TELECOMMUTING IN THE CONSTRUCTION INDUSTRY: AN INVESTIGATION INTO THE WANT OF UTILISING AVAILABLE TELECOMMUNICATION TECHNOLOGIES

by

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Treatise submitted in partial fulfilment of the requirements for the

MASTER OF SCIENCE (PROJECT MANAGEMENT)

in the Faculty of Engineering, Built Environment and Information Technology
University of Pretoria

Study leader: Mr Jacques Abrahamse

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DECLARATION

I declare that this research is entirely my own, unaided work, except where otherwise stated. All sources referred to are adequately acknowledged in the text and listed.

I accept the rules of assessment of the University of Pretoria and the consequences of transgressing them.

This treatise is being submitted in partial fulfilment of the requirements for the degree of MSc (Project Management) at the University of Pretoria.

It has not been submitted before for any degree or examination at any other university.

Signature of Student

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ABSTRACT

Title of Treatise:	Telecommuting in the Construction Industry: An Investigation Into the Want of Utilising Available Telecommunication Technologies
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Research by traffic engineers has shown that most of the vehicular traffic in South Africa is carried on major roads in Gauteng (Van der Merwe, 2005:slide 11). Traditionally professionals in the built environment travel to and from work sites to carry out compliancy inspections and attend meetings at which their expertise is required. The increasingly congested roads increases travelling time to work sites with the result that highly qualified professionals in the built environment sector effectively become less productive. A quantitative research project, effected through the distribution of a questionnaire to contactable, registered professionals in the built environment sector, was carried out in order to establish details of their travelling habits, of their knowledge of telecommunication technologies, usage of specialist software and of their work preferences. Literature on telecommuting suggests that telecommunication technologies are available that can be utilised by built environment professionals in Gauteng to reduce their travelling time and thereby improve available productive time. The preferences expressed in the Questionnaire by the respondents indicate that a change in the way that built environment professionals work and a migration towards telecommuting, is necessary. The study concludes with recommendations on possible solutions to the problems identified and on how to address the respondents' preferences.

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LIST OF ABBREVIATIONS AND ACRONYMS

2G means second generation

3G means third generation

CAD means Computer Aided Design

CDMA means Code-Division Multiple Access

ECT Act means The Electronic Communications and Transactions Act, 2002. No. 25 of 2002

EU means European Union

GPRS means General Packet Radio Service

GSM means Global System for Mobile Communication

ICT's means Information and Communication Technologies

ISDN means Integrated Services Digital Network

ITU means International Telecommunication Union

MMS means Multimedia Message System

NGN means Next Generation Networks

PDA means Personal Digital Assistant

WASPA means The Wireless Application Services Providers Association

Wi-Fi means Wireless Fidelity

Wi-MAX means Worldwide Interoperability Microwave Access

WLAN means Wireless Local Area Network

WLL means Wireless Local Loop

WWW means World Wide Web

(*x*)bps means bits per second where, for example "k", depicts kilo

(*x*)DSL means any type of Digital Subscriber Line where, for example "A", depicts Asynchronous

1.0 INTRODUCTION

1.1 INTRODUCTION

In this chapter, the milieu of the problem, the questions asked and the reasons for asking them are described in an attempt to obtain suitable answers to these questions, as well as the limitations and the assumptions made and to emphasise the importance of this study and describe how the research was conducted.

1.2 DEFINITION OF THE MAIN PROBLEM

Gauteng province in South Africa is well known for its highly congested highways and urban roads, particularly during peak hours. Peak hours differ from highway to highway and from road to road and cannot be pinpointed to exact periods for large metropolises in which millions of people live and work. In a slide show presentation on the Gautrain project, Van der Merwe (2005:slide 4) indicated that there were more than 5 million people living and working in Gauteng. Van der Merwe (2005:slide 9) also showed that the peak hours on the N1 freeway at the New Road traffic counting station extended from 06:15 to 09:45 and from 15:15 to 18:45, if the 1,000 vehicles per each 15-minute timeframe is used as a benchmark. Peak traffic flows therefore occur over two 3½-hour periods in the mornings and afternoons. This indicates that in 2000 the roads were congested for 29% of the time every day and, with the currently recorded 7% annual increase in traffic flow, the traffic flow figures in 2008 may be much higher, with workers being forced to travel both earlier and later in order to avoid congestion. Construction work on the road infrastructure in preparation for the 2010 Soccer World Cup currently exacerbates traffic flow problems, the expectation being that these will be greatly diminished on completion. Van der Merwe's traffic flow study (Van der Merwe, 2005:slide 9), conducted on 03 October 2000, indicated that the volumes of southbound traffic in the mornings were double those of northbound traffic and that the situation was practically reversed in the afternoons. At approximately 06:45 the volume of southbound traffic peaked

at about 112 vehicles per minute and that of northbound traffic at about 52 vehicles per minute. At approximately 16:45, the volume of northbound traffic peaked at about 107 vehicles per minute and that of southbound traffic at about 65 vehicles per minute. This definitely appears to indicate that workers live in the Pretoria area but work in the Midrand and Johannesburg areas. It seems illogical to travel long distances daily to and from work, where development of residential land and construction of housing is usually done in response to reasonable demands and near to people's places of work. This phenomenon therefore warrants further study to determine the reasons for its existence. Other reasons, such as the quality of environment, people's preferences for residence area etc., may all be factors of a speculative nature and should not be taken into consideration in this study but should be left for a future in-depth investigation.

The dilemma is understood to be that highly qualified and professional people in the broader construction industry spend many unproductive hours each week travelling to and from home and between office and work on these highly congested roads. The purpose of this study is to determine:

- the work-related travelling habits of professionals in the construction industry,
- professionals' knowledge of telecommunication technologies,
- what their usage of industry related computer software programs are, and
- their preferences or expectations of "telecommuting".

Put more simply, where do they travel to and from, what is their knowledge of the telecommunication technologies available, what software programs do they use and how often and "how" do they want to 'telecommute'. Perceptions and a lack of knowledge may possibly be revealed and may require further investigation. The main emphasis of this study is thus placed

on the loss of time caused by unproductive travelling and its associated consequences thus constitute the main emphases of this study.

