access and quality, although shortages of basic healthcare services, and inadequate health and transportation infrastructure in the region, underscore the need for alternative services as medical woes of SSA countries.

I can understand the concerns of healthcare service providers using telemedicine in the light of available health funds and the small percentages of SSA citizens’ capacity to purchase healthcare insurance, as well as problems such as access to Internet or inability to interface telemedicine with mainstream healthcare provision in many SSA countries. However, in view of the SSA region’s massive and diverse healthcare requirements, telemedicine holds a distinct promise of providing complementary support to conventional (face-to-face) methodologies of healthcare. Thus it makes sense that telemedicine is seen in terms of addressing citizens’ right to health services. In light of this possibility, I can better understand my supporting results that experts believe that visually-based telemedicine would primarily address issues related to 60% of SSA rural communities, including fewer resources and socially excluded groups.

6.1.2 Impacts of Telemedicine Social Outcomes on Telemedicine Value Outcomes

6.1.2.1 Telemedicine social outcomes are positively related to telemedicine value outcomes.

Telemedicine social outcomes are the most significant impact influencing telemedicine value outcomes, which is in agreement with the objective of telemedicine and the motivation to implement telemedicine technology since the 1970s: for telemedicine to be adopted, decision makers must prove that this technology serves the needs of modern healthcare services related to equity of access, quality of care, human resource distribution, and cost control (Hailey et al., 2002; Heinzelmann et al., 2005; Jennett et al., 2003a). My findings confirm that telemedicine systems could facilitate the distance separation of patients from the healthcare delivery system, and reduce delays in providing healthcare service to patients in cost effective ways. Furthermore, the potential of telemedicine systems to enhance access to specialists for underserved citizens will facilitate improvement in the quality of treatment. However, the importance of cost
benefits of telemedicine systems is the strongest driving force for telemedicine transfer in the SSA region, due to the challenge facing healthcare services, where greater efficiency in performing health services can moderate the conflict between access to healthcare services and the demands of society. In this light, telemedicine should focus on poor coverage of specialty services in the region, stimulating telemedicine systems that match the general demands of healthcare services. My findings also show that as the cost and complexity of health services increase, providers look for cost effective means of patient care. Thus, telemedicine has the potential to help both patients and providers narrow geographic and socioeconomic barriers. However, it should be observed that while telemedicine is not a total solution, it has the potential to reduce costs and increase access to healthcare services that will promote healthcare improvement in SSA.

The study further indicates that without telemedicine, healthcare staff practicing in remote rural areas face potential isolation. It makes sense that telemedicine has a capability for teleeducation (distance education for healthcare workers using information technologies), such as learning from specialist consultants, through experiences addressing the conditions presented in particular cases, reducing professional isolation by allowing physician to physician consultation, and using stored data as a learning tool. This implies that physicians also believe that their ability to satisfactorily perform their tasks very much depends on the availability of adequate resources.

6.1.3 Impacts of Policies on Telemedicine Transfer Outcomes

6.1.3.1 General ICT policies are positively related to telemedicine capabilities.

The literature generally states that ICT policies regulate demand and supply of ICTs, as well as sectoral ICT diffusion such as e-health, e-education and e-government (Kraemer et al., 2002; Raman and Yap, 1996; Wolcott et al., 2001). My findings confirm that general ICT policies have significant influence on telemedicine capabilities. This implies that public policy, including administrative reforms such as e-government and demographic factors such as health status indicators (high infant mortality, low life expectancy and epidemiology dominated by infectious disease) are more important in the adoption of re-distributive polices that influence decision making in various public domains (McNeal et al., 2003), whereas economic development policy is more important.
for development policies (Mooney, 2001). Thus, considering socioeconomic and demographic situations in ICT policies potentially influences changing the healthcare system for the better, as the following respondent comments suggest:

“ICT Policies and government involvement in the diffusion of Internet and telemedicine play an important role.”

“Modern medicine is at its infancy. A lot of lobbying at policymakers’ level and a lot of awareness creation efforts should be applied at the professional level – this is also important because the infrastructure (education) cannot be built in the traditional way overnight.”

The respondents also believe that in most SSA countries the ICT infrastructure is controlled by governments and upheld through policies that influence the acquisition and use of ICT technologies, such as support of ICT infrastructure in rural areas. Therefore, government attitudes may potentially influence the transfer of telemedicine. Furthermore, my findings suggest that African governments value ICTs largely for their social benefits, such as education (Mbarika, 2004) and health (Kifle et al., 2006a) and not merely for technology or the economic impact of the ICT technology. However, in most SSA countries, the formulation and implementation of policies in ICT sectors is still underdeveloped and sometimes non-existent.

“Policies contribute to hindering ICT since most SSA countries lack basic infrastructure...”

“The public sector should set aside funding to promote and implement ICT for health. This should be given high priority, including application to telemedicine.”

### 6.1.3.2 e-Health policies are not significantly related to telemedicine capabilities

My findings indicate that e-health policies are related to telemedicine capabilities in the infrastructure model, but not in the overall model. A possible explanation of the infrastructure model result differing from the overall model could be
that cultural effects were included in the overall model. Based on these findings, it might be argued that the nature of e-health policies is affected not only by national (domestic) environments, but must also take into account international acceptable standards. It makes sense that it is necessary to integrate globally acceptable policy principles at the national level of decision-making. Moreover, another explanation is that the different levels of telemedicine in other regions includes jurisdiction, demographic, economic, social and cultural factors.

On the other hand, it can be observed that e-health policy needs to be an extension or part of the larger domain of the health service delivery system, and e-health policy must also be integrated into existing general health policies (Scotte, 2003) to be effective and functional in the case of SSA. This makes sense, considering that even if telemedicine were sustainable, it requires a special budget. Hence, telemedicine can benefit form the large domain of health service budgets, as well as ensuring integration into the mainstream of the healthcare system. Moreover, the integration of e-health policy into existing health policies is also important for decision makers seeking funding and/or technical assistance. This is especially true when one considers the small percentages of health budget/expenditures and the diverse types of healthcare problems, including HIV/AIDS and malaria.

“If telemedicine is concerned as part of healthcare services, quality, economic, and legal conditions must be considered.”

“Telemedicine is important, and it needs a budget for ICT related equipment, software and personnel.”

“E-health policy issues of telemedicine should be developed at the SSA regional level.”

Furthermore, because most SSA countries lack strategies that facilitate the harnessing of new ICTs for healthcare development, those countries that have formulated policies lack proper implementation plans and review strategies (Filip, 2004). The disadvantage with this situation is that very few SSA countries are able to have proper
implementation plans and review strategies. Consequently, this has an effect on telemedicine transfer in SSA. This is very crucial in the case of SSA countries, due to existing facts such as very limited IT diffusion experience and human resources. This implies that policies and implementation strategies are important in facilitating the acquisition and use of ICT in the healthcare sector.

6.1.3.3 Data security policies are positively related to telemedicine capabilities.

This study founds that data security policies are a significant positive influence on telemedicine capabilities. It is understandable that issues like privacy, confidentiality, availability and standards have emerged as significant factors with a great impact upon transferring and integrating telemedicine services into the traditional health system. This shows that telemedicine technologies begin working with more than one healthcare organization (not at one university hospital or pilot level), since security and standards become a major risk issue.

“I am concerned about information availability through appropriate access as well as confidentiality ...”

“The complexity of this issue impacts not only on data privacy, security and protection, but also derivative uses of the data. A clear delineation is needed in such settings to give patients reassurance that healthcare information will not be used to adversely influence workplace decisions on hiring, promotion, projects.”

This means that it is necessary for any telemedicine transaction (data, image, text) to have procedures established for security and standards when a telemedicine program gets into routine delivery of health care services. Therefore, data security policies which should be addressed are those identified by the research community as pertinent issues for telemedicine transfer, such as privacy, confidentiality, availability, licensure, technology (exchange format) and semantic (terminology and concepts) standards and liability at both national and international levels.

“Information system staff have to be equally responsible and aware of the ethics of medicine, not only the operation of the computer system...”
“I think the principal issues that remain unresolved for the telemedicine implementation are not related to technology, but rather, to societal issues -- perception, privacy rights and property issues around health care data.”

Furthermore, prior research shows that standardization of telemedicine is very important, and consequently increases the quality of transmitted data (image, data and text), and also reduces the total costs of transmission. Poor quality transmitted images in telemedicine may cause incorrect interpretations and misdiagnoses (Degoulet and Fieschi, 1999). In addition, to address most stakeholders’ (providers, physicians, patients) concerns, and also to overcome shortcomings of quality and costs of healthcare service, research communities in industrial countries have adopted medical specific standards that are universally accepted, such as Health Level Seven (HL7) and Digital Imaging and Communication in Medicine (DICOM). However, it is interesting to note that the adoption of these medical standards is strongly dependent on the availability of technology infrastructure and policies of each country. Moreover, the physicians were aware of limitations such as the fact that systems under development are mostly developed without application of national or international standards. This renders difficult the interoperability of different systems and infrastructure. Therefore, for telemedicine to be transferred, security and standards are a major part of SSA physicians’ concern. Even though the importance and necessity of these standards have been well received by the physicians, there is concern about their full implementation within the existing ICT infrastructure.

“The technical standards must be realistic in terms of the application environments...they have to be simple”

“Technology standardization and simplification is important for implementation of telemedicine in developing countries”
6.1.4 Impacts of Policies on ICT infrastructure

6.1.4.1 General ICT polices are not significantly related to ICT Infrastructure.

Various studies indicate the influences of policies on development of ICT infrastructures (Chechi et al., 2002; Kamel, 1995; Mbarika et al., 2005; Musa et al., 2005a; Musa, 2006). However my findings do not correspond to these studies and the general notion that ICT policies influence ICT infrastructure. Most of these previous studies, however, were performed in the context of other sectors or developed countries. In the SSA context, my findings are similar to those of Okoli (2003), that there is no general influence of ICT policies on ICT infrastructure. I think this indicator does not seem to hold in the SSA region. One reason could be the role of the governments and attitudes towards ICT policies. I might also argue that general ICT polices exist in almost all SSA countries, as a token gesture to show that the government is “doing something” about ICTs, but there is little or no genuine interest in implementing them. Hence, general ICT policy without detailed commitments as to how this policy can be translated into concrete programs and initiatives for implementation at the local level cannot in itself support development of ICTs. This observation emphasizes the important role played by governments regarding focusing upon on a particular sector target, and providing a framework towards implementation on a micro-scale.

“Policies are a means of getting funds but they are not seriously implemented on the ground or followed by implementation plans, despite the fact that this should be the first step.”

“In general governments have to emphasize ICT policies in practice, not only to have them on paper...”

“For a policy to be practically implemented requires promotion of education and training and the condition of more pilot study...”

Theses comments further suggest that the relation between establishing general ICT polices and implementation is not clear. Reasons include a lack of follow-up,
lack of government full commitment, limited resources and low priority. For example, despite advocating telecommunication privatization, the implementation of these policies is low in some SSA countries. Because of this factor, the presentation or non-existence of general ICT polices has little influence on ICT infrastructure. Essentially, in some cases policies are bottlenecks for implementation of ICT-related projects.

Another interpretation of this finding is based on prevailing infrastructure in SSA. The physicians believe that in the SSA region, except for a few institutions and pilot projects, healthcare organizations and physicians are totally unprepared to use the computerized systems within their institution, let alone to use telemedicine operating in a network environment. Also, most of them are concerned with privacy, confidentiality, and security and policy issues related to who owns and who has access to use the data within the healthcare system. This is especially true when policy and the use of technology might interfere with their traditional practice routines.

6.1.4.2 e-Health and data security policies are positively related to ICT Infrastructure.

The other area that I looked into in this research is the relationship between e-health and data security policies and ICT infrastructure. My results are consistent with previous studies, that e-health and data security have an impact on ICT infrastructure (Perednia et al., 1998; Puskin and Sanders, 1995; Sandberg, 1995; Wild and McCube, 1996). The respondents believe that perhaps when a government goes beyond just health policy to e-health policy, this indicates its serious dedication to the value of ICT infrastructure for social benefits. Also, it is common for ICT infrastructures to be established without adequate attention to security. However, security does not necessarily stop the establishment of the infrastructure, but it is important for the availability and confidentiality of medical data in telemedicine systems.

It is very significant that physicians distinguished between general ICT polices and focused on a particular sector’s target policies which, approaching implementation on a micro-scale, influence ICT infrastructure. It seems that general ICT policies have little influence on the actually incidence of ICT infrastructure; a possible reason for this might be a lack of connection between policy enactment and follow-
through. However, it is very interesting that physicians believe that when the government has a genuine desire to use ICTs for development, such as e-health, e-education or e-commerce, they become more specific and policies significantly influence the state of ICTs and telemedicine outcomes. In this case, e-health and data security polices show serious thinking on the part of policy makers, who are trying to solve real problems and develop new services. This helps to equitably coordinate sectoral ICT activities and ICT infrastructure development.

6.1.5 Impact of ICT Infrastructure on Telemedicine Transfer Outcomes

6.1.5.1 ICT Infrastructure is positively related to telemedicine capabilities.

That ICT infrastructure influences telemedicine capabilities has been consistently documented by prior research (Adam, 1996; Datta and Mbarika, 2004; Meso and Duncan, 2000; Puskin and Sanders, 1995). This indicates that lowering technology barriers, such as reliable telephone and electric service, and technical knowledge to maintain communication systems, is critical to telemedicine transfer. This is particularly important in this study, because telemedicine can be used to deliver healthcare to rural poor areas in SSA countries. A number of studies have shown differences between developed and developing countries, as well as a technology gap between urban and rural area within SSA countries themselves. Although it may seem obvious, however, my results also reveal that telephone networks and computers are scarce in the region. This is quite crucial when one considers transferring telemedicine to SSA, where there exists inadequate IT infrastructure (telephone, electricity, computer), let alone access to the Internet; in most case hospitals do not have a telephone line to improve on the current practices.

“We need capacity building in all spheres – infrastructure, human resources, and content development. “

“Internet service in our country is very poor; therefore, before using telemedicine, we should have to improve it at least.”
Most respondents believe that unless basic infrastructure services such as power (electricity) access and costs have been addressed, the future of telemedicine in SSA will still hang in the balance. Furthermore, most physicians believe that the digital divide between urban and rural areas is a major factor influencing the transfer of telemedicine in SSA. For example, Internet connectivity is often seen as a status symbol, mostly limited to urban centers. In addition, the cost of Internet remains a strong deterrent in many SSA countries. This problem is further compounded by the fact that the government is the sole Internet Service Provider (ISP) in some SSA countries. As a result, the government is responsible for fixing prices and controlling resources to acquire ICT infrastructure.

“Shortage of computers, Internet and manpower, make it difficult to use telemedicine technology in SSA countries.”

“Improving health care for patients through the use of telemedicine technology requires willingness of governments to invest in ICT in the healthcare information infrastructure.”

This result advises us that a simple and economically affordable low-cost telemedicine system is an important factor for successful telemedicine transfer outcomes. A possible reason for this explanation is that in rural areas of many SSA countries, telephone networks, bandwidth and computers are scarce, in addition to low income levels and other conditions. This indicates how these various factors can affect the way healthcare is delivered in the region. My study also establishes that infrastructural capabilities provide useful guidance to enhance telemedicine capabilities.

“Because of the availability and investment expense of infrastructure, SSA countries should use “store-and-forward” and “visually-based applications” as a cost effective and simple technology to apply telemedicine services”

“ICT infrastructure can be shared between different sectors like education and agriculture.”
6.1.6 Impacts of Health Environment on Telemedicine Transfer Outcomes

6.1.6.1 Telemedicine Readiness is related to telemedicine capabilities.

The results also indicate that telemedicine readiness influences telemedicine transfer outcomes I examined in the research model, confirming that dissatisfaction with existing conditions, such as the economic need to contain the seemingly uncontrollable growth of healthcare expenditures, the need for better resource allocation, and the rising awareness of and need for "quality" healthcare, potentially encourage the adoption of telemedicine (Brady, 2005; Doolittle and Cook, 1999; Hu et al., 2000). The study provides substantial evidence that limited access or no alternatives to healthcare in the SSA region are seen as fundamental conditions under which telemedicine services should be considered. This is particularly important in SSA, where more than 60% of the region is unable to provide the populace with basic healthcare services.

“Readiness of healthcare organizations to adopt telemedicine technology with proper motives and due consideration its advantages”

“I believe most physicians and patients do not yet recognize the benefits that will allow for the use of telemedicine technology; therefore, creating awareness among physicians and the general public is important.”

“Many physicians are simply adopting a wait and see attitude before taking even the smallest steps, despite the carefully documented benefits that may accrue from the quality of care and productivity when using telemedicine”

In particular cases, respondents feel that physicians’ dissatisfaction with the existing setup, and willingness to devote extra time to learning telemedicine as a solution to their problems, would help telemedicine transfer. One possible explanation is a lack of support from specialists in the area; telemedicine would potentially force this problem to be dealt with. Another explanation is the role of champions who especially understand the potential value of telemedicine, and are able to increase the level of readiness of the stakeholders to consider adopting telemedicine. The lack of healthcare workers, and the impact of their migration from developing to developed countries, particularly from those
in the SSA region, are significant components in finding alternative solutions. It is also
difficult to separate these crises from the existing poor education system and scant
availability of medical schools in SSA countries (more than 24% have no medical school,
and 46% have only one); this fact helps us understand the possible benefits of
telemedicine.

“Telemedicine from theory to practice aspect would be a
challenge; therefore, we must have a more practical way to
illustrate the exact problem.”

“Affordability of telemedicine at country, university, and
department levels should also be considered in looking at
means or options to reach the peripheral health institutions
and the external support (aid).”

“There is a growing doubt of institutions, including the
medical profession, therefore awareness and training is
important.”

6.1.6.2 Health Infrastructure is positively related to telemedicine capabilities.

The study indicates the importance of telemedicine in increasing access to
health services, dissemination of health related information, and medical education. This
finding is consistent with a long line of research that shows that healthcare infrastructures
innovate only in response to some perceived performance gap (Bashshur et al., 2002;
Martinez et al., 2004; Moore, 2002). This is not surprising, since the primary aim of
telemedicine system progress is a quest for improvement in the efficiency and cost-
effectiveness of the existing health infrastructure. Such a motivation to improve always
relates to a low level of satisfaction with existing health care. The argument is that the
lower the satisfaction with the existing health care system, the greater the incentive to
change. This is particularly important in this study, because the healthcare infrastructure
of many SSA regions is characterized by shortages of budget, facilities, drugs, and human
resources. Devising efficient methods and realizing the objective of “health for all” are
promising aspects of telemedicine being integrated into healthcare. This implies that
physician providers are aware of the limitations of the existing health infrastructure, and
work under stress in uncertain healthcare systems, characterized by pressures for efficiency and societal health care cost control.

“We also feel that issues related to organization and management of telemedicine should be addressed.”

“Telemedicine programs need to be introduced in the medical curriculum during undergraduate courses.”

“Telemedicine technology is good and there is no problem of having it at the moment even in developing countries, but we should consider other human factors which influence it directly. For example, asking physicians to work in pilot project; how long can they practice it without payment?”

6.1.6.3 Health Infrastructure is not directly related to Telemedicine Social Outcomes.

There is no direct relationship between a low level of healthcare infrastructure and the social outcomes of telemedicine. It seems obvious that telemedicine may be a useful technique for delivering healthcare in the SSA region, and there are instances where the provision of telemedicine services assuredly meets an important social need driven by profit, although existing healthcare facilities and manpower available are far from satisfactory. This study also indicates that telemedicine offers a possible solution to grave medical challenges of the region, primarily influencing telemedicine social outcomes. However, it can be observed that the health infrastructure is not directly related to social outcomes; it may exert only an indirect effect. This is confirmed by supplementary analysis (see Figure 6.1) of data where the path from telemedicine capabilities to social outcomes is removed. Based on this supplementary analysis, hypothesis H9b concerning the relationship between healthcare infrastructure and telemedicine social outcomes is supported with a path of 0.221 (t = 2.236; P (t) = 0.026). One possible reason for the indirect effect may be that health infrastructure is directly related to telemedicine capabilities. I argue that the relationship exists, but that it is indirect, not direct, and the indirect effect may be stronger than the direct effect. Hence, this finding provides partial support for the original hypothesis.
Figure 6.1 Supplementary Analyses

“National priorities with regard to telemedicine, budget allocation for ICTs in general and telemedicine in particular; specially for the majority of rural community is must consider.”

“It is important and good to improve the healthcare ICT standards and to involve or budget for ICT and training because physicians’ basic computer skills are poor.”

“Telemedicine requires long term commitments not only active in the project life time, it is also important to use the experiences of the pilot project for development of healthcare.

Another possible explanation for the relationship between low levels of health care infrastructure and the possibility of adopting telemedicine is the heterogeneous character of healthcare organization. For example, there are many different kinds of clinical specialties in one healthcare organization. Thus, to change over requires an assessment of the impacts of the clinical application to all clinical specialties. This heterogeneity of healthcare institutions further complicates the task of telemedicine outcomes transfer, and this may counterbalance any positive influence in the healthcare system. It also indicates that the full impact of using telemedicine technology to improve healthcare in all clinical applications, without increasing the infrastructure and skill of healthcare staff, would lead them to make negative decisions. Moreover, if telemedicine
is introduced into a healthcare system without proper planning or forethought concerning local interests and overall community needs, there may be negative effects in terms of telemedicine social outcomes.

“The most important factors seem missed--the human resources of diverse expertise required for telemedicine and organizational issues in the health sector.”

“Telemedicine is practically not effectively in use due to our institutional problem such as not paying for additional time spent to use the technology.”

It is generally agreed that pilot project tests of telemedicine applications are easier because they are usually conducted in a specialized clinical application, such as in a teaching university environment. A closer look at these situations reveals that many of them are simply groups of stand-alone systems, with little or no integration to existing main healthcare structure. Therefore, for healthcare providers or managers, the challenge in adopting a telemedicine project is to overhaul the existing one and to build an integrated system. As a result of telemedicine services being insufficiently integrated into the operation of a hospital or delivery of healthcare, it is difficult to determine how they affect the costs and access to service given via telemedicine. This has additional implications for the overall healthcare infrastructure that conforms to standards and supports interoperability of the system. Generally, my findings also show that where there is good health infrastructure, perhaps telemedicine is not valued so much. In addition, when health infrastructure is poor, then telemedicine is unable to stand on its own.

“The private sector is important for the implementation of telemedicine because they provide a good organization and business model.”

“Telemedicine application should not only be introduced in government hospitals but also in private and non-governmental organizations.”
6.1.7 Impacts of Telemedicine Transfer Implementation on Telemedicine Transfer Outcomes

6.1.7.1 Implementation Effectiveness is positively related to telemedicine capabilities.

The study’s findings indicate that increased management support, training, championing and internal knowledge are significant. This finding supports the view that implementing complex technology involves a process of reducing knowledge barriers (Attewell, 1992). The extent to which an organization can lower these knowledge barriers may determine its ability to transfer telemedicine. Among others, two obstacles are identified as most critical. First, the lack of a skilled labor force (Tornatzky and Fleischer 1990) in the market slows the transfer process. Second, telemedicine systems may not be considered in the context of vested interests of existing health care provider organizations (Aas, 2001).

“Training and exposure is important. Most healthcare professionals should have basic skills for computer and Internet use before introducing telemedicine at each institution.”

“Leadership vision is an important factor for validity of introduction of telemedicine.”

“Availability of technological awareness, medical specialists and professionals is a critical success factor for telemedicine.”

The study also found that systems providers should put more emphasis on educating physicians, and provide support to facilitate the migration process. In most cases when technical barriers are being lowered, physicians need to be convinced that the telemedicine application will be easy and will provide accurate diagnosis. This finding also indicates that physicians should be consulted and involved when telemedicine project decisions are made. Moreover, physicians’ involvement in initial project formulation will ensure that their various needs and interests are well addressed and
considered. As Sheng et al. (1999) noted, telemedicine is multidisciplinary; it requires all parts to be involved for the success of its implementation. However, in most SSA region cases, the actual user or physician is not involved in the formulation of the project, and this has a big impact upon the transfer of telemedicine.

“I think it will be important to train physicians before dealing with telemedicine; the benefits and important issues must be addressed correctly.”

“Telemedicine is not well introduced among SSA physicians and it is not easily accessible.”

“The availability of the technology, lack of computer knowledge, the Internet and other infrastructure for telemedicine and the investment costs with traditional medicine are some of the issues highlighted.”

“In SSA where physicians are busy receiving lots of patients on a daily basis, it is difficult to imagine how they could find time to go through all the medical records and other various variables.”

6.1.7.2 Decision-making factors are positively related to telemedicine capabilities.

The study of priority setting exercises for decision making to adopt telemedicine clinical applications is significant. This finding is similar to that of (Tulu, 2005), who found that good decision making factors to adopt a technology include providing a more flexible environment for health providers, offering more choices for health care selection, and providing better utilization of healthcare resources. In this context sub-Saharan African healthcare facilities and investments are extremely low (WHO, 2005). Therefore, it is important to have rational decision-making criteria that will help the region resolve multiple healthcare problems, including deteriorating healthcare facilities and scarce trained healthcare professionals. Hence, investing in ICT for healthcare most likely is not the major priority, unless it is believed that telemedicine will help improve some of the current basic healthcare problems at the national level.
My findings also indicate that it is important to understand the specific application area and purpose based on medical domains, the channel used to deliver telemedicine services, infrastructure needs and requirements for this application, capabilities of the existing organizational and human resources, and the impact of cost, while making decisions about telemedicine applications. This makes sense, considering that the region’s poor healthcare resources and ICT infrastructure might discourage applications such as telediagnosis, and might prohibit online communication between patients and physicians. Therefore it is important to make clinical decisions based on the application domain.

This result also indicates that generally considering priorities for the use of limited resources is as important as for any activity; however, a more explicit process of setting priorities may help decision makers focus limited resources more rationally. It thus emphasizes the relevance to any priority-setting exercise of possible clinical applications of telemedicine, including how common it is, and how likely to be integrated into routine operations. Moreover, physicians believe that these considerations in most cases focus on societal perspectives. However, resource issues in relation to the potential costs and benefits of telemedicine application also affect the capability of telemedicine.

6.1.8 Impacts of Culture on Telemedicine Transfer Outcomes

6.1.8.1 Power Distance as well as interactions between implementation effectiveness and decision-making factors are positively related to telemedicine capabilities.

The study shows that power distance has a significant positive effect on telemedicine capabilities and its interaction with telemedicine transfer implementation. This is surprising since the power distance among SSA countries’ physicians’ are high and decision-making is commonly not a team approach as in most western countries. Generally, higher level power distance influences the relationship between physicians, because subordinates are inclined to take the opinion of their supervisors without contradiction (Hasan and Dista, 1999; Hofstede, 2000).

In most SSA countries healthcare institutions are hierarchical, and physicians in the upper echelon of the hierarchy are respected immensely. A possible
reason for this might correlate with previous research conducted by Hofstede (2000), explaining power distance: “...less powerful members of institutions within the country accept that power is unequally distributed...” This is more likely in SSA countries. For example, individuals’ beliefs and actions are constrained by respect of job seniors, and instead of acting on their own beliefs, they often act on direct orders from superior management. This means that SSA physicians perceive the role of “leader” as a controller rather than a colleague.