The next three points are provided for clarification purposes for the use of the word “want” in the treatise title:

- a lack of knowledge of telecommunication technologies, meaning that professionals do not know about available telecommunication technologies that could assist them to work both smarter and faster,
- a need for telecommunication technologies, meaning that a professional has a need for a particular technology but does not necessarily know how to go about meeting that need,
- a requirement for telecommunication technologies, meaning that a professional may have some knowledge of the required technology, needs it to solve a work method problem and thus desires it.

1.3 THE PROBLEM

The problem is to determine whether built environment professionals in the construction industry are aware of the available telecommunication technologies that could assist them to utilise their time more efficiently by reducing their travelling times

1.4 SUB-PROBLEMS

1.4.1 The first sub-problem is to establish the extent of differences in knowledge of telecommunication technology between professionals of different age groups. Questions on specific disciplines, qualifications and registration, office hierarchy, age, gender and population groups were therefore asked and linked to responses on telecommunication technology knowledge.

1.4.2 The second sub-problem is to establish the travelling habits of professionals in the construction industry, meaning from where and to where do they travel, for what purpose and how many

hours do they spend travelling, as well as what they would like to do in order to reduce travelling time and hours.

1.4.3 The third sub-problem is to determine what software programs are utilised and what problems professionals experience with these with regard to compatibility. The existence of this sub-problem is justified by the existence of the many specialist software programs that are currently available and used in the construction industry, coupled with the time wasted in having to learn these programs and transferring and/or in converting documents to other formats.

1.5 HYPOTHESES

While the author was carrying out research for a study assignment, he read a short story titled “The Machine Stops” by E. M. Forster (1909), of which the following are excerpts:

> “The Machine is much, but it is not everything. I see something like you in this plate but I do not see you. I hear something like you through this telephone but I do not hear you. That is why I want you to come.”(Forster, 1909:2)

and

> “… - the civilisation that had mistaken the functions of the system, and had used it for bringing people to things, instead of for bringing things to people.” (Forster, 1909:5)

This 100-year old work of fiction already hypothecated modern telecommunication technologies on the one hand and, on the other hand, simultaneously expressed the social danger of being present, yet absent. With reference to the above quotes, are we subconsciously set on having to be “present” in the physical sense to be effective?

A thorough search in the academic realm was conducted to obtain the details and results of research and studies carried out on teleworking in the construction industry. Very little could be found in line with the study. However, two examples of these unrelated professional work but still to do with the construction industry, are mentioned below.

- The use of mobile telephony by a construction worker to show his supervisor the carpentry work that had been done by him during the day, and
- A video presentation by RADVISION (2003) of a Japanese construction worker, also showing his supervisor his work output for the day.

During the author's attendance at the University for block weeks for study purposes, the numbers of single-user vehicles travelling on the roads in Gauteng were noticed. Fellow students were asked about this and their replies, as well as the apathetic acceptance of congested roads led to this phenomenon being investigated further.

The main and sub-problems stated in Section 1.4 above form the basis of the required and expected hypotheses as stated below, which in turn give substance to this study.

1.5.1 The younger generation is perceived to be very knowledgeable about telecommunication technologies, the potential that telecommunication technologies have to assist them in working more efficiently and are more inclined than their older colleagues to use modern telecommunication technologies. The following hypothesis is expected: Younger professionals have a greater knowledge of available telecommunication technologies than their older colleagues. .

1.5.2 The second hypothesis is that professionals in the construction industry want to reduce their travelling time for various reasons but do not know how to go about achieving this.

1.5.3 The third hypothesis is that professionals in the built environment sector have to use many different types of software programs to satisfy the needs of different clients.

1.6 LIMITATIONS

The Gauteng Province in South Africa was selected for this study because it is densely populated and covers a substantial area.

1.6.1 The study was limited to professionals in the construction industry in Gauteng whose names were provided by the professional registration bodies and who complied with the provisions of the Council for the Built Environment Act (Act No. 43 of 2000).

1.6.2 A total of 579 of the 8,272 Questionnaires sent out to professionals in the construction and built environment industries were returned. Only 504 of these were considered for this study as the information supplied in these was considered to be valid and acceptable. The remaining 75 responses were rejected on the grounds of being invalid and they were incomplete. It is to be noted that the engineering profession is by far the largest response group.

1.6.3 Although a considerable amount of literature is available on telecommuting in general, very little is available on telecommuting in the construction industry, which makes it practically impossible to provide comparative results. While the author was carrying out the research for a University assignment on the subject Construction Equipment and Information Technology (CET 810), the author contacted Dr.

Sirkka Heinonen, a respected Finnish telework researcher and author on the subject, to find out if any research contemplated for the present study had been done. She responded by electronic mail as follows: "… it is en *(sic)* interesting idea to study telework in the construction industry. As far as I know there is no work done."

1.6.4 Although ICTs can potentially be provided on the "Gautrain" coaches, the possible traffic-lessening effect of that project, the imposition of traffic penalties on single-user vehicles and of endeavours to promote "driving" or "lift" clubs and car pools will not be addressed in this study.

1.6.5 Literature relating to telecommuting and current advertisements for telecommuting professionals in the construction industries to work overseas will only be used selectively to indicate an emerging trend.

1.6.6 The underlying technologies that make telecommuting possible will only be presented in the broad sense prevalent at the time the Questionnaire was prepared and sent out.

1.7 DEFINITIONS OF TERMS

In the context of this treatise, the following definitions will apply:

1.7.1 The term "professionals" in the construction industry generally refers to architects, engineers, quantity surveyors, landscape architects, construction and project managers, property valuators and facilities managers who are registered with professional bodies but it does not necessarily mean they are consultants.

1.7.2 The term "construction industry" includes the activities involved in the provision, use and maintenance of physical facilities and infrastructure in the built environment.

1.7.3 "Gauteng" means all the towns within the borders of Gauteng Province as detailed in the Local Government: Municipal

Demarcation Act (Act 27 of 1998) of the Republic of South Africa.

1.7.4 “Acceptable responses” means those questionnaires in which all the essential sections had been fully completed without modification and where the respondents resided and worked in Gauteng.

1.7.5 “Essential sections” means all sections except Sections 6, 7, 12 and 14, for which vacant spaces are considered as negative or irrelevant.

1.7.6 “Gautrain” means the Gautrain Rapid Rail Link under construction between Pretoria and Johannesburg and between Johannesburg and OR Tambo International Airport.