In the SSA medical community, general practitioners or junior physicians are dominated by, and highly dependent upon, the senior physicians’ opinion. The leading physicians are expected to be authoritative, and junior physicians are “expected to be told” what to do. In such an environment, it is highly unlikely that junior physicians contradict senior physicians. Junior physicians must “obey without questions,” especially if the hierarchy consists of old males in authority positions. This is deeply rooted in most SSA cultures which place a high value on individual status or a high respect for hierarchy. Therefore, even if telemedicine use were to be mandated, most of the decision-making is dependent on higher rank persons, and has an influence on telemedicine capabilities. However, most senior physicians do not understand what is involved in using this technology; they think and decide without consulting physicians involved in the process of telemedicine, who might become more functional than their own time and technology limitations allow. This explanation is based on prevailing SSA cultures and traditions with societies high power distance and high levels of masculinity tend to be accepting of the “obey without question,” mode of operation. This is in spite of the fact that majority of physicians were young, male professionals working in highly imaged-based clinical specializations where exposure to telemedicine was likely to be greater than in non-image based professions.

“One physician comments that the high official just thinks that telemedicine implementation and commencement is as easy as buying computers and software, install them, and connecting two hospitals.”
Another explanation could be, as is well known in the literature, that the cost of telemedicine technology has fallen, and as most governments and researchers have recognized the potential benefits of telemedicine, particularly in developing countries, improved access to health services is being enjoyed by the majority of SSA rural communities. However, there is a general tendency for telemedicine systems to be driven from central government, rather than by the physicians on the ground. Additionally, with no actual first-hand knowledge, it is often the decision makers who decide on the telemedicine project, rather than actual clinical users of telemedicine. Therefore it is most important for the actual users of telemedicine technology to be involved in all stages of planning and implementing telemedicine systems, to minimize the risk involved in telemedicine capabilities; the system should be user-friendly, the physicians must be well trained to function effectively, and technical support is crucial for telemedicine applications.

“We do not have an IT department in our hospital. We do not know how we can get expert advice to deal with this kind of technology; even if it is easy to use, things can still go wrong...”

“We have consulted physicians abroad, but since our resources and setup are different (poorer) than their facilities, we still encounter problems in implementing their advice.”

The study also provided evidence that implementing telemedicine can be terminated or enforced because of a decision by a top rank person; specifically, in SSA society, top ranking people can either facilitate or impede the success of telemedicine. The senior physicians can force or motivate the junior physicians to use telemedicine; on the other hand, they can have minimum support from senior physicians, so that the project cannot easily be executed. Besides senior official support, the success of telemedicine depends on knowledge of telemedicine technology among stakeholders. This means that the stakeholders need at least the ability to understand what telemedicine can do. Furthermore, some researchers argue that much of the computerization change has been driven from the bottom up (Aah, 1997; Jennett et al., 2003; Meyer and Rowan,
1977). However, most healthcare organizations are hierarchical, top-down, and senior officials set the stage and provide an enormous amount of influence over the pace of innovation and change. In particular, decentralization of healthcare organization and professional responsibilities for care is a necessary change. One of the reasons that power distance has a positive effect is that senior managers do in fact support telemedicine, in most cases for political reasons.

6.1.8.2 Uncertainty Avoidance, as well as interactions between implementation effectiveness and decision-making factors, are not significantly related to telemedicine capabilities.

Although the literature generally states that high scores on uncertainty avoidance tend to prevent technology change because of fear of uncertainty, in my findings uncertainty avoidance has little impact on telemedicine capabilities. My results do not find that high formalization, redundancy, high authority, or intolerance of ambiguity in most SSA healthcare organization design, influence uncertainty avoidance; relevant factors may include the level of ICT infrastructure and human resources in the SSA region.

It seems that higher uncertainty avoidance cultures are uncomfortable with ambiguity; therefore, they are expected to reduce uncertainty by getting detailed instructions and comfortable levels of knowledge (Thatcher et al., 2003). However, it is very interesting that my findings differ from previous research; the data do not support interaction between uncertainty avoidance and telemedicine capabilities. It seems that uncertainty avoidance factors are not significant in SSA, unlike other regions of the world. One reason may be that the practice and research of telemedicine is still in its early stages in SSA countries, which consequently are less oriented to using telemedicine. Moreover, individuals in strong uncertainty avoidance cultures are very concerned and respectful of rules; therefore, detailed guidance is important to using the system. This is because the physicians consider the telemedicine system more useful if they believe it is simple to use. This issue does not involve the medical error or risk avoidance issue, but rather how one handles ambiguity in using the telemedicine system.
“Knowledge and attitude towards using telemedicine will be improved if we organize domestic workshops and seminars appropriate to local conditions and staff.”

“Awareness and cultural changes on how to improve the healthcare services are important.”

“Experience should be shared among developing countries and healthcare institutions, not with only industrialized countries that have absolutely different setups.”

6.1.8.3 Technology Culturation and interactions between implementation effectiveness and decision-making factors are not significantly related to telemedicine capabilities.

This aspect of the study relates to technology culturation; when physicians are exposed to technology from advanced nations, and they conduct their practice well, the desired outcomes are more likely to be success. However, SSA physicians do not believe that exposure to advanced technology alone, especially by simply participating in conferences or workshops, will have much influence on telemedicine capabilities. Most physicians in contrast believe that technology culturation has negative impacts on telemedicine capabilities, because of the “brain drain” and poor socioeconomic conditions of SSA, especially when this is not conducive for them to return home. Another reason could be that physician exposure to a relatively technology-intense culture itself cannot be a solution for purposes of clinical care. Even in the presence of correct diagnosis, treatment facilities and drugs are still an issue to improve the current situation. Moreover, the telemedicine technology readiness of all stakeholders, and proper implementation of telemedicine projects, is more important than a few physicians being exposed to the technology of industrial countries.

“The experiences and development of industrialized countries are not the same as SSA countries, specifically technology, culture and legal matters.”
“We are practicing 18\textsuperscript{th} century medicine, so the concept of telemedicine initiative is three steps forward in our practice. Therefore, adequate training is mandatory; each medical practitioner should be given knowledge and awareness. However, most of our physicians will not return home. Therefore institutional change and healthcare policy are important for fulfilling our ideas.”

“Poor historical background does not give physicians incentive to come back home.”

6.2 Contributions and Implications of the Research

Telemedicine applications have the potential to greatly improve cost-effectiveness, quality and accessibility of healthcare. While the practice and research of telemedicine is still at its early stages in SSA, there exist several current and potential practical and research implications associated with telemedicine transfer within the region (Kifle \textit{et al.}, 2006d; Mbarika, 2004). I argue that telemedicine is a multi-disciplinary science; thus the IS community can be a major player in addressing social, economic and cultural issues to tackle the medical dilemma of SSA by investigating the factors that pose challenges to the transfer of telemedicine. Moreover, the findings of this study contribute to understanding two new concepts relevant to transfer, with regard to visually-based telemedicine technology to SSA regions: the focus on national infrastructure and culture models. It also makes a contribution to theoretical research into mainstream IS by extending its theoretical validity and empirical applicability to a visually-based telemedicine clinical application, using a store-and-forward technology in the SSA context. In the following section I discuss the contribution of this research and its implications for future work.

6.2.1 Contribution of the Research

Telemedicine has been one of the main issues in developing countries, since the first world telemedicine symposium convened in Portugal, 30 June - 1 July 1997; it is gaining visibility, particularly in international strategies to address healthcare issues in
the developing countries, such as “the millennium goals for health”. This research offers a distinctive perspective, focusing on visually-based clinical applications in the SSA region, and considerable attention on the national infrastructure and cultural aspects of telemedicine transfer outcomes (social and value). Although the use of visually-based clinical applications using store-and-forward technology is growing in the SSA region, this study provides insight into the factors influencing the transfer of telemedicine in the region. I raise the issue of infrastructure and culture to cover all possible dimensions that are necessary to consider technological and non-technological impact on the use and transfer of telemedicine in developing countries. With the continuing discussion of ICT for development in the research and practical community, I present in this thesis understanding of local factors which could influence the transfer of telemedicine technology. Previous research, which was to some extent blind to the perspective of ICT infrastructure when examining IT “transfer”, also seemed to neglect the potential influence of culture in technology transfer.

Moreover, the main contribution of this thesis is in its effort to analyze telemedicine transfer (social and value) outcomes in different aspects, including national infrastructural and cultural aspects. This thesis also contributes to theory extension and testing in a new context, i.e. the integration of two important models of infrastructure and culture to predict telemedicine transfer outcomes (social and value). Furthermore, the study integrates theoretical perspectives and empirical findings of research in telemedicine transfer to SSA, specifically visually-based clinical applications. I have also examined the role of policies (ICT, e-health and data security), infrastructure, health environment, culture-specific beliefs and values, telemedicine transfer implications, and technology culturation, in promoting telemedicine transfer in the healthcare sector.

Furthermore, I argue that telemedicine is not only about clinical applications for patient treatment or technology innovation, but also introducing information systems to the healthcare sector. Thus, based on this assumption, I have drawn upon different disciplines and cross-disciplinary boundaries, and argue that resources from different fields should be considered in evaluating factors influencing the transfer of telemedicine. The issue of bringing cross-disciplinary investigation together has been valued as a means of solving problems and answering questions that cannot be
satisfactorily addressed using simple, reductionist approaches (Klein, 1990). In this regard, one contribution of this study is bringing to attention the diversity of issues and traditions that need to be addressed in telemedicine transfer.

Moreover, the study presents two models associated with infrastructure and culture that have been empirically tested, statistically analyzed and interpreted in the light of the literature that I reviewed. The study illustrates how policies (i.e. ICT, e-health and data security) influence telemedicine capabilities. The study manages to encapsulate the effect of national policies, and shows how they impact telemedicine outcomes as well as issues related to ICT infrastructure. The study also demonstrates the ambiguous potential of telemedicine improving access, quality and cost, generally and particularly in the SSA context, which struggles between current problems such as HIV/AIDS, malaria and long-term investment in a poor healthcare system. I have found empirical support that lowering technical and government attitude barriers is critical for the transfer of telemedicine outcomes in SSA. I have also found that, consistent with previous research, uncertainty avoidance in telemedicine transfer outcomes does not have much influence on telemedicine transfer outcomes. Moreover, traveling to technology-intense cultures does not influence telemedicine transfer outcomes.

My result confirms the belief of physicians that telemedicine has real social value in health outcomes, and points out that increasing patient access to healthcare, and saving societal cost, have very significant effects on telemedicine capabilities. My study also highlights the need of specific policies such as e-health and data security, rather than general ICT polices. The result confirms that reducing technical and infrastructure availability barriers improves practical knowledge, and enhances telemedicine and traditional medicine outcomes. It is also interesting to discover that if there is good health infrastructure, perhaps telemedicine is not valued so much; also when health infrastructure is poor, then telemedicine is unable to stand on its own.

Furthermore, the results suggest generally considering a more explicit priority-setting exercise focused on societal perspectives, in terms of possible clinical application of telemedicine, to use limited resources more rationally. It also indicates that limited access and a lack of alternative health care are fundamental conditions under which telemedicine services are to be considered, and prosperity reengineering should be
viewed as a continual iterative decentralized improvement of health and human resources. The study also highlights the fact that power distance works towards advancing telemedicine capabilities. Moreover, the study indicates that exposure to advanced technology alone does not have much influence on telemedicine capabilities; rather it has a negative impact on the poor healthcare system of the SSA region, because of the brain drain phenomenon. Generally, all my findings significantly contribute to comprehensively understanding the use of visually-based clinical services employing store-and-forward communication for socioeconomic benefit decisions.

6.2.2 Implications for Practice

This study also has important implications for practice, and could provide some prescriptive directions for policy makers in the SSA governments, and motivation to adopt visually-based clinical applications of telemedicine. Besides the general implications for the governments and the research community, multinational companies involved in telemedicine and other ICT projects could better understand the factors influencing the transfer of telemedicine in SSA. Government policy makers will have new insight into the effectiveness of various national infrastructures on telemedicine transfer in their respective countries. This could help them focus efforts on visually-based clinical applications and low-cost (store-and-forward) telemedicine technology.

The most significant implication of my findings is that I offer healthcare providers advice that can be important in implementing visually-based clinical applications and store-and-forward telemedicine, due to its low cost and the rapid growth of the internet in the region. In order to promote telemedicine technology transfer to some extent, carefully comparing applications and existing infrastructure, as well as choices of hardware and software appropriate to the country, will help the success of telemedicine. These days, there is increased interest in ICT for development, with consideration of local issues. In most cases developing countries are not able to adapt imported practices, due to several issues such as lack of knowledge and capacity (Kifile, 2006). However, this study offers a greater understanding of SSA local issues related to infrastructure and culture. Telemedicine use is an ongoing adoption and development process; it does not just occur by transferring from developer to user. Therefore, the study finds that this
ongoing process depends on a combination of various technical and non-technical factors, and therefore focuses on evaluating visually-based telemedicine applications, their effects on accessibility and costs of healthcare, and their impact on telemedicine transfer outcomes. This study describes how important it is to identify the application dimension (visually-based or not), environmental circumstances (urban and rural), communication infrastructures (bandwidth capabilities) and policies (e-health, data security, legal, standard); all these factors affect the decision-making process and telemedicine capabilities in SSA regions. Moreover, the transfer of telemedicine is a process that requires time, adequate support and resources. Therefore, introducing and using visually-based telemedicine requires “champions” that are interested in the use. Moreover, telemedicine is a network technology that needs to address standardization and security, which are crucial to success.

This study is also important to telemedicine infrastructure providers, such as telecommunication equipment manufacturers and service providers; my empirical findings can improve their direction by providing insight into local healthcare organizational practices and cultural aspects that have to be considered for the transfer of visually-based clinical systems. Therefore, international and multinational organizations may be in a better position when they consider the design of a telemedicine system, so that the physicians of developing counties find the telemedicine system user-friendly.