1.7.7 The Greek word “*tele*” literally means “*from a distance*” and when it is combined with performing a task, it becomes “*work from a distance*”.

1.7.8 “Commute” means to travel to and from or go back and forth between, a place of residence and a place of work.

1.7.9 “Telecommuting” therefore means to travel or go back and forth to a place of work, but from a distance and by other means than in the physical.

1.7.10 Telecommuting, telework, telepresence and e-work as such are not technologies but represent a concept or way of working that utilises a very broad spectrum of technologies and services offered by the whole tele-business and by applying tele-processes.

1.7.11 Tele-business includes all parties involved, from the governing body, the developer or manufacturer of the hardware, the software house, the telecommunication carrier and Internet service provider to the retailer and user.

1.7.12 Tele-processes are the connection of hardware to, and the utilisation of, telecommunication systems that carry or transport

voice, video and data generated by software systems installed on the hardware.

1.7.13 Man Work Days is the nett number of available work days in an average year for a five day a week worker after weekend days, public holidays, consecutive vacation leave days and assumed consecutive sick leave days had been subtracted.

1.7.14 “Daily” is meant to be a full work day, “Weekly” is meant to be one full work day in a week, “Monthly” is meant to be one full work day in a calendar month and “Occasionally” is meant to be one full work day every three months or quarter of a year.

1.7.15 “compatibility” as used in this study means that a file produced by one same type software program can be utilised by another same type software program without trouble.

1.8 ASSUMPTIONS

A major assumption is that the area from Johannesburg in the south through Midrand to Pretoria in the north is the activity hub of Gauteng, in which 80% of built environment professionals live and work. The Questionnaire covers a broad spectrum and a fairly large number of assumptions require clarification. The following specific assumptions pertaining to this study are therefore made:

1.8.1 The rapidly expanding telecommunication technologies and the possibilities they offer will have to be promoted to a much greater extent if the abilities of the available professionally qualified workforce are to be maximised.

1.8.2 The acceptable responses will be considered as a representation of the experiences, perceptions and expectations of built environment professionals.

1.8.3 The cryptic questions in the Questionnaire are understood by Professionals in the construction industries and they would truthfully answer them to the best of their knowledge.

1.8.4 Built environment professionals are traditionally reluctant and sceptical about new technologies and systems and are slow to adapt to and/or change.

1.8.5 As almost all built environment professionals utilise mobile telephones, notebooks and PDA's during the course of their work, this electronic telecommunication equipment could be utilised much more effectively with available tele-business processes and software.

1.8.6 Because of the nature of their work, a large number of professionals in the built environment travel for work purposes, some of whom, such as valuers and civil/structural engineers, do so extensively.

1.8.7 Major peak time traffic congestion problems are experienced in the central Gauteng area, especially when an accident has occurred on a major route.

1.8.8 For the purposes of this study, only public holidays, minimum vacation leave days and fully paid sick leave days will be used for determination of annual Man Work Days and Weeks, which are calculated as follows:

365.25 calendar days (allowing for leap years)
-12.00 public holidays
-21.00 leave days (minimum consecutive days)
-14.00 sick leave days (fully paid)

318.25 calendar days.

For a five-day work week, there are therefore:

318.25 x 5 ÷ 7 = 227.321 Man Work Days per annum
(7 calendar days in 1 week)

and

227.321 ÷ 5 = 45.464 Man Work Weeks per annum

and

227.321 ÷ 12 = 18.943 Man Work Days in a month.

To establish a uniform day time basis in the evaluation and comparison of data, the above figures will be used for the conversion of information gathered from the Questionnaires on daily, weekly, monthly and occasional usage to a uniform “Man Work Day” format and calculated as follows:

Daily = 1.000 Man Work Day

Weekly = 0.200 Man Work Day

(i.e.: 2 work days per week ÷ 5 week days = 0.4 Man Work Day)

Monthly = 0.053 Man Work Day

(227.321 Man Work Days ÷ 12 months = 18.943 Man Work Days and once a month is calculated at 1 ÷ 18.943 Man Work Days = 0.053 Man Work Days)

Occasionally = 0.018 Man Work Day

(Once a quarter means 0.053 Man Work Days ÷ 3 months in a quarter = 0.018 Man Work Day and “Occasionally” is taken as once a quarter)

Thus, if a respondent utilises a specific type of software once a month, it has a 0.053 Man Work Day effect on his daily time utilisation.

To prevent skewing of data, the above figures are calculated to the third decimal place to allow for small number conversions but the results will be reported to only one decimal place. In order to calculate total responses the third decimal figure is finite and is then rounded up to the nearest first decimal place and all results less than 0.1 will be rounded up to 0.1. If the above calculation methods or the application thereof are in error, they will have minimal influence on the results as this error will be carried throughout the entire analysis. The results will be summarised in tables and depicted in graphic formats to show trends.

1.9 IMPORTANCE OF THE STUDY

Urbanisation and the pressure that large metropolises put on infrastructure provision and usage have become major concerns in areas such as Pretoria, Midrand, Johannesburg and other towns and settlements immediately around them as presented by Van der Merwe (2005) in his presentation on the Gautrain Rapid Rail Link. Buildings that have reached end of their useful life can be – and usually are – replaced by modern buildings but this place a burden on the limited space available for transportation infrastructure.

Van der Merwe (2005: slide 13) commented on "(traffic volumes in corridor growing at 7% p.a. for more than a decade)" where "corridor" means the area between Pretoria and Johannesburg. Van der Merwe (2005:slide 11) states that "If congestion is not addressed the economy of the province will suffer and the quality of life of the individual will decrease." Van der Merwe (2005:slide 11) shows that the traffic volume in Gauteng was 340 vehicles per kilometre, whereas in the Western Cape the province with the next highest traffic volume, the traffic volume was about 40 vehicles per kilometre. Van der Merwe (2005:slide 4) added that Gauteng covers only 2% of the total surface area of South Africa but that 70% of the country's workforce operates in this province. He also states that Gauteng has the most developed infrastructure in Africa. His initial survey was conducted on 03 October 2000 and, if the historic traffic volume increase of 7% p.a. is used, the traffic volume between Pretoria and Johannesburg would double by 2010.

Traffic problems, commuting and vehicular travelling in Gauteng form one part of this study. As the use of, and hypothecated problems experienced with, specialist software is another problem, a specific question on industry standards and regulation of software was included in the Questionnaire to address this problem. Some earlier work on standardisation, most probably with the intention to prevent future problems with software compatibility, has been done and is presented in the next paragraph

A synopsis of the INFO-COMM (1985:i) report, as commissioned by the Transportation Computer Committee in South Africa, reads; “INFO-COMM is a draft standard for the exchange of data within the construction industry.” Government institutions in South Africa, private computer technology role players, private construction companies and the built environment professional bodies participated in the drafting of this document. As far as could be determined, this document never went past the draft stage and no other “interchangeability standards” document on the specific subject could be found. The INFO-COMM document indicates that the industry recognised the need for standardisation but never followed through on the initial initiative. If it had been adopted as a standard, interchangeability of documents produced by different software program vendors might have prevented the use of multiple software programs in a single office to satisfy clients’ needs. Some clients have their own “design offices” and use specific vendor software packages. Consulting offices have to produce and submit documents in a fully compatible format to clients with their own design offices. This requirement forces consulting offices to procure a variety of software packages of the same type and to train staff in their use. It is both time-consuming and costly to multi-train staff in the use of various software programs. Training time on software programs is not billable, which places a financial burden on the consulting offices. Since the present study places a large emphasis on time, the “wastage” of time on multi software usage to produce the same end result, remains relevant. No solution or regulation could be found that controls or regulates the compatibility of software of the same type but the ECT Act (2002) has been promulgated to regulate the telecommunication and internet technologies and it is presented below.

The ECT Act (2002:clause 2.(1)) is purported to control and guide the whole telecommunications industry. In its “Comment on the Proposed Guidelines for Recognition of Industry Representative Bodies (IRB’s) In Terms of Chapter XI of the ECT Act (2002)” WAPSA states that substantive

recommendations in the Act might unintentionally exclude the non-internet telecommunication services (WAPSA, 2004:1). The author is of the opinion that Acts are prescriptive with regard to technologies and, if clauses and stipulations in an Act hinder the application of newer technologies, such an Act can be considered as archaic and therefore obsolete. Chaos will then ensue because clauses would then be left open for individual and opinionated interpretations.

Modern, first world telecommunication technologies are available in South Africa and, to a great extent, in the Gauteng metropolises and can assist professionals in the built environment to work more effectively but the question remains as to whether these are utilised.

Boshoff (2004:slide 10) states that the construction industry in South Africa is traditionally slow to adopt modern technologies. Boshoff (2004:slide 43) poses a belated but concluding question at the end of the presentation: "Is the construction industry (sufficiently) responsive to the change….?" Boshoff (2004:slide 10) answers himself with a statement: "If the uptake of technology by the construction industry is a measure of responsiveness to change, we have little chance of survival." Smith (2003:6) echoes this statement when he says that "…. it is clear that the majority of Quantity Surveyors are *resisting* (researcher's emphasis) active involvement in the CAD area." He also comments on the poor utilisation of CAD programs and on the effect of low usage if the profession wants to remain a key player in the project procurement department. In his research, Smith (2003:9) states that "The QS will be a key player in the construction industry in 10 years time". According to Smith (2003:9), 33 per cent of the respondents "strongly agreed" and 57 per cent "agreed" with this statement. If 90 per cent of quantity surveyors therefore recognise their importance in the construction industry but more than half resist using industry-provided software, Boshoff's (2004:slide 10) "chance of survival" question may become a statement in a few years time!

Wadiwalla (2003:36) states that: “The previous era of globalisation was built around falling transportation costs. Today’s era is built on falling telecommunications cost resulting from the development of the microchip, fibre optics, satellites and the Internet.” It is notable that Wadiwalla did not mention the mobile and wireless telecommunication technologies in her research, most probably because, by the time her treatise was written, the wireless telecommunication technology “explosion” was just about to start in South Africa. In the telecommunication industry it is common knowledge that the past few years have seen a radical decrease in the costs of providing telecommunication services to subscribers. The mass production of high-quality communication tools, such as mobile telephones, and the maximisation of wireless and fixed-line capabilities broadened usage and the cost of providing users with telecommunication services dropped in relation to the drop in network provision cost. The foregoing make modern telecommunication much more affordable than a few years ago and widespread usage provides network operators with sufficient income to improve telecommunication service selection and quality on a continuous basis. Telecommunication service selection gives subscribers an opportunity to bundle services in such a way that they serve specific needs. Because of the large number of network service providers available, subscribers demand higher quality services, which in turn require the continuous upgrading of networks.

The traffic problems already experienced in Gauteng, the telecommunication technologies now available and the ECT Act (2002), the lack of software compatibility standards and observations made in other research projects and during lectures with regard to the slow adoption by built environment professionals, as indicated above, demonstrate the importance of the present study.

In this study, the following are accepted as working guidelines and as points which require thorough investigation and which, it is hoped, will eventually lead to the hypotheses being answered.

1.9.1 Attention will be drawn to the time spent by professionals in the construction industries in Gauteng, South Africa, in travelling between their homes, workplaces and construction sites that could possibly have been spent more productively.

1.9.2 A wide selection of telecommunication technologies is available that can substantially reduce the time spent in travelling.

1.9.3 A very wide range of available software to produce the same end results is utilised, but software of the same type is mostly either totally incompatible or only compatible to a limited extent. The CAD software programs currently available are not fully interchangeable, resulting in loss of data or detail. General office-use programs, such as word processing and spreadsheet packages, also suffer loss of detail if these programs' export facilities are used to make them compatible with competitive packages.

1.9.4 Although telework and telecommuting are modern ways of increasing productivity, the construction industry is slow to adapt to a modern way of work.

These points were taken up in the Questionnaire to test the knowledge, perceptions, habits and preferences of the respondents.

1.10 STRUCTURE OF THE STUDY

In **Chapter 1,** the importance and relevance of the study with regard to the current traffic situation in Gauteng, the availability of modern telecommunication technologies, the utilisation of software programs and associated problems are stated, on which the research discussed in the ensuing chapters is based.