Moreover, as IT becomes an increasingly important part of the health sector, healthcare providers can benefit from understanding visually-based clinical systems using store-and-forward systems with low-cost technology in national and cultural situation; this is important for transfer of telemedicine technology. The results also show the importance of establishing niche areas of specialization and different clinical applications within the healthcare sector, because different applications, such as radiology, dermatology and pathology, have reached different maturity levels, involving ease of use, non-emergency situations, and low costs, similar to those used in the study. It is also important for the telemedicine system developer to balance data security with standards of medical acceptance and technology.

The study also highlights the importance of understanding the physicians’ and policy makers’ degrees of exposure to ICT, and particularly to telemedicine
technology. This will help in understanding the status of ICT in the healthcare sector, and will add value to physicians’ ability to collaborate with each other. Moreover, it will increase the awareness of policy makers, and allow them to understand what is possible in the use of telemedicine technology for visually-based clinical applications. In this aspect, the telemedicine transfer outcomes model gives a good framework for policy makers to consider the adoption of visually-based telemedicine applications, and helps the formulation of rational decisions.

6.3 Implications for Research and Recommendations for Further Research

This research framework could lead to further testing of new theoretical models grounded in the IS literature that explain the processes of telemedicine transfer in the context of developing countries. With such an approach, IS researchers can offer further important contributions to the academic and scientific community, industry, and government sectors in SSA and, by extension, to other developing countries. Potential contributions include: (1) establishing a rigorous, empirically driven theory base for telemedicine transfer in SSA. As previously mentioned, no known previous study has empirically examined telemedicine technology within the SSA context; (2) findings of studies that focus on the SSA region could be used to hypothesize similar telemedicine-and other ICT-related issues in the context of other less developed countries. In essence, findings of such research may spur IS researchers to explore the ability to generalize these findings across different developing countries, with socioeconomic environments similar to those of SSA countries.

Research regarding telemedicine in general is very rare in developing countries. I strongly believe that further research is important in this area. This can be done by using longitudinal multi-method case study analysis of cross comparisons of multiple projects within the country. Findings of such research could eventually be carried over to other developing countries with similar contingencies.

In most SSA countries, there is a rationale for adopting an innovation, and in the field of healthcare, it is most often based on some evaluation of a pilot project, even though most of the claims (cost cutting and efficiency) are not well documented through scientific research (Wootton, et al., 2000; AHRQ 2001). Relatively image-based
applications with convincing evidence of effectiveness are documented, such as teleradiology, telepathology and teledermatology (Brauchli et al., 2004, 2005; Kifle et al, 2006b). Thus, looking at the study domain in individual countries or specific telemedicine applications will hopefully provide deeper insights to policymakers with the ability to assess the impact of system changes on telemedicine outcomes (quality, access, cost and healthcare services). The study also focuses attention to investigating whether or not existing IS theories can be generalized and empirically tested in different national infrastructure and culture contexts.

Moreover, as noted in the literature review and the course of the study, my theoretical model is not exhaustive, particularly in the area of the impacts of organization and individual on telemedicine capabilities; these issues suggest the need for additional research, incorporating other variables not measured in this study, such as healthcare organizational and physician acceptance of telemedicine technology (Venkatesh et al., 2003; Chau and Hu, 2001). An interesting approach would be exploring these issues through qualitative and quantitative methodology. Focus groups such as radiology applications in organizational analysis, case studies and mixed methodological approaches could lend support to these data through triangulating techniques (Yen, 1978). I believe that modified TAM (Musa et al., 2005a,) or UTAUT (Venkatesh et al., 2003) questionnaires could be included in a modified or revised version of this instrument.

Furthermore, recent theoretical work on IT transfer in developing countries has been promising. However, empirical confirmation has just begun. A vigorous stream of empirical research could be built around infrastructural and cultural impacts of IT transfer at the national level. In addition, future research could work towards combining multiple theoretical streams into more integrated views of IT transfer at the organizational and individual levels. Finally, while I focused on national and cultural issues with respect to my research questions and method, there are many other issues, such as organizational and physician acceptance, that influence telemedicine transfer in SSA.
Some of these concerns are reflected, conditional to my observation, through physician comments, such as:

1. Telemedicine must address the majority of the rural areas and especially at primary care level where most of the problems can be easily solved by getting a second opinion, such as radiology, dermatology, pathology, and ophthalmology.
2. Telemedicine systems require a real commitment of all the involved parties, especially support from governments.
3. Telemedicine services depend on the acceptance of physicians who must own the system; therefore their involvement is important in the development and implementation of the project.
4. Standards and security are often mentioned as relevant points.
5. Telemedicine technology should be user-friendly, and users must be well trained and supported to function effectively.
6. Economic sustainability for long routine practice and maintenance of the equipment is also important.
7. It is highly desirable to improve government policy for access, cost and availability of the Internet, especially in the rural areas.
8. Education in medical schools and arrangements of seminars and workshops for specialists in the use of technology is necessary.
9. The role of nurses and other healthcare technicians needs to be emphasized and increased.

6.4 Limitations of the Research

While the study follows rigorous methods, I recognize that there are limitations of this research which cannot be totally avoided. One limitation is due to the cross-disciplinary nature of the research, including data characteristics and the theoretical base for the model. First, telemedicine in SSA is still in its early stages. During the literature review, I found a lack of telemedicine publications in developing countries, specifically in SSA regions (Wootton, et al., 2000; Kifle et al., 2005b). Thus most of the literature I reviewed comes from other regions, like North America, Australia, and
Europe. This may not accurately describe the phenomena and situation in SSA, especially with the infrastructural and cultural differences between industrial and SSA countries. We believe that despite the limited publication in SSA of research on telemedicine, it is relevant and important to conduct more intensive studies.

Second, since telemedicine is relatively new in SSA, the pool of actual users of telemedicine was not that big during the period of this study. It will take many more years to come up with meaningful generalization of the results to other developing countries. For example, although all the respondents to this study have some knowledge of telemedicine, less than 26% are actual users of the technology. Therefore, generalizability must be considered as an issue. To address this concern, as the use of the technology grows in SSA, further research could focus more on responses by specialty groups and location.

Third, quantitative methods have their strengths, but also their weaknesses, and a multi-pronged approach would be extremely helpful (Yen, 1999). It is also useful to explore qualitative (field or case study) methodologies, to help better understanding of the phenomena. But these require adequate time and reliable patterns of technology usages in SSA healthcare organizations.

Finally, telemedicine research in the IS community is very new; little research is conducted and published on SSA, specifically measuring non-technological factors that influence the transfer of telemedicine technology. As Byrne (1989) stated, the interpretation of these statistical numbers and analysis is determined by the amount of research done in the subject area. He further stated that result interpretation depends on the researcher’s subjective appraisal. Therefore, care should be exercised when generalizing these results to including other settings. Researchers have to do more studies, and comparative studies have to be done to extend observations into other continents which have similar socioeconomic structures.
6.5 Conclusion

This study has contributed to the importance of IT in healthcare systems by investigating telemedicine transfer outcome factors through a theoretical model. On the research front, I have also contributed to the expansion of the theoretical scope and empirical applicability of transfer of telemedicine technology. This study also responds to the call for more research efforts in telemedicine, showing signs of rapidly expanding ICT investment and deployment in SSA countries. In addition, the findings are encouraging and provide theoretical and practical insights into IT transfer in the healthcare sector.

The findings of this study provide interesting insights into the factors influencing telemedicine transfer in SSA. As shown in Table 5.6, the overall model explains about 44% of the variation in telemedicine capabilities, 31.5% of ICT infrastructure, 36% of telemedicine social outcomes, and 22% of value outcomes.

The first main subject of the work relates to the national infrastructure model of telemedicine outcomes. In this perspective, physicians believe that general ICT policies are not significant, while policies specifically pertaining to telemedicine (e-health and data security) are positively related to the level of ICT infrastructure. I also found that general ICT and data security policies influence telemedicine capabilities. Moreover, physicians believe that the quality of healthcare infrastructure significantly influences telemedicine capabilities, but is not directly related to telemedicine social outcomes.

The second main subject relates to the cultural model of telemedicine outcomes. In this perspective, physicians believe that objective decision making factors are strongly related to telemedicine capabilities. Moreover, the study shows that implementation effectiveness has a significant effect on telemedicine capabilities. Also, physicians believe that power distance positively influences telemedicine capabilities, but that uncertainty avoidance or technology culturation have no significant effect on telemedicine capabilities. Moreover, physicians believe that there are significant interactions between power distance and implementation effectiveness as well as rational decision-making factors on telemedicine capabilities; they do not believe that there is any
significant interaction between uncertainty avoidance, implementation effectiveness, or decision-making factors on technology culturation, nor between uncertainty avoidance and telemedicine capabilities, in the SSA culture context.

In summary, SSA is in great need of adequate healthcare services. Health indicators in SSA remain extremely low, even by developing countries’ standards. The economic condition of the region is one of the main obstacles prohibiting health insurance and medical care by governments. Telemedicine has made significant contributions to healthcare services in the industrial world. Nevertheless, the transfer of telemedicine technology faces many challenges in developing countries because of technical, economic, organizational, and cultural issues. These include lack of reliable and affordable telecommunications and power infrastructures, high costs of Internet and other infrastructure services, resistance to behavior changes, and lack of government awareness. Researchers have identified a variety of critical factors affecting computer system success; I also observed in my findings issues such as lack of top management support, poor quality system design, inadequate resources, hostile culture toward technology, lack of commitment to change, inadequate pilot testing, and insufficient project planning. These different factors often give rise to different expectations of telemedicine outcomes.

Clinical application of telemedicine may potentially increase accessibility to healthcare services, and bring new services to disadvantaged populations in rural areas of SSA. This is consistent with the claims of telemedicine’s potential to increase access and quality, as well as reducing costs of healthcare. Nevertheless, the strength of these claims is limited by a lack of comprehensive research; they have not been demonstrated adequately in the research community. Yet telemedicine still receives increased attention as a means of improving effectiveness and efficiency of healthcare services. Furthermore, the feasibility of using telemedicine in many clinical areas, particularly visually-based clinical applications such as teleradiology, teledermatology, telepathology, and teleophthalmology, are expanding rapidly, and their maturation is also seen in the perceptual evolution of telemedicine. Thus, this innovation will change healthcare delivery to the development of health services in SSA countries. Also, with rapid advances in Internet and mobile technology, store-and-forward visually-based
telemedicine applications have become essential, transforming SSA’s historically poor “forgotten continent” healthcare sector.
References


192


DICOM: The Value and Importance of an Imaging Standard’, http://www.rsna.org/REG/practicerers/dicom/index.html (visited 10/10/05)


214


Developed Countries” The Communications of the Association for Computing Machinery (CACM), Vol. 48, No. 12, pp. 111-116.


220


Wikipedia (2005) http://en.wikipedia.org/wiki/infosec (visited 03/05/05)


227


## Appendix 1. The World’s 48 Least Developed Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Africa</th>
<th>Asia and Pacific</th>
<th>Americas</th>
<th>Middle East</th>
<th>Year of entry to list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Angola</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>1998</td>
</tr>
<tr>
<td>Bangladesh</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1975</td>
</tr>
<tr>
<td>Benin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Bhutan</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Burundi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Cambodia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1991</td>
</tr>
<tr>
<td>Cape Verde</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1977</td>
</tr>
<tr>
<td>Central African Republic</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1975</td>
</tr>
<tr>
<td>Chad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Comoros</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1977</td>
</tr>
<tr>
<td>Congo D. R.</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1991</td>
</tr>
<tr>
<td>Djibouti</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1982</td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1982</td>
</tr>
<tr>
<td>Eritrea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1998</td>
</tr>
<tr>
<td>Ethiopia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Gambia</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1975</td>
</tr>
<tr>
<td>Guinea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Guinea Bissau</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1981</td>
</tr>
<tr>
<td>Haiti</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Kiribati</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1986</td>
</tr>
<tr>
<td>Lao (PDR)</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Lesotho</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Liberia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1990</td>
</tr>
<tr>
<td>Madagascar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1991</td>
</tr>
<tr>
<td>Malawi</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Maldives</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1971</td>
</tr>
<tr>
<td>Mali</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1971</td>
</tr>
<tr>
<td>Mauritania</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1986</td>
</tr>
<tr>
<td>Mozambique</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1988</td>
</tr>
<tr>
<td>Myanmar</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1987</td>
</tr>
<tr>
<td>Nepal</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1971</td>
</tr>
<tr>
<td>Niger</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Rwanda</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1971</td>
</tr>
<tr>
<td>Samoa</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1971</td>
</tr>
<tr>
<td>Sao Tome &amp; Principe</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1982</td>
</tr>
<tr>
<td>Senegal</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1982</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1991</td>
</tr>
<tr>
<td>Somalia</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Sudan</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Tanzania</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1971</td>
</tr>
<tr>
<td>Togo</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>1982</td>
</tr>
<tr>
<td>Tuvalu</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1986</td>
</tr>
<tr>
<td>Uganda</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1971</td>
</tr>
<tr>
<td>Vanuatu</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>1985</td>
</tr>
<tr>
<td>Yemen</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>1971</td>
</tr>
</tbody>
</table>

**Total (48)** | **33** | **13** | **1** | **1**

**Source:** OHRLLS, 2004 (http://www.un.org/special-rep/ohrlls/ldc/default.htm)
Appendix 2. Telemedicine Cases – Radiology and Pathology

**Case One – Teleradiology**

An Ethiopian woman (B.Y.) who suffered chronic back problems for several years, and who was living 600 km. west of Addis Ababa, the capital city of Ethiopia, traveled to Jimma in 1981 to obtain better medical treatment. The blood, sputum, and urine tests were conducted and a chest X-ray was taken to determine the underlying causes for her back pain. Blood, sputum, and urine tests came back negative but the chest X-ray revealed that she had Bone Tuberculosis (TB). Based on the findings, the doctor ordered the two known TB medications, Isoniazid and Rifampicin as well as some pain medications for her. Weizero B. depended on these medications from 1982-2002.