Chapter 2 provides an overview of the definition of telecommuting, the terminologies attached to this and of how telecommuting is applied in the world. Reference is made to how modern work stresses and commuting in urban areas affect family life and how telecommuting can improve this. Chapter 2 also describes telecommunication and the underlying technologies that make telecommuting possible. A short description of the available technologies in South Africa is also given. Emphasis is placed on how the available technologies affect commuting on highly congested urban roads and on the possibility of applying this in the construction industry.

Chapter 3 addresses the research methodology applied to address the main and sub-problems as stated in Chapter 1. The methods of collecting data for the study are presented and described. The specific methods for handling the data and for the grouping of these in such a way that the sub-problems described in the hypotheses are addressed are presented.

Chapter 4 discusses the findings from the research and the extent to which they answered the hypotheses. The findings are presented in summarised tables and are then discussed.

Chapter 5 addresses the results of the findings of the research as presented in Chapter 4 and are illustrated by means of graphs and maps. Results pertaining to the hypothecated questions, sub-problems and main problem are presented.

Chapter 6 highlights some of the questions, findings and results of the study and includes recommendations based upon the outcome of the research.

1.11 SUMMARY

In this chapter, the “want” of utilising telecommunication technologies by built environment professionals was explained, which provides substance to the

main problem of the hypotheses. The sub-problems to the hypotheses, namely the effects of a possible age gap between users of telecommunication technologies on their knowledge of these technologies, and on their travelling habits and software usage are stated.

In summary, the following three hypotheses are stated, namely (i) that younger professionals have a greater knowledge of available telecommunication technologies than their older colleagues; (ii) that professionals in the built environment want to reduce travelling time and (iii) that professionals in the built environment sector have to use many different types of software programs to satisfy the needs of different clients.

The reasons for limiting the survey to Gauteng Province is explained, as well as the wide availability of literature on telecommuting in contrast to extremely limited availability literature and studies on telecommuting in the construction industry.

The core terms used in the study are explained, with emphasis being placed on the use of the prefix “tele”, which means “from a distance”.

The assumptions of the study are explained, in which the concentrated presence of built environment professionals in Gauteng is highlighted. Further assumptions with regard to urbanisation, rapidly expanding telecommunication technologies, habits of the professionals, extensive travelling and peak time vehicle traffic congestion in Gauteng are made.

The study is important, as built environment professionals should be made aware of available telecommunication technologies that could increase their work output. They should sincerely consider a change in their methods of working and should embrace the telecommunication technologies available.

2 LITERATURE SURVEY

2.1 INTRODUCTION

Much has been written about telecommuting in a broader sense, mostly pertaining to computer-based workers who provide a service to employers and the public from their homes. Literature that is relevant to – or may be relevant to – telecommuting in the construction industry, is reviewed in this chapter. Modern telecommunication technologies are in a constant and rapidly changing cycle of improvement and, for the purpose of this study, the status of technologies at the time of the survey, is assured to be maintained.

Telecommuting is something that has been in existence for more than 35 years. In an article on the Network World website, Mears (2007:1) refers to Jack Nilles as the father of telecommuting. A general observation from many writings on telecommuting indicates that Nilles is indeed regarded in the worldwide telecommuting fraternity as the “father” of telecommuting. He established the concept of telecommuting as long ago as 1973 and coined the words “telecommuting” and “telework”.

Much literature, discussions, reports and guidelines on telecommuting are available in the academic realm, originating from and addressing past and current situations in the USA and the EU but very little of this pertains to South Africa and no documented information could be found in South Africa applicable to the built environment.

In this chapter, the work of experts in telecommuting, the technologies that make telecommuting possible and the travelling time attached to telecommuting are presented and discussed.

2.2 TELECOMMUTING DEFINED

Although the term “telecommuting” was defined in 1.7.7 through 1.7.9 above, some additional explanations are required in order to ensure that telecommuting is understood correctly and not interpreted in any other way.

2.2.1 Telecommuting as such is not a technology but is rather a concept or way of working, as described below, which utilises a very broad spectrum of technologies and services offered by the entire tele-business sector and by the application of tele-processes. Tele-business has already been defined and makes telecommunication possible.

2.2.2 Telecommuting thus takes place when an employee is not required to be a front-office or first-line public liaison officer in direct contact with the public or clients but who works remotely from his home. For this reason he is considered as a teleworker with the following characteristics;

2.2.2.1 He does not travel to and from his employer’s head office or base on a daily basis to execute work,

2.2.2.2 He has a suitable office space or work environment at his home which he uses as a remote office,

2.2.2.3 He has a telecommunication landline or wireless link that provides him with sufficient speed and bandwidth to connect with the head office computer, server, any other centre or remote work station,

2.2.2.4 He has the necessary hardware and software to execute work assignments on a remote computer,

2.2.2.5 He probably has videoconferencing or teleconferencing facilities, either computer-based or high definition television, and

2.2.2.6 He effectively “commutes” to work via telecommunication processes.

The above additional explanations of the term “telecommuting” above will ensure that the meaning of this word in the context of this study is clearly understood.

The literature studied and consulted is presented in the next subsection.

2.3 LITERATURE CONSULTED

General research has revealed that actually much research has been done and that writings on telecommuting are available for most industries but that very little on telecommuting in the construction industry could be found. The author has studied the publications, articles and journals of many respected authors on the subject of telecommuting and some of the author’s perceptions from these writings were developed from repetitions of the same concepts and research findings.

The Internet, the writings and speeches of respected persons and politicians who are considered as knowledgeable on the subject of telecommuting in various industries, were researched and applicable sections of their work, opinions and guidelines are discussed in the following paragraphs.

Gore (1994:1) called for international cooperation in building a Global Information Infrastructure (GII). This was echoed by Barclay (1998:1) in a report on the EU’s action plan for the provision of an “Information Superhighway”. This action plan states “… a resource which changes the way we work together and the way we live together.” The purpose of this action plan was to prepare the European Union to meet the challenges of life and work in the new millennium. The other northern hemisphere countries soon followed suit. The EU issued a decree that, with effect from 1 January 1998, all the restrictions preventing telecommunications companies from operating anywhere within the Union would be annulled. This effectively meant that any operator or network service provider could now cover the whole of the EU with its own network.

In this electronic age there is still a perception that highly skilled persons involved in and on construction projects should be “on site” to “see” and discuss progress, problems, etc. All the tele-business and electronic support systems are already in place to enable, for example, a quadriplegic design and supervision engineer to work as effectively as an able-bodied person. The well known Professor Stephen William Hawking is a fitting example of an academic and physicist who utilises modern telecommunication and computing technologies to overcome a major disability. In 2000 President Bill Clinton of the United States of America issued a memorandum to all heads of Federal agencies and departments in that country, the subject of which was “Employing People with Significant Disabilities to Fill Federal Agency Jobs that can be performed at Alternate Work Sites, Including the Home” (Clinton, 2000:1). An anonymous quote in that memorandum reads: “See the Ability not the Disability!”

Cooper, quoted by Gainey *et al. (1999:1).*in a Questia Journal Article Excerpt (attached as Annexure D), described telecommuting as “... the practice of working from one’s home, or at a satellite location near one’s home, where employees use communication and computer technology to interface with internal and external stakeholders” (Cooper, 1996). Employees utilise telecommunication and computer technologies to communicate and interface within an organisation and with external parties and associates. Other terms, such as “e-work” and “tele-presence” are also used to describe what is in essence telecommuting. Nilles (1997) is the author of a book called “Making Telecommuting Happen” which is a complete how-to-do manual for telework program development and management. There is no specific definition on telecommuting and there is much debate on this, but InnoVisions Canada (2006:1) states that North Americans prefer to define it as “telework, often referred to as telecommuting, occurs when paid workers reduce their commute by carrying out all, or part of, their work away from their normal places of business, usually from home.” Not everyone agrees with this definition. Gordon (2003:2) states that: “Some believe that all telework

requires the use of technology; others believe that it refers only to employees, while others - especially in Europe - believe it applies to employees and all self-employed home-based workers. Either way, in the end, what matters is how you and your company view and use the concept to your advantage." Gray *et al.* (1993) are the authors of "Teleworking Explained" whose title is self-explanatory. If the literal translation of the Greek word "tele" is taken into consideration, the "work" referred to in the above passages cannot be understood in the physical sense and has to refer to a means. For the purpose of this study, we therefore stand by the definition of a tele-worker or telecommuter as a person who performs work from a remote place by utilising the telecommunication technologies available and who performs tele-work or telecommutes.

In 1987 the Hudson Institute published a report "Workforce 2000," which is regarded as a landmark report on the future of working and maintaining a stable family life. Writings by a variety of researchers and the results of research in general all indicate that the negative pressures of modern society and work stresses on family life have become of great concern to many employers. Sensitivity towards a proper balance between work and family life is therefore universally recognised. According to the report by Van der Merwe (2003:9), office-bound workers in Gauteng, leave their homes very early in the morning and return home very late in the evening. They are effectively estranged from their young children during the important family bonding and development time of their lives. In a Questia Journal Article Excerpt from 1999 attached as Annexure D, Gainey *et al* (1999) quote Boyett & Boyett (1995) who say that "Employees view telecommuting as a way to better balance the demands of work and family." In the same Journal Article Excerpt, Gainey *et al* (1999) quote McNemey (1995) who states that "…telecommuting has been found to dramatically increase productivity. This point is further emphasised by Weiss (1994) who is quoted by Gainey *et al* (1999) as follows: "Studies have shown that employees can be expected to produce 20% to 30% more when they telecommute." Can it then be

surmised that workers with a healthy family life and stable home environments are more productive than those suffering from insecure homes? However Heinonen (2004:4) warns of the risk of social alienation for full-time tele-workers but, from studies carried out, states that up to two days of telework per week should not pose any threat. Gajendran and Harrison (2007:1524-1541) echo this view by stating that: “Telecommuters who work away from their corporate office for more than two-and-a-half days per week have poor relationships with their co-workers (but not with their supervisors), though.” The relationship between a teleworker and supervisor is good because they interact by utilising available telecommunication technologies. Care should therefore be taken that social interaction with co-workers is maintained by keeping a good balance between telecommuting and presence in the office.

General research of European and American companies indicates that workplace flexibility and alternatives to the traditional workweek are becoming increasingly popular and some companies in the United States of America reduced their workweek from 40 to 30 hours with limited expectations of “homework” and found that the actual productivity per week had increased. The Washington State University Cooperative Energy Program (1998) conducted a case study for the Seattle Housing Authority, which introduced a 10-hour workday and a 4-day workweek during the daylight savings time period of the year so as to maximise workforce output. This was done successfully in order to meet the requirement that certain construction and building maintenance activities can only take place during the summer months.

The introduction and acceptance of telecommuting as a way of working in both the USA and the EU has lessened the employers’ burden of providing office space and other workplace facilities because the tele-worker seldom visits the office and therefore does not require office space. In turn, the employer does not have to rent or make provision for office space and full-

day parking. All telecommuting and telework writers are in agreement that considerable savings in office space requirements are evident. There is no clear cut percentage saving because those companies that embrace teleworking differ in how much teleworking they support. Researchers therefore quote different saving percentages. Several authors (Gordon, 2003; Gray *et al*., 1993; Hoffman, 2001; Nilles, 1993) in some or other way state that single-user office space has been replaced by central and open-plan docking stations which teleworkers visit by appointment in order to download and update vital information which otherwise would have taken considerable time to do remotely. This situation will soon change as a consequence of the rapidly increasing bandwidth availability and of high-speed transfer rates becoming a norm, based on demand by high-profile users.

Several authors (Gordon, 2003; Gray *et al*., 1993; Hoffman, 2001; Nilles, 1993) state that telecommuting has become more popular among American and European employers as they can retain talent, increase productivity and reduce the overhead costs of their companies. According to these authors, this is a work option that also helps employees to balance their work and family demands. Based on their work it is clear that some companies provisionally allow teleworkers to do *ad hoc* work for other companies, because the wider the exposure that the tele-worker receives, the greater the possibility of a positive return to the home company. General research on the Internet indicates that global brainpower and a knowledge base, referred to as “Knowledge Communities”, which can be exploited worldwide, is one of the major advantages of a teleworker. Huysman and De Wit (2001:1) refer to knowledge sharing with the correct application of information communication technologies and to how ten large international companies apply knowledge sharing. An “expert” or “specialist”, as defined in dictionaries, does not encompass the finiteness of a micro-specialist designer. This telecommuting concept can easily be explained by the American way of building construction, where there are specialist contractors for each element of a

structure, from foundation to enclosed environment control. Each specialist fulfils a specific need in the construction process of a structure. Vacancy advertisements on the WWW for telecommuting construction industry specialists are increasing continually. On 22 April 2005, on the home page of its website, a South African company, Millennium Workplace Initiatives (www.mwi.co.za), reported a R40 000 annual saving for each employee tele-working for two days per week. They also mention a 30 per cent increase in productivity, an 80 per cent decrease in absenteeism, a 46 per cent saving in corporate clothing and grooming and a significant reduction in traffic congestion, all related to vehicular commuting. It also emphasised stress reduction and a significant improvement in family and personal lifestyles.