In 2002 her son, D.B. (who lives in California, USA) brought some of her X-rays to the United States for further interpretation. The two radiologists who checked these X-rays indicated that Weizero B. did not have Bone TB. They confirmed that her back pain may have been due to scoliosis (i.e. a lateral curvature of the spine with rotation of the vertebrae within the curve) or a degenerative condition in the cervical spine.

Today, we believe that teleradiology can minimize some of these problems.

**Case Two – Telepathology**

A 14-year-old boy arrived at the Black Lion Hospital’s outpatient department in Addis Ababa with a left popliteal swelling (under knee swelling). A sample was taken by fine needle aspiration and sent to the pathology department. After a thorough examination of series of slides, the department senior pathologist interpreted the findings as osteosarcoma, since both the history and the physical examination suggested malignancy. Still, the department staff continued to discuss the case at the weekly slide discussion, because the group could not reach a definite decision about the possibility of malignancy. On the one hand, we have the young boy waiting for his treatment, while on the other we have surgeons waiting for the pathologists’ final decision as to whether the problem was a malignancy or something else. The consequence of a surgical intervention would be amputation of the leg. In this case, they sought a second opinion and received a definite and competent answer from the Black Lion Hospital Pathology and Surgical Team for the proper medical management of the case.
## Appendix 3. Publication Selection Criteria

| Article Selection Criteria (Alavi and Carlson, JMIS, Vol. 8 no. 4, 1992) |
|--------------------------|-----------------------------|
| Articles published in a refereed Journal or Conference |
| Articles specifically address use of telecommunication networks (internet) to healthcare |
| Articles specifically address IS research |
| Articles specifically address Telemedicine research |
| Articles specifically address ICT and developing countries |

### Keyword Selection

We selected by examining the title for the following keywords as the basis for our searches:
Telemedicine, e-health, healthcare, health, outcomes, socioeconomic (Access, Cost savings, and Quality of care), and developing countries (Third World, Underdeveloped, Least Developed Countries, Africa)

*Subject and Heading:* Telemedicine, Socioeconomic, Outcomes, evaluation frameworks

*Subheading:* economics, social, education, organization, infrastructure, internet, policy, environment, standard, security, culture, developing countries, third world, underdeveloped, Least Developed Countries, Africa, SSA, Access, Cost, effectiveness, ICT

*Language:* English


### Articles Classification Schemes:

(Alavi and Carlson, JMIS, Vol. 8 no. 4, 1992)


<table>
<thead>
<tr>
<th>Type</th>
<th>Authors</th>
<th>Year</th>
<th>Title</th>
<th>Approach</th>
<th>Type</th>
<th>Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conference</td>
<td></td>
<td></td>
<td></td>
<td>Empirical</td>
<td>Action Research</td>
<td>MISQ</td>
</tr>
<tr>
<td>Journal</td>
<td></td>
<td></td>
<td></td>
<td>Non-Empirical</td>
<td>Case Study</td>
<td>CACM</td>
</tr>
</tbody>
</table>
Appendix 4. High-level Survey

Telemedicine in Ethiopia

Telemedicine is the use of medical information exchanged from one site to another via electronic communication for the health and education of the patient or health care provider and for the purpose of improving patient's care.

**INSTRUCTIONS:** The following list contains questions addressing various issues and factors that writers and researchers on ICT and Telemedicine issues have identified as important. Please rate the importance of each issue for Telemedicine in Ethiopia using the one-to-seven scale below, where “1” means “low importance” and “7” means “high importance”.

<table>
<thead>
<tr>
<th>Issue</th>
<th>Low Importance</th>
<th>Moderate Importance</th>
<th>High Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>General policies on Information and Communication Technologies (ICT)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health-related ICT Policies - Medical Informatics, Public Health and Business</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policies Focusing on Safeguard and Ensure on the Security, Privacy, Standard, and Confidentiality of Data</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability and Quality of Telephone Infrastructure (land-line and Mobile telephones) and Electricity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability and Quality of Internet Access</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability and Quality of Computers and Data Communication Networks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policies that Specifically Create Awareness and Promote use of Telemedicine</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of Telemedicine Based on Real Need and Poor Condition of with the Current Health Services Conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policies that Generally Create Awareness and Promote Use of ICTs and Internet in the society (e-education, e-business...)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factors Related to the Implementation of ICTs in General - Technology Acceptance (Physicians and others)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor Related to Telemedicine Application Priority Setting Criteria (Like Time, Geographical Location, Acceptance, Access to Care, Technology, Medical Specialty, Finance...)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beliefs and Values due to Ethiopian Culture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure to Western ICTs Technologies</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please write any comments about Telemedicine in Ethiopia or add other major factors or issues we should consider that have not been covered in this section:
Thank you very much for your responses to our questions. Telemedicine in Ethiopia is a complex issue, and/or our survey can only touch on some of these. We would very much appreciate your comments on a few more important in the areas. We would very much appreciate your comments on a few more important in the areas.

Please write any other important comments about Telemedicine in Ethiopia that have not been covered in this study:

Please write any comments about the survey itself (for example, about the design or administration)

Thank you very much for completing this survey! Your responses will be very valuable in the successful development of telemedicine in Ethiopia as well as other developing countries.
### Appendix 5. High-level Survey Result

<table>
<thead>
<tr>
<th>Construction</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICTP</td>
<td>6.4583</td>
<td>0.8836</td>
</tr>
<tr>
<td>EHPL</td>
<td>6.4583</td>
<td>0.7211</td>
</tr>
<tr>
<td>SIPL</td>
<td>6.0000</td>
<td>1.4744</td>
</tr>
<tr>
<td>ICTI</td>
<td>6.4583</td>
<td>1.1788</td>
</tr>
<tr>
<td>ICTH</td>
<td>6.3750</td>
<td>1.2091</td>
</tr>
<tr>
<td>TIMF</td>
<td>6.0833</td>
<td>1.2129</td>
</tr>
<tr>
<td>TSIN</td>
<td>5.4167</td>
<td>1.4720</td>
</tr>
<tr>
<td>TBIT</td>
<td>5.4583</td>
<td>1.5598</td>
</tr>
<tr>
<td>TMPL</td>
<td>5.2500</td>
<td>1.3910</td>
</tr>
<tr>
<td>TSCT</td>
<td>4.9583</td>
<td>1.5458</td>
</tr>
<tr>
<td>TRP</td>
<td>5.5000</td>
<td>1.4446</td>
</tr>
<tr>
<td>CBAS</td>
<td>4.5417</td>
<td>2.1055</td>
</tr>
<tr>
<td>TECL</td>
<td>5.4167</td>
<td>1.2129</td>
</tr>
</tbody>
</table>

**Item Means**

<table>
<thead>
<tr>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
<th>Max/Min</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7212</td>
<td>4.5417</td>
<td>6.4583</td>
<td>1.9167</td>
<td>1.4220</td>
<td>0.3971</td>
</tr>
</tbody>
</table>

**Item Variances**

<table>
<thead>
<tr>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Range</th>
<th>Max/Min</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.9009</td>
<td>0.5199</td>
<td>4.4330</td>
<td>3.9130</td>
<td>8.5261</td>
<td>0.9250</td>
</tr>
</tbody>
</table>

**Reliability Coefficients**

- 13 items
  - Alpha = 0.8106
  - Standardized item alpha = 0.8132
Appendix 6. Postal Version of the survey

Telemedicine Survey

Important definitions for the survey

Sub-Saharan Africa (SSA): For this survey, SSA refers to all African countries excluding North Africa (Morocco, Algeria, Tunisia, Libya, and Egypt), and the republic of South Africa.

Telemedicine: the use of medical information exchanged from one site to another via electronic communication for the health and education of the patient or health care provider and for the purpose of improving patients care.

Image based telemedicine applications: less contact with patients and mostly applied for consultation or second opinion, (such as, teleradiology, telepathology, teledermatology, teleophthalmology, telecardiology) most common use of store-and-forward images.

Internet: E-mail, the world Wide Web (WWW), FTP, chat, instant messaging, Voice over IP, and other services.

ICT or IT: Information and Communication Technologies (ICTs) or Information Technologies (IT) includes all telephone, computer and network-based technologies: wireless, fixed, satellites, the Internet and so on

Select one country in Sub-Saharan Africa for this survey: ______________________________________________

(In the space above, please write the country in SSA that you are most familiar with.

What is your specialty (self declared): ______________________________________________________________

How would you describe your knowledge of ICT in health care: O not at all O somewhat O knowledgeable O Very knowledgeable

Please answer all questions in this survey to the best of your ability.

Telemedicine outcomes in Sub-Saharan Africa

Adaptation of telemedicine technology in many organizations has been driven by legitimate motivations, including service improvement (the degree to which health care service for individuals and population), access (timely receipt of appropriate care), cost effectiveness (economic value of the resource use associated with the pursuit of defined objectives or outcome), acceptability (with the degree to which "patients, clinicians, or others" are satisfied with a services or willing to use it), efficiency and competitiveness enhancement.

Please indicate how much you agree or disagree that image based telemedicine applications in your country will have the following potential.

<table>
<thead>
<tr>
<th></th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice improvement: Telemedicine service reduce medical error by means of evidence-based care through best practices made possible by integrated decision-support tools as well as more knowledgeable workers through convenient and accessible online continuing education.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>2. Cost: From informed decision-making leading to more efficient use of medical and clinical resources.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>4. Service: Using telemedicine infrastructure to close loop on data and information, horizontal and vertical.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

Please write any comments about telemedicine potential impacts in Sub-Saharan Africa that have not been covered in this survey:

235
Please indicate how much you agree or disagree that image based telemedicine applications in your country will have the following social impact.

## Social Impacts in Sub-Saharan Africa

<table>
<thead>
<tr>
<th></th>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Telemedicine service will <strong>increase patient access</strong> to care for underserved rural and urban populations</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>2. Telemedicine service will <strong>reduce patient waiting time</strong></td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>3. Telemedicine services will result in more <strong>timely advice and intervention means of consultation service</strong></td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>4. Telemedicine services will <strong>improve discharge planning</strong> and follow-up care of patients</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>5. Telemedicine services will decrease <strong>unnecessary referrals</strong></td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>6. Telemedicine service will make <strong>specialty care more accessible</strong> to underserved rural and urban populations</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>7. Telemedicine services will <strong>decrease the isolation</strong> of health professionals</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>8. Telemedicine services will result to see more patients out of the reference hospital</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>9. Telemedicine service will <strong>enhance efficiency</strong> of a physician</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>10. Telemedicine service will <strong>easier</strong> physician job.</td>
<td>D D D D D N A A A</td>
</tr>
</tbody>
</table>

Please write any comments about telemedicine social impacts in Sub-Saharan Africa that have not been covered in this survey:

## Value Impacts in Sub-Saharan Africa

**Value Impacts:** Please indicate how much you agree or disagree with the following statement about the impact of telemedicine in the context of image based telemedicine application in your country.

<table>
<thead>
<tr>
<th></th>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Telemedicine service will increase revenues of health center</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>2. Telemedicine service will save costs</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>3. Telemedicine service will save physicians time and efforts</td>
<td>D D D D D N A A A</td>
</tr>
<tr>
<td>4. Telemedicine service will result in new jobs in your country</td>
<td>D D D D D N A A A</td>
</tr>
</tbody>
</table>

Please write any comments about telemedicine value impacts in Sub-Saharan Africa that have not been covered in this survey:
ICT Policy in Sub-Saharan Africa

Some policies influence information and communication technologies (ICTs) by encouraging or setting a trend, whereas others regulate ICTs by implementing and enforcing definite laws. Some policies target the supply of ICTs by focusing on organizations that create and provide ICTs, whereas others target the demand for ICTs by focusing on people and organizations that use them.

How much do you agree or disagree with the following statements about current policies, concerning ICTs in your country?

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The government influences the supply of ICTs (for example: by funding ICT research and Innovation; by providing educational and training and services; and subsidizing ICT development)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>2. The government influences the demand of ICTs (for example: by providing skill training; subsidizing the cost of purchasing ICTS; and providing programs for ICT awareness and promotion)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>3. The government regulates the supply of ICTs (for example: by requiring computer education; removing economic barriers to ICT trade and innovation; and establishing standards and requirements for research and development in ICTs)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>4. The government regulates the demand of ICTs (for example: by requiring specific ICT-related standards, products or processes be used by government agencies or private agencies)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>5. Privatization and liberalization: The government gives ownership and control of telecommunications provision to private enterprises, and private enterprises can freely compete in the mobile phone, ICT and ISP markets.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>6. The Government efforts the development of ICTS (for example: number of projects to be implemented in the policies; number of laws adopted by the government regarding ICT - intellectual property; the amount of financial resources mobilizing)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

Please write any comments about ICT policy in Sub-Saharan Africa that have not been covered in this survey:

---

e-Health (Telemedicine) Policies in Sub-Saharan Africa

e-Health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

How much do you agree or disagree with the following statements about e-health policy (Telemedicine), concerning ICTs in your country?

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. e-health promotion: The government generally supports and actively promotes the practice of ICT for health (for example is e-health incorporated to national health policy; include demonstration project funding, infrastructure development that support not only health care but also educational, and other purpose such as health management activities, etc...)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
2. **Awareness of e-health:** The government generally creates awareness of the concept and benefits of e-health to the health service providers as well as the patients. (for example preparing procedure, promoting the advantage of the technology, etc...)

3. **Research and development:** The government actively support for ICT related projects (equipment, training), capital expenditures, etc. In health sector by word and action.

4. **Freedom from e-health barriers:** The government support for long term sustainability of e-health (Such as tax free, promote the investment of private or non governmental sector, long term funding, incorporate in the education system, etc)

Please write any comments about e-health policy in Sub-Saharan Africa that have not been covered in this survey:

---

### Computer Security & Standards Policies in Sub-Saharan Africa

**Computer Security** relates to the physical safety of information, including protection against accidental loss as well as against unauthorized alteration. Privacy relates to the quality or condition of being secluded from the view of others and free from unsanctioned intrusion, while confidentiality relates to ensuring that persons with a specific clinical responsibility that see patient information are bound to secrecy.