The built environment professional still has to make decisions that will take too much time to be set up for computation by electronic systems. In some cases a professional has to visually decide whether something is acceptable or meets a standard that is sometimes vague, with a phrase such as “to the satisfaction of the engineer or architect” being a well known example. For this to happen, a built environment professional has to be on site or be in a position as if he were “on site” and it takes (billable) time to physically be on site. In metropolitan areas professionals may spend an entire day travelling between their place of work and a construction site for a 30-minute inspection or site meeting. Niles (1994:40) stated that: “Surface travel volume is made up of vehicle trips. Telecommunication volume is made up of electronic and optical information flows.”

Van Staden (2004:3), General Manager for Communicate Personnel in Gauteng, states that “While telecommuting is becoming increasingly popular, many employers are still hesitant about allowing employees to work out of the office.” She repeats the numerous questions asked by Gil Gordon on addressing fears, advantages and disadvantages on telecommuting in his various writings. These questions broadly cover the following aspects:

- Do you have sufficient space for an office at home?

- Do you have access to high speed telecommunication technologies where you live?
- Are you sufficiently self-disciplined to manage a full work day from a home based office?
- Can you work in a quiet environment for long periods of time?
- Does your family understand that you're working and cannot attend to them?
- Can you work with people you do not see?
- What are the benefits for all?
- Flexibility in work arrangements includes a number of options:
    - work schedules,
    - shorter workweeks,
    - workload sharing,
    - interchangeable jobs,
    - voluntary part-time work, and
    - phased or protracted retirement.

Since the employee provides the office space, it would be fair if the employer provided or gave an allowance to the telecommuting employee to buy the furniture and equipment necessary to enable him to work from home. A general committee room at work, in which employees meet from time to time to strengthen work relation bonds between them, should also be provided.

All the literature consulted provided information on and discussed the advantages of telecommuting and the reduction in the physical movement of employees to their places of work. The authors on telecommuting stress the fact that social interaction and quality and quantity time with family are important. They also voice warnings with regard to alienation from the workplace and to the lack of social interaction with co-workers.

The underlying technologies that make telecommuting possible will be stated in the next section.

2.4 UNDERLYING TECHNOLOGIES

As stated in Section 1.6 and for the purposes of this study, the underlying technologies that make telecommuting possible will only be presented in the broad sense prevalent at the time the Questionnaire was prepared and sent out. Infrastructure and/or the equipment that forms the backbone of tele-communication as operated by tele-business needs some explanation to enable the different technologies to be understood. Communication towers, microwave dishes, optical fibre cable, radio transmitters and receivers, as well as all the equipment that makes transmission of radio, microwave and light signals possible, are generally referred to as the "backbone" of telecommunication.

According to the International Energy Agency's world wide electricity provision report in 2002 1.6 billion people (IEA, 2004:slide 24) and more than 70% of Africans (IEA, 2004:slide 23) had no electricity service. Telecommunication equipment requires electricity to work but, in a special report, Jensen (1999:1) reports that tele-density in sub-Saharan Africa was 1 in 200 and that: "Most of the telecommunication network is analogue and many sections are highly unreliable …" (Jensen, 1999:1).
If one discusses the underlying or support technologies of telecommuting as a modern way of working, the following need to be noted:

It would be superfluous to mention basic telecommunication technologies, such as voice landlines, simple data lines and facsimile lines, all of which are wired from the customer's premises to the service provider and beyond. Nevertheless, telecommuting still has a function and is used alongside and as a supplement to modern telecommunication technologies. Al Basheer (2009:1) stated that technology interconnection problems are experienced in many underdeveloped countries in Africa and in under-serviced rural areas.

Based on his personal experience in Zambia, he was able to state that the older types of telecommunication technologies, such as analogue landlines and radio communication, are still the only mode of telecommunication in many under-developed countries and in remote rural areas. Users of these old telecommunication technologies may need to contact a first world teleworker but cannot do so on account of the interconnection problems they experience (Jensen, 1999:2). The author visited the national fixed line telecommunication operator premises in Livingstone, Zambia in August 2006 and can confirm the use of older telecommunication technologies.

A computer capable of meeting the memory, graphics, voice, sound, video and processing requirements of the purpose for which they are used, together with all the related software and peripheral support equipment, such as scanners and printers, is the first requirement for a teleworker. The details of computer hardware requirements will not be discussed here because any basic, modern personal computer is capable of meeting teleworking requirements. In this study, it is assumed that selection of a personal computer is a matter of preference and, economic factors, coupled with software operating requirements and is the subject of a separate study.

Equally as important as the required hard- and software, effective teleworking requires a high-speed telecommunication line with sufficient bandwidth that can carry large data files or streams securely between the points of access and delivery.

The connection or link between tele-workers' computers and other computers, mainframes and servers can be via a fixed landline (copper or optical fibre) or wireless connection and, although they are not exhaustive but reasonable for the purpose of this study. In terms of standard copper lines, these technologies are mentioned below:

- Standard analogue connection has a speed limitation of nominally 32 kbps via a modem and cannot be used for transporting large bits of data over long periods of time.
- ISDN connection has either a 64 kbps single digital line connection speed or 128 kbps dual digital line connection speed and is the preferred tele-communication speed for general home use and even for some small enterprises.
- (*x*)DSL represents the number of alternative digital subscriber line services that offer higher bandwidth services. The prefix (x) determines the type of service offered, with variable speed packages of nominally 2 mbps and mu*l*tiples thereof and is generally called dedicated leased line services.

"Fibre to home" means that a service provider or carrier provides optical fibre lines to each and every home, over which all forms of communication, whether voice, data or graphic, can be transported, with encoding and decoding devices that can change digital streams to analogue streams if required.