How much do you agree or disagree with the following statements about security and standards policy, concerning ICTs in your country?

1. The government **ensures the setup of data security** standard and procedures (for example support the necessary hardware and software, maximize prevent systems and data failures and effective recovery of the system, satisfy the required level of system and data integrity and quality)

2. The government **ensures the standardization** of interconnectivity, interoperability and quality of information of computer networks

3. The government **ensures the availability of legal measure** (for example against misuse, negligence & for not adhering to the prevention and recovery standards & procedures set at national/sectoral/institutional levels)

Please write any comments about computer security policy in Sub-Saharan Africa that have not been covered in this survey:
ICT Infrastructures in Sub-Saharan Africa

ICT infrastructure is a physical system of telecommunications pathways and connections that transmit voice, video, and data, and encompassing a web of telecommunications, information, and computing technologies.

How much do you agree or disagree with the following statements about the current state of infrastructure for information and communication technologies in the context of image based telemedicine applications in urban as well as rural area in your country?

<table>
<thead>
<tr>
<th>Statement</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There is an adequate number of national and international trunk/backbone (long distance) phone and data circuits.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. Are there any restriction or limitations legal or technical in the use of data rate transmission and the use of encryption,</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. There is an adequate number of ICT workers skilled in developing and maintaining ICTs, training others how to use ICTs, and managing ICT infrastructures.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4. There is an adequate number of Wireless Networks, such as VSAT, satellite and microwave links</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. There is steady supply of electric power, whether by national grids or backup electrical generators in urban area.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. There is steady supply of electric power, whether by national grids or backup electrical generators in rural area.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. Urban health institutions have adequate access to phone services, whether land telephone lines, mobile/cellular phones.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. Rural health institutions have adequate access to phone services, whether land telephone lines, mobile/cellular phones.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9. Urban health institutions have adequate access to the internet, whether from home, work, internet cafes, telecenters, or other locations.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>10. Rural health institutions have adequate access to the internet, whether from home, work, internet cafes, telecenters, or other locations.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>11. Computers, networks and internet access are affordable for most health sector institutions in urban area.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>12. Computers, networks and internet access are affordable for most health sector institutions in rural area.</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Please write any comments about ICT Infrastructure in Sub-Saharan Africa that have not been covered in this survey:

Organizations and Health Environment in Sub-Saharan Africa

The strongest form of readiness for organization is a combination of "real need" and expresses dissatisfaction with current conditions so that member of the community are willing to adopt new practice (telemmedicine) to create change.

How much do you agree or disagree with the following statement about organization readiness in your country.

<table>
<thead>
<tr>
<th>Statement</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Structural change: The organization generally supports and actively promotes the structural change when introducing telemedicine (strong leadership, invest in training and experiment with the telemedicine technology, etc) and necessary</td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

239
sustaining factor of successful telemedicine (adequate funding cost associated with telemedicine service, human resources and equipment)

2. **Workflow change:** The organization generally aware of the concept and benefit of telemedicine and willing to allocate new responsibilities (practitioners, technical and administrative personnel, etc)

3. **Process redesigning:** The organization noted the outcome of interest (telemedicine) to address issues that have been raised or that may be potentially raised in implementing (reimbursement, liability issues, market driven force, etc)

How much do you agree or disagree with the following statement about the health infrastructure in urban as well as rural area in your country.

DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree

<table>
<thead>
<tr>
<th>1. Urban citizens have adequate access to primary healthcare</th>
<th>bDB bD bN bA bAA bAAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Rural citizens have adequate access to primary healthcare</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>3. Urban health institutions have adequate budget allocation for healthcare</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>4. Rural health institutions have adequate budget allocation for healthcare</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>5. Urban health institutions have adequate facilities (hospitals, health centers, private clinics, pharmacies etc...)</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>6. Rural health institutions have adequate facilities (health centers, health stations, private clinics, rural drug vendors, pharmacies etc...)</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>7. Urban health institutions have adequate human resources (physicians, health officers, nurses etc...)</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>8. Rural health institutions have adequate human resources (physicians, health officers, nurses etc...)</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>9. Urban health facilities have essential drugs and medical supplies</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>10. Rural health facilities have essential drugs and medical supplies</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>11. Urban health institutions have adequate human resources (physicians, health officers, nurses etc...)</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>12. Rural health institutions have adequate human resources (physicians, health officers, nurses etc...)</td>
<td>o o o o o o</td>
</tr>
</tbody>
</table>

Please write any comments about health environment in Sub-Saharan Africa that have not been covered in this survey:

**Attitude and Behaviors related to Telemedicine in Sub-Saharan Africa**

The degree to which a person believes that using a particular system would enhance his or her performances.

To what extent do you agree or disagree with the following statements about the usefulness of telemedicine in Sub-Saharan Africa An individual's positive or negative feelings (evaluate affect) about performing the target behavior

DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree

<table>
<thead>
<tr>
<th>1. Top managers support the project by word and action</th>
<th>bDB bD bN bA bAA bAAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Users are closely involved in the design and development of the system</td>
<td>o o o o o o</td>
</tr>
<tr>
<td>3. Users are computer literate and they are adequately trained in using the system</td>
<td>o o o o o o</td>
</tr>
</tbody>
</table>
4. There is at least one person (not necessarily a top manager) who purposefully champions the project by encouraging and advocating it

5. The system development team is skilled in the pertinent technologies

Please write any comments about attitude and behaviors in Sub-Saharan Africa that have not been covered in this survey:

The degree to which a person believes that using a particular system would be free of effort as well as an individual's positive or negative feelings (evaluate affect) about performing the target behavior.

To what extent do you agree or disagree with the following statements about the easy to use in the context of image-based telemedicine in your country.

<table>
<thead>
<tr>
<th>Statement</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Health professional generally do not trust ICTs or Telemedicine</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>2. Health professional generally do not care using telemedicine even if additional credentialing and licensure procedures were required.</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>3. Physicians, management and other health care providers generally concerned about data security, privacy and confidentiality when considering using ICTs or telemedicine</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>4. Physicians generally perceive telemedicine as an additional burden when working overload and stress</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>5. Physicians generally accept telemedicine if there specialty related with visual or screen based consultation (for example radiology, dermatology, pathology, ophthalmology...)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>6. Physicians are concerned about possible liability issues associated with the use of Telemedicine</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>7. Managers typically prefer to adopt ICT or Telemedicine only if it has been proven to be effective</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>8. Manager do not usually delegate important task to employee</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>9. Managers usually hesitant to attempt new ICT or Telemedicine applications</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>10. Manager frequently use their authority and power when dealing with subordinates</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>11. Subordinate are usually afraid to express disagreement with their supervisor</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Please write any comments about attitude and behaviors in Sub-Saharan Africa that have not been covered in this survey:
Telemedicine decisions making factors in SSA

Several core questions are generally relevant to any priority-setting exercise such as, access, cost, plan etc. Most of these considerations assume a societal or policy-level perspective.

Please indicate how much you agree or disagree with these statements about the priority-setting to select image-based telemedicine application in your country:

| DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree |
|---|---|---|---|---|---|---|
| 1. Impacts of efficiency: The significant and prevalence of the problems to be addressed, the needed information being available on a timely basis, burden of illness (e.g., mortality, quality of life), Variability across regions or population subgroups. | ○ | ○ | ○ | ○ | ○ | ○ |
| 2. Impact of save costs: The likelihood affect the decisions about adoption of telemedicine and integration into routine operations (for example the alternatives to which the telemedicine application will be compared, new area of application, medical equipment heights quality and expensive, etc) | ○ | ○ | ○ | ○ | ○ | ○ |
| 3. Impact of technology: The level and availability of technical infrastructure in terms of bandwidth (high cost, inadequate access, basic phone lines, internet service providers, quality, delivery outcomes, etc.) | ○ | ○ | ○ | ○ | ○ | ○ |
| 4. Impact of social: Telemedicine is base on the need of the patient & practitioner (for example limit access to health care, travel long distances for specialized services, isolation of practitioners) | ○ | ○ | ○ | ○ | ○ | ○ |
| 5. Impacts of new trends: The emerge of new type of diseases in health care (For example subspecialization in health care, new type of health problem - HIV/AIDS etc.) | ○ | ○ | ○ | ○ | ○ | ○ |

Please write any comments about telemedicine priority setting factors in Sub-Saharan Africa that have not been covered in this survey:

Technology Culturation in Sub-Saharan Africa

Technology Culturation represents a person’s exposure to a relatively technology-intense culture such as Europe or USA.

Please indicate how much you agree or disagree with the following statements about the amount and nature of travel of physicians and managers for conferences, workshops, exhibitions, etc - ICTs or telemedicine:

| DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree |
|---|---|---|---|---|---|---|
| 1. Most have traveled to technologically – advanced country for official purposes | ○ | ○ | ○ | ○ | ○ | ○ |
| 2. Most have traveled to technologically – advanced country for personal purposes | ○ | ○ | ○ | ○ | ○ | ○ |
| 3. Most have attended a computer - related conferences either within Sub-Saharan Africa or in another developing countries | ○ | ○ | ○ | ○ | ○ | ○ |
| 4. Most have attended a computer-related conferences in a technologically – advanced country | ○ | ○ | ○ | ○ | ○ | ○ |

Please write any comments about technology culturation in Sub-Saharan Africa that have not been covered in this survey:
Background Information

1. Name: __________________________________________________
2. Title:__________________________________________________
3. Are you female or male?  O Female           O male
4. How old are you? ___________ Years
5. What is the highest academic degree you have received? _______________
6. Are you Physicians or ICTs expert (other please specify)? O Physicians    O ICTs    O Others______________
7. Name of organization: _________________________________________
8. Type of organization: _________________________________________
9. Location of organization. _______________________________________
10. In which Country is the organization located? _______________________
11. How long have you used computers in general? _______________ Years
12. How long have you used the Internet? _______________ Years

Final Comments

Thank you very much for your responses to our specific questions. Telemedicine in Sub-Saharan Africa is a complex issue, and our survey can only touch on some of these. We would very much appreciate your comments on a few more important in the areas.

Please write any other important comments about Telemedicine in Sub-Saharan Africa that have not been covered in this study.

Please write any comments about this survey itself (for example, about the design or administration).

Thank you very much for completing this survey! Your responses will be very valuable in the successful development of Telemedicine in Sub-Saharan Africa as well as other developing countries.

To receive a copy of the results when the study is completed, please write your e-mail

Email address: ___________________________________________________________
Appendix 7. WWW Version of the survey

Telemedicine Survey

Important definitions for the survey

Sub-Saharan Africa (SSA): For this survey, SSA refers to all African countries excluding North Africa (Morocco, Algeria, Tunisia, Libya, and Egypt).

Telemedicine: The use of medical information exchanged from one site to another via electronic communication for the health and education of the patient or health care provider, for the purpose of improving the patient’s care.

Image-based telemedicine applications: Diagnosis is achieved by visually examining perceived features from images, (such as, teleradiology, telepathology, teledermatology, teleophthalmology, telecardiology).

Internet: E-mail, the World Wide Web (WWW), FTP, chat, instant messaging, Voice over IP, and other services provided over the Internet.

ICT or IT: Information and Communication Technologies (ICTs) or Information Technologies (IT) includes all telephone, computer and network-based technologies: telephone, wireless, wired, satellites, the Internet and so on.

Select one country in Sub-Saharan Africa for this survey: [ ]
(In the space above, please write the country in SSA that you are most familiar with.

What is your specialty? [ ]

How would you describe your knowledge of ICTs in health care? [ ] No knowledge at all [ ] somewhat knowledgeable [ ] Very knowledgeable

Please answer all questions in this survey to the best of your ability.

Please indicate how much you agree or disagree the current use of that image-based telemedicine applications in your country will have the following outcomes.

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Image-based telemedicine currently uses store-and-forward technologies such as email over than real-time interactive video.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>2. Image-based telemedicine currently uses standard telephone services as network service (that is, Plain Old Telephone Service [POTS] and/or Integrated Services Digital Network [ISDN]).</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>3. There is enough demand for image-based telemedicine consultation service.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>4. There are well-defined procedures for clinical protocol and preparation of a case (image acquisition, storage in an appropriate format, aggregation with clinical data and transmission) during image-based telemedicine consultations.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>5. Image-based telemedicine consultations are currently being used to change diagnoses, treatments and ongoing regimes that result in clinical improvement, quality of care and significant effects on the clinical process of care.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>6. Image-based telemedicine is currently being used to influence the health care process by allowing the primary health care center physician to participate more actively in treatment.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>7. Image-based telemedicine is currently being used as a learning tool to increase the level of expertise of doctors and other medical professionals.</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>
Please write any comments about telemedicine potential impacts in Sub-Saharan Africa that have not been covered in this survey:

Please indicate how much you agree or disagree that image-based telemedicine applications in your country will have the following social impacts:

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>1. Telemedicine will increase patient access to care for underserved citizens.</td>
</tr>
<tr>
<td>2. Telemedicine will reduce patient waiting time and result in more timely advice and intervention.</td>
</tr>
<tr>
<td>3. Telemedicine will improve follow-up care of patients.</td>
</tr>
<tr>
<td>4. Telemedicine will decrease unnecessary referrals to tertiary care.</td>
</tr>
<tr>
<td>5. Telemedicine will improve collaboration among health care professionals.</td>
</tr>
</tbody>
</table>

Please indicate how much you agree or disagree that image-based telemedicine applications in your country will prove valuable in the following ways:

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>1. Telemedicine service will increase revenues of health centers.</td>
</tr>
<tr>
<td>2. Telemedicine service will save costs for patients and health care providers.</td>
</tr>
<tr>
<td>3. Telemedicine service will reduce the time and effort of health care professionals.</td>
</tr>
</tbody>
</table>

Please write any comments about telemedicine social and value impacts in Sub-Saharan Africa that have not been covered in this survey:

Some policies influence information and communication technologies (ICTs) by encouraging or setting a trend, whereas others regulate ICTs by implementing and enforcing definite laws. Some policies target the supply of ICTs by focusing on organizations that create and provide ICTs, whereas others target the demand for ICTs by focusing on people and organizations that use them. How much do you agree or disagree with the following statements about current policies concerning ICTs in your country?

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>1. The government influences the supply of ICTs (for example: by funding ICT research and innovation; providing educational and training and services; and subsidizing ICT development).</td>
</tr>
<tr>
<td>2. The government influences the demand of ICTs (for example: by providing skill training; subsidizing the cost of purchasing ICTS; and providing programs for ICT awareness and promotion).</td>
</tr>
<tr>
<td>3. The government regulates the supply of ICTs (for example: by requiring computer education; removing economic barriers to ICT trade and innovation; and establishing standards and requirements for research and development in ICTs).</td>
</tr>
</tbody>
</table>
4. The government regulates the demand of ICTs (for example: by requiring that specific ICT-related standards, products or processes be used by government or private agencies).

5. Privatization and liberalization: The government gives ownership and control of telecommunications provision to private enterprises, and private enterprises can freely compete in the mobile phone, ICT and ISP markets.

6. The government promotes the development of ICTs (for example: number of projects to be implemented in the policies; number of laws adopted by the government regarding ICTs or intellectual property; mobilizing financial resources).

Please write any comments about ICT policy in Sub-Saharan Africa that have not been covered in this survey:

E-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology. How much do you agree or disagree with the following statements about e-health or telemedicine policies in your country.

1. E-health promotion: The government generally supports and actively promotes the practice of ICT for health.

2. Awareness of e-health: The government generally creates awareness of the concept and benefits of e-health to health service providers as well as to patients.

3. Research and development: The government actively supports ICT related projects (equipment, training, capital expenditures, etc) in the health sector by word and action.

Please write any comments about e-health policy in Sub-Saharan Africa that have not been covered in this survey:

Computer Security relates to the physical safety of information, including protection against accidental loss as well as against unauthorized alteration. Privacy relates to the quality or condition of being secluded from the view of others and free from unsanctioned intrusion. Confidentiality relates to ensuring that persons with a specific clinical responsibility that see patient information are bound to secrecy.

How much do you agree or disagree with the following statements about security and standards policy concerning ICTs in your country?

1. The government ensures the setup of data security standards and procedures (for example, they support the necessary hardware and software, try to prevent systems and data failures and effective recovery of the system, and attain a satisfactory level of system and data integrity and quality).
2. The government **ensures** standardization of interconnectivity, interoperability and quality of information of computer networks.  
3. The government **provides** legal protection for data security concerns (for example, laws are in place and enforced that guard against misuse, negligence, and failure to adhere to the prevention and recovery standards and procedures set at national/sectoral/institutional levels).

Please write any comments about computer security policy in Sub-Saharan Africa that have not been covered in this survey:

ICT infrastructure is a physical system of telecommunications pathways and connections that transmit voice, video, and data, and encompassing a web of telecommunications, information, and computing technologies.

How much do you agree or disagree with the following statements about the current state of infrastructure for information and communication technologies in the context of image based telemedicine applications in urban as well as rural areas in your country?

<table>
<thead>
<tr>
<th>Country</th>
<th>DDD (Strongly Disagree)</th>
<th>DD (Disagree)</th>
<th>D (Somewhat Disagree)</th>
<th>N (Neutral)</th>
<th>A (Somewhat Agree)</th>
<th>AA (Agree)</th>
<th>AAA (Strongly Agree)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Rural</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
</tbody>
</table>

Please write any comments about ICT Infrastructure in Sub-Saharan Africa that have not been covered in this survey:

How much do you agree or disagree with the following statement about organization readiness in your country.
1. **Structural change**: Health institutions generally support and actively promote the structural changes involved when introducing telemedicine (strong leadership, investment in training and experimenting with telemedicine technology).

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Workflow change**: Health institutions are generally aware of the concept and benefits of telemedicine and are willing to allocate new responsibilities to health professionals, technical and administrative personnel.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Organizational transformation**: Health institutions are willing to change the type of services and focuses as a result of introducing telemedicine.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

How much do you agree or disagree with the following statement about the health infrastructure in urban and rural areas in your country?

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Urban** citizens have adequate access to primary healthcare, water and sanitation.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. **Rural** citizens have adequate access to primary healthcare, water and sanitation.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. **Urban** health institutions have adequate budget allocation for healthcare.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. **Rural** health institutions have adequate budget allocation for healthcare.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. **Urban** health institutions have adequate facilities (hospitals, health centers, private clinics, pharmacies, etc).

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. **Rural** health institutions have adequate facilities (health centers, health stations, private clinics, rural drug vendors, pharmacies, etc).

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. **Urban** health facilities have essential drugs and medical supplies.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. **Rural** health facilities have essential drugs and medical supplies.

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. **Urban** health institutions have adequate human resources (physicians, health officers, nurses, etc).

<table>
<thead>
<tr>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. **Rural** health institutions have adequate human resources (physicians, health officers, nurses, etc).

Please write any comments about the health environment in Sub-Saharan Africa that have not been covered in this survey:
Several core questions are generally relevant to any priority-setting exercise, such as access, cost, plan, etc. Most of these considerations assume a societal or policy-level perspective.

Please indicate how much you agree or disagree with these statements about the priority setting to select image-based telemedicine applications in your country.

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Impacts of efficiency: Telemedicine implementation decisions are made based on the significance and prevalence of the problems to be addressed, timely availability of needed information, and seriousness of medical conditions.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>2. Impact of cost savings: Telemedicine implementation decisions are made based on the potential of cost savings.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>3. Impact of technology: Telemedicine implementation decisions are made based on the level and availability of technical infrastructure such as bandwidth, high cost, inadequate access, basic phone lines, internet service providers, quality, and delivery outcomes.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>4. Impact of social factors: Telemedicine is decided based on the needs of the patient and practitioner (for example limited access to health care, need to travel long distances for specialized services, and isolation of practitioners).</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

Please write any comments about telemedicine priority setting factors in Sub-Saharan Africa that have not been covered in this survey:

Please indicate how much you agree or disagree with these statements about implementation factors for an image-based telemedicine application in your country.

<table>
<thead>
<tr>
<th>DDD=Strongly Disagree; DD=Disagree; D=Somewhat Disagree; N=Neutral; A=Somewhat Agree; AA=Agree; AAA=Strongly Agree</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Management support: Top managers support the project by word and action.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>2. User involvement: Health care professionals, administrators, patients, and other stakeholders are closely involved in the design and development of the system.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>3. User competency: Health care professionals are computer literate and they are adequately trained in using the system.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>4. Internal champion: There is at least one person who purposefully champions the project by encouraging and advocating it.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>5. System Development Personnel: The system development team is skilled in the pertinent technologies.</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

Please write any comments about implementation factors in Sub-Saharan Africa that have not been covered in this survey:
Technology Culturation represents a person's exposure to a relatively technology-intense culture such as Europe or USA.

Please indicate how much you agree or disagree with the following statements about the amount and nature of travel of physicians and managers in your country to other countries.

<table>
<thead>
<tr>
<th>Statement</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Most have traveled to technologically-advanced country for official purposes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Most have traveled to technologically-advanced country for personal purposes.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Most have attended a computer-related conferences either within Sub-Saharan Africa or in other developing countries.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Most have attended a computer-related conferences in a technologically-advanced country.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please write any comments about technology culturation in Sub-Saharan Africa that have not been covered in this survey:

Please indicate how much you agree or disagree with the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Health practitioners generally feel that it is important to have job requirements and instructions spelled out in detail so they always know what they are expected to do.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Health practitioners generally do not trust ICTs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Health practitioners typically prefer to adopt ICTs only if it has been proven to be effective.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Health practitioners are usually hesitant to attempt new ICTs applications.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please indicate how much you agree or disagree with the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>DDD</th>
<th>DD</th>
<th>D</th>
<th>N</th>
<th>A</th>
<th>AA</th>
<th>AAA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Senior health practitioners in health institutions frequently use their authority and power when dealing with subordinates.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Senior health practitioners in health institutions do not usually delegate important tasks to subordinates.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Subordinates are usually afraid to express disagreement with their superiors.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Background Information

1. Name: 

2. Title: 

3. Organization: 

4. Indicate your gender  Female  male 

5. Indicate your age group  20-30  30-40  40-50  50-60  above 60 

6. What is the highest academic degree you have received?  MD  PhD  MSc  BSc  Other (please specify ) 

7. Are you a health practitioner or an ICT professional?  Health Practitioner  ICT professional  Others (please specify ) 

8. What kind of organization do you belong to?  Public  Private  Non Governmental  Others (please specify ) 

9. How long have you used computers in general?  Less than 1 year  1 to 2 years  2 to 3 Years  3 to 5 years  More than 5 years 

10. How long have you used the Internet?  Less than 1 year  1 to 2 years  2 to 3 Years  3 to 5 years  More than 5 years 

Final Comments

Thank you very much for your responses to our specific questions. Telemedicine in Sub-Saharan Africa is a complex issue, and our survey can only touch on some of these. We would very much appreciate your comments on a few more important in the areas.

Please write any other important comments about telemedicine in Sub-Saharan Africa that have not been covered in this study.
Please write any comments about this survey itself (for example, about the design or administration).

Thank you very much for completing this survey! Your responses will be very valuable in the successful development of telemedicine in Sub-Saharan Africa as well as in other developing countries.

To receive a copy of the results when the study is completed, please write your e-mail address here:

Email address: 

Submit  Reset
Appendix 8. Letter to invitation

Dear ______________

The research team on Sub-Saharan Africa at the Department of Computer and System Sciences, Stockholm University /KTH (Sweden) would like to request your help with our research project. We are studying experts' perceptions on the most pertinent issues affecting the success of telemedicine in Sub-Saharan Africa (SSA). Through your affiliation with [Org], we have identified you as an expert on telemedicine in Sub-Saharan Africa. Even if you are not from this particular region of Africa, we value your expertise.

The results of this important study will be valuable to health care provider, policy makers, and government and NGO officials in SSA. We would like to ask you to please participate by completing our survey. At your request, we will give you a report of the results of the survey, as we believe this issue is an important one to you and your organization.

Within the next few days, we will e-mail you a link to the Web page for the Web-based version of the survey. When you receive the survey link, we would greatly appreciate it if you would take the time to complete it. Your responses will be very valuable in the successful development of telemedicine in Sub-Saharan Africa. If you have any questions about this survey, please contact Mr. Mengistu Kifle:

E-mail: kifle@dsv.su.se
Phone: +46 (08) 16-3499
Fax: +46 (08) 703-9025

Thank you in advance for your kind assistance. Once again, please expect to receive the survey link in a few days.

Sincerely,

Mengistu Kifle,
Department of Computer and System Sciences
Stockholm University /KTH
Stockholm, Sweden

PRIVACY NOTICE: We very much respect your privacy; we contacted you because of your recognized expertise in telemedicine issues related to Sub-Saharan Africa. However, if you would rather that we not contact you, please reply to kifle@dsv.su.se and let us know.
Appendix 9. Letter Link to the Survey

Dear _______________

The research team on Sub-Saharan Africa at the Department of Computer and System Sciences, Stockholm University /KTH (Sweden) would like to request your help with our research project. We are studying experts' perceptions on the most pertinent issues affecting the success of telemedicine in Sub-Saharan Africa (SSA). Through your affiliation with [Org], we have identified you as an expert on telemedicine in Sub-Saharan Africa. Even if you are not from this particular region of Africa, your input is very valuable. In addition, please kindly forward this e-mail to other experts inside or outside your organization whom you personally consider appropriate.

The results of this important study will be valuable to health care provider, policy makers, and government and NGO officials in SSA. We are sure you would want a copy of the results of this important study. Please provide your e-mail address in the place specified at the end of the survey. However, if you are not willing to respond or you feel this survey does not apply to you, please let us know immediately, and we will remove your e-mail address from our list.

Please kindly take the time to complete this survey. All individual responses will remain confidential. You have the option to provide any additional information so that we may contact you for possible follow-up questions. However, any names or identifying information that you give will not be shared with anyone other than the researchers. Furthermore, all data collected from this questionnaire will be presented in aggregate only, and your name will not be attached to the information you provide. Your participation in this study is purely voluntary, and you may stop at any time.

CLICK THE FOLLOWING LINK TO GO TO THE SURVEY (or copy this entire link to a Web browser):
http://www.dsv.su.se/~kifle/

Please kindly complete the survey as soon as possible. If you have any technical problems, or other questions or comments, please don't hesitate to contact us by e-mail or telephone. If you prefer, you could print out this survey and return it by fax or postal mail. Our contact information is:

E-mail: kifle@dsv.su.se
Phone: +46 (08) 16-3499
Fax: + 46 (08) 703-9025

Postal mail:
Mengistu Kifle,
Department of Computer and System Sciences
Stockholm University /KTH
Forum 100 Electrum, SE-164 40 KISTA
Stockholm, Sweden

Thank you very much for your kind assistance. Your responses will be very valuable in the successful development of Telemedicine in Sub-Saharan Africa.

Sincerely,

Mengistu Kifle
Appendix 10. Reminder Letter

Dear ____________

A couple weeks ago we sent you the link to a Web survey asking experts for their assessments to the most pertinent issues affecting the success of telemedicine in Sub-Saharan Africa (SSA). We have not yet received your response, and we respectfully ask that you please respond as soon as possible.

So far, respondents have included physicians, telemedicine consultants, government policy makers, international organizations, university, computer system developers and others. They are based in every major African region, as well as Asia, Europe, Canada and the United States. We have contacted you because of your recognized expertise in this area, related to your affiliation with [Org]. Regardless of whichever country you might operate in, we are very grateful for your expected assistance in completing this important survey. Please complete the survey by clicking on the following link (or copying it to a web browser):
http://www.dsv.su.se/~kifle/

As a token of gratitude for your taking the time to read our e-mail, we would like to offer you a copy of the result of this survey even if you are not able to complete it for whatever reason. If you would like a copy of the result, please just e-mail us with a request, or fill in your e-mail address at the end of the survey if you do complete it. Health care provider, policy makers, and government and NGO officials like you will use the results of this study in furthering the development of telemedicine in SSA.

If you have any technical problems, or other questions or comments, please don't hesitate to contact us by e-mail or telephone. If you prefer, you could print out this survey and return it by fax or postal mail. Our contact information is:

E-mail: kifle@dsv.su.se
Phone: +46 (08) 16-3499
Fax: + 46 (08) 703-9025

Postal mail:
Mengistu Kifle,
Department of Computer and System Sciences
Stockholm University /KTH
Forum100 Electrum,SE-164 40KISTA
Stockholm, Sweden

Thank you very much for your kind assistance. Your responses will be very valuable in the successful development of Telemedicine in Sub-Saharan Africa.

Sincerely,

Mengistu Kifle
Appendix 11. Related Publications

Paper 1.


This paper examines the use of teleophthalmology to reduce incidences of blindness in Ethiopia, a Sub-Saharan Africa country. We use case studies to identify factors aggravating the problem of blindness, and present teleophthalmology as an ongoing viable response for Ethiopia’s acute shortage of ophthalmologists. Using both primary and secondary data collection approaches, we report the need for telemedicine as well as the adoption and application of teleophthalmology in Ethiopia. To aid our argument, we present the teleophthalmology process model along with an infrastructure and support model. The paper then examines the comparative benefits of teleophthalmology in terms of economic and socio-economic benefits. We place the dimensions of infrastructure, process, and outcomes in a comprehensive framework. The overall goal of the study is to contribute towards developing a model that could be relevant to healthcare providers in SSA countries and to complement the earlier works in the teleophthalmology field.

Paper 2.


Rising costs for the provision of healthcare have been a major subject for debate in both developing and developed countries. Developing countries deal with various problems in the provision of health services and healthcare. Some of these problems include acute shortages of healthcare professionals and medical facilities. Such shortages have resulted in growing numbers of citizens from developing countries traveling abroad to seek necessary health services. This paper examines the role of telemedicine in the healthcare system, and analyzes the costs and benefits of introducing telecardiology services into Ethiopia. This analysis is carried out as a cost-benefit comparison study for the treatment of cardiac patients traveling abroad versus patients treated via telecardiology for second opinion. In general, patient travel is usually expensive and inconvenient; avoiding unnecessary travel can save unnecessary costs. On the other hand, a decision to send patients abroad only when necessary and with the support of specialists, can help contribute to better outcomes for health providers as well as for patients. The study concludes not only that telecardiology is necessary for financial and technical issues, but also that there is need of further research focusing upon social, organizational, security, confidentiality, standards and polices dimensions.
Paper 3.


In this study, we examine the potential benefits of telemedicine diffusion in Ethiopia and discuss its challenges. We also address three factors that could potentially influence the diffusion of telemedicine in Ethiopia: (1) active participation of higher institutions; (2) Ethiopian foreign alliances; and (3) government involvement. The diffusion of telemedicine presents many challenges in developing countries because of cultural, social, economic, organizational, and technical issues. In addition to those challenges, many decision makers, healthcare professionals, and patients lack basic information about telemedicine services and their potential benefits for healthcare. Lack of awareness has resulted in misconceptions and resistance to telemedicine. Our study does not claim that telemedicine can solve all Ethiopian medical challenges. However, we contend that it is a good starting point to reach Africans who live in areas with limited medical facilities and personnel.

Paper 4.


In this study, we proposed model combines (42 constructs) from the Technology Acceptance Model (TAM) (Davis, 1989); Diffusion Innovation Theory (DIT) (Rogers, 1995); and the Theory of Planned Behavior (TPB) (Ajzen, 1985; 1988; 1991). We also reviewed other factors that might affect telemedicine adoption, and conducted tests on a sample of 174 Ethiopian physicians using Partial Least Square (PLS). Our survey was administered at several hospitals that were scheduled to implement telemedicine applications in the near (6-9 months) future. As Bashsur (1997) stated, physicians’ rejections of this novel technology is one of the reasons that telemedicine implementations have failed in the past. Our findings reveled several factors that would influence physicians’ intentions to adopt telemedicine. Six of the ten hypotheses were significantly supported; three of the hypotheses showed weaker support. Perceived compatibility among Ethiopian physicians is positively related to their perceptions of the ease of use of telemedicine and it is the highest path coefficient in the entire model. Furthermore, this research presents findings relevant to the adoption of telemedicine technology that rarely appears in mainstream IS/IT research.
This study addresses factors that explain the intention of physicians to adopt telemedicine technology. Based on the theoretical foundations of technology adoption models, a revised model is proposed and tested by means of a questionnaire with two groups of physicians (Ethiopian and Canadian) that were, at the time of the survey, just about to use telemedicine technology. The first group is comprised of Ethiopian physicians primarily based in Addis- Ababa, Ethiopia. These physicians work in various medical facilities, as well as at an Addis-Ababa university teaching hospital. The second group consists of physicians based in Canada. These physicians (some based in rural areas) are involved in clinical, teaching, and research activities. Results analyzed with PLS indicate that in both cases, the African (Ethiopian) and Canadian physicians' perceptions of the usefulness of telemedicine are positively related to their intention to adopt this technology. There were some differences between Ethiopian and Canadian physicians when their own self-perception, the perceived ease of use of the technology, or the perceived voluntary nature of use was tested against their behavioral intention to adopt telemedicine. The revised model helps to distinguish the varying degrees of the intention to adopt telemedicine between two regionally distinct groups of physicians. Furthermore, this research sheds some light on the differences in adoption patterns between telemedicine users in the developing world versus the developed world.
No 91-004 Olsson, Jan
An Architecture for Diagnostic Reasoning Based on Causal Models
No 93-008 Orci, Terttu
Temporal Reasoning and Data Bases
No 93-009 Eriksson, Lars-Henrik
Finitary Partial Definitions and General Logic
No 93-010 Johannesson, Paul
Schema Integration, Schema Translation, and Interoperability in Federated Information Systems
No 93-018 Wangler, Benkt
Contributions to Functional Requirements Modelling
No 93-019 Boman, Magnus
A Logical Specification for Federated Information Systems
No 93-024 Rayner, Manny
Abductive Equivalential Translation and its Application to Natural-Language Database Interfacing
No 93-025 Idestam-Almquist, Peter
Generalization of Clauses
No 93-026 Aronsson, Martin
GCLA: The Design, Use, and Implementation of a Program Development
No 93-029 Boström, Henrik
Explanation-Based Transformation of Logic programs
No 94-001 Samuelsson, Christer
Fast Natural Language Parsing Using Explanation-Based Learning
No 94-003 Ekenberg, Love
Decision Support in Numerically Imprecise Domains
No 94-004 Kowalski, Stewart
IT Insecurity: A Multi-disciplinary Inquiry
No 94-007 Asker, Lars
Partial Explanations as a Basis for Learning
No 94-009 Kjellin, Harald
A Method for Acquiring and Refining Knowledge in Weak Theory Domains
No 94-011 Britts, Stefan
Object Database Design
No 94-014 Kilander, Fredrik
Incremental Conceptual Clustering in an On-Line Application
No 95-019 Song, Wei
Schema Integration: - Principles, Methods and Applications
No 95-050 Johansson, Anna-Lena
Logic Program Synthesis Using Schema Instantiation in an Interactive Environment
No 95-054 Stensmo, Magnus
Adaptive Automated Diagnosis
No 96-004 Wærn, Annika
Recognising Human Plans: Issues for Plan Recognition in Human - Computer Interaction
No 96-006 Orsvärn, Klas
Knowledge Modelling with Libraries of Task Decomposition Methods
No 96-008 Dalianis, Hercules
Concise Natural Language Generation from Formal Specifications
No 96-009 Holm, Peter
On the Design and Usage of Information Technology and the Structuring of Communication and Work
No 96-018 Höök, Kristina
A Glass Box Approach to Adaptive Hypermedia
No 96-021 Yngström, Louise
A Systemic-Holistic Approach to Academic Programmes in IT Security
No 97-005 Wohed, Rolf
A Language for Enterprise and Information System Modelling
No 97-008 Gambäck, Björn
Processing Swedish Sentences: A Unification-Based Grammar and Some Applications
No 97-010 Kapidzic Cicovic, Nada
Extended Certificate Management System: Design and Protocols
No 97-011 Danielson, Mats
Computational Decision Analysis
No 97-012 Wijkman, Pierre
Contributions to Evolutionary Computation
No 97-017 Zhang, Ying
Multi-Temporal Database Management with a Visual Query Interface
No 98-001 Essler, Ulf
Analyzing Groupware Adoption: A Framework and Three Case Studies in Lotus Notes Deployment
No 98-008 Koistinen, Jari
Contributions in Distributed Object Systems Engineering
No 99-009 Hakkarainen, Sari
Dynamic Aspects and Semantic Enrichment in Schema Comparison
No 99-015 Magnusson, Christer
Hedging Shareholder Value in an IT dependent Business society - the Framework BRITS
No 00-004 Verhagen, Henricus
Norm Autonomous Agents
No 00-006 Wohed, Petia
Schema Quality, Schema Enrichment, and Reuse in Information Systems Analysis
No 01-001 Hökenhammar, Peter
Integrerad Beställningsprocess vid Datatstystemutveckling
No 01-008 von Schéele, Fabian
Controlling Time and Communication in Service Economy
No 01-015 Kajko-Mattsson, Mira
Corrective Maintenance Maturity Model: Problem Management
No 01-019 Stirna, Janis
The Influence of Intentional and Situational Factors on Enterprise Modelling Tool Acquisition in Organisations
No 01-020 Persson, Anne
Enterprise Modelling in Practice: Situational Factors and their Influence on Adopting a Participative Approach
No 02-003 Sneiders, Eriks
Automated Question Answering: Template-Based Approach
No 02-005 Eineborg, Martin
Inductive Logic Programming for Part-of-Speech Tagging
No 02-006 Bider, Ilia
State-Oriented Business Process Modelling: Principles, Theory and Practice
No 02-007 Malmberg, Åke
Notations Supporting Knowledge Acquisition from Multiple Sources
No 02-012 Männikkö-Barbutiu, Sirku
SENIOR CYBORGs- About Appropriation of Personal Computers Among Some Swedish Elderly People
No 02-028 Brash, Danny
Reuse in Information Systems Development: A Qualitative Inquiry
No 03-001 Svensson, Martin
Designing, Defining and Evaluating Social Navigation
No 03-002 Espinoza, Fredrik
Individual Service Provisioning
No 03-004 Eriksson-Granskog, Agneta
General Metarules for Interactive Modular Construction of Natural Deduction Proofs
No 03-005 De Zoysa, T. Nandika Kasun

260
A Model of Security Architecture for Multi-Party Transactions
No 03-008 Tholander, Jakob

Constructing to Learn, Learning to Construct - Studies on Computational Tools for Learning
No 03-009 Karlsgren, Klas

Mastering the Use of Gobbledygook - Studies on the Development of Expertise Through Exposure to Experienced Practitioners' Deliberation on Authentic Problems
No 03-014 Kjellman, Arne

Constructive Systems Science - The Only Remaining Alternative?
No 03-015 Rydberg Fähræus, Eva

A Triple Helix of Learning Processes - How to cultivate learning, communication and collaboration among distance-education learners
No 03-016 Zemke, Stefan

Data Mining for Prediction - Financial Series Case
No 04-002 Hulth, Anette

Combining Machine Learning and Natural Language Processing for Automatic Keyword Extraction
No 04-011 Jayaweera, Prasad M.

A Unified Framework for e-Commerce Systems Development: Business Process Patterns Perspective
No 04-013 Söderström, Eva

B2B Standards Implementation: Issues and Solutions
No 04-014 Backlund, Per

Development Process Knowledge Transfer through Method Adaptation, Implementation, and Use
No 05-003 Davies, Guy

Mapping and Integration of Schema Representations of Component Specifications
No 05-004 Jansson, Eva

Working Together when Being Apart – An Analysis of Distributed Collaborative Work through ICT from an Organizational and Psychosocial Perspective
No 05-007 Cöster, Rickard

Algorithms and Representations for Personalised Information Access
No 05-009 Ciobanu Morogan, Matei

Security System for Ad-hoc Wireless Networks based on Generic Secure Objects
No 05-010 Björck, Fredrik

Discovering Information Security Management
No 05-012 Brouwers, Lisa

Microsimulation Models for Disaster Policy Making
No 05-014 Näckros, Kjell

Visualising Security through Computer Games
Investigating Game-Based Instruction in ICT Security: an Experimental approach
No 05-015 Bylund, Markus

A Design Rationale for Pervasive Computing
No 05-016 Strand, Mattias

External Data Incorporation into Data Warehouses
No 05-020 Casmir, Respickius

A Dynamic and Adaptive Information Security Awareness (DAISA) approach
No 05-021 Svensson, Harald

Developing Support for Agile and Plan-Driven Methods
No 05-022 Rudström, Åsa

Co-Construction of Hybrid Spaces
No 06-005 Lindgren, Tony

Methods of Solving Conflicts among Induced Rules
No 06-009 Wrigstad, Tobias

Owner-Based Alias Management
No 06-011 Skoglund, Mats

Curbing Dependencies in Software Evolution
No 06-012 Zdravkovic, Jelena

Process Integration for the Extended Enterprise

261
No 06-013 Olsson Neve, Theresia
Capturing and Analysing Emotions to Support Organisational Learning:
The Affect Based Learning Matrix
No 06-016 Chaula, Job Asheri
A Socio-Technical Analysis of Information Systems Security Assurance
A Case Study for Effective Assurance
No 06-017 Tarimo, Charles N.
ICT Security Readiness Checklist for Developing Countries:
A Social-Technical Approach