The following statements on wireless links and networks are based on experience and knowledge gained by the researcher over the past 12 years in the infrastructure environment of the telecommunication industry and on the status of telecommunication technologies at the time of the survey.

- Standard radio wave links, although slow and of limited application, is still in use in certain parts of Africa for basic electronic mail applications. Jensen (1999:1), states that: "... most African countries have developed some form of low-cost local dial-up store and forward e-mail service with a gateway to the internet."
- Digital microwave radio link systems, as opposed to slow analogue systems, are used for improved speed and quality.
- Wi-Fi is a modern, high-speed, large bandwidth telecommunication

system that has range limitations. It is used in high-density office environments or where there are concentrations of potential users in close proximity or where telecommunication demands are high.

- Wi-MAX is the latest technology available for a type of network. It has qualities similar to those of Wi-Fi but can be used for distances of 16 kilometres or more from a single fixed point of service.
- GSM services have improved tremendously over the past few years and speeds of up to 3.6 mbps, coupled with high-quality data, voice and video transmission services, can be obtained in telecommunication.
-

From the researcher's own experience, a broad spectrum of software required to make teleworking in the industry a reality is already available and can be summarised as follows:

- Reputable security and firewall software that is released and updated on-line as soon as new viruses are detected.
- Electronic mail software capable of transporting large size files
- Computer Aided Design (CAD) software (inclusive of virtual reality or three-dimensional software if needed) that can at least be received and read or seen by all personas involved in the teleworking group assigned to a project.
- Design and Control Analysis Systems software (structural, energy, lighting, waste and effluent, etc.) that can calculate and predict the existence of dormant and fully occupied buildings to assist engineers in determining the most efficient and cost-effective design alternatives.

Cost and Accounting Systems software that can execute the full spectrum of cost control from concept to a fully operational building are listed below:

- Sunk cost calculations, (unrecoverable costs already incurred on a proposed project regardless of the future of the project) and tracking of such expenses.

- Quantity surveying processing from estimation through tendering, ordering and costing to issue of the final certificate and to usage beyond these stages.
- Spreadsheet software utilisation in a wide range of applications in support of other software packages that are not capable of providing the required information in a specific required format.
- Site and project management software that includes surveying, monitoring of execution, scheduling and procurement of software, and
- Property and facilities management software that addresses the lease, usage, maintenance, upgrading, refurbishing, expansion, conversion, etc. of a building in order to ensure optimum facility provision and running.

Several authors (Gordon, 2003; Gray *et al*., 1993; Hoffman, 2001; Nilles, 1993) state that computers, computer programs and safe and secure physical and wireless connections to central offices from the place of work and to other peripheries should be included in the checklists in order to make telecommuting happen.

2.5 AVAILABLE TECHNOLOGIES

Details of the hardware equipment, software systems and of the speed and quality offered by telecommunication technologies are presented below:

- Personal computers and/or notebooks, telecommunication technologies and their software can – and are already –being used to perform standard calculations based on set formulae. They are used to assist built environment professionals in the calculation of permutations at very high speeds. One disadvantage is that they cannot yet fully simulate the human mind in commercial applications.
- Mobile telephony is available with GPRS and MMS functionality and, with the excellent coverage that the telecommunication network service providers in South Africa offer, telecommunication to almost

anywhere is possible

- Although Wi-MAX is a new and recently approved telecommunication technology, it has a distinct distance advantage over fixed line Wi-Fi.
- The transmission of live video over fixed line, mobile and satellite connections is possible and, given the plummeting costs of end-user equipment, this provides an excellent option to reduce travelling time to and from site.

According to Al Basheer (2009:1), information and communication technologies in Africa are constantly and rapidly expanding and are being renewed at a phenomenal rate, which makes telecommuting even easier. According to the ITU report "Telecommunication/ICT Markets and Trends in Africa 2007" submitted at the Connect Africa Summit held in Kigali, Rwanda on 29-30 October 2007 (p. 17 – Figure 3.2.1), the number of mobile telephone subscribers in Africa increased from approximately 25 million in 2001 to almost 200 million in 2006.

2.6 TRAVELLING TIME

As already mentioned earlier and as is known to those in the construction industry world wide, built environment professionals tend to spend hours each day travelling to and from construction sites sometimes only to perform menial tasks that could be done with the assistance of experienced "on-site eyes" through tele-presence. Feeder and urban roads are becoming increasingly congested, resulting in professionals taking longer times to travel between home and office at the same time as everybody else is on the road. It is not uncommon for professionals to spend more than one hour daily commuting to work. Gustafson (2008:1) found that workers who commute for more than one hour per day lose their sense of belonging to their home towns and regions.

McClure (2001:1) stated that: "Perhaps with the exception of a few areas, it is taking workers longer and longer to get to and from work." Central Gauteng

is indisputably not an exception to this and this statement is very true of this province. Van der Merwe (2005:slide 13) stated that the traffic volumes on the N1 between Pretoria and Johannesburg practically double every 10 years and asked whether the Gautrain project would ease traffic volumes?

Langa and Conradie (2003:1) conducted research into the perceptions and attitudes of public sector officials in Pretoria regarding the possible introduction of teleworking. In the abstract of the research report, they stated that: "*It was found that there was firm support among the officials for public sector teleworking".* The question arises to what extent the recommendations of their research were implemented, if at all.

The ever-increasing traffic congestion in metropolitan areas demands a solution, the lack of which will lead to a breakdown in work output in Gauteng if current trends are maintained. While driving towards an intended work destination, a professional may be afforded the opportunity to be productive by making mobile telephony calls or discuss work with a colleague present in the vehicle. Otherwise a built environment professional is not considered as productive when driving but driving remains a means to become productive.

2.7 TELECOMMUNICATION TECHNOLOGIES

The telecommunication technologies in Section 16 of the Questionnaire will not be discussed and compared in detail to show each attributes, advantages and disadvantages. These aspects are the subject of a study which goes beyond the purpose of this study. Each of the telecommunication technologies mentioned in this study addresses specific needs and has to serve for purpose, with specific requirements being taken into consideration in the selection of a particular technology.

However, with reference to the "want" as contained in the title of this treatise, it is important to note that data transfer rates and image transfer quality are important factors in the selection of a technology for a particular application.

The quality of modern telephony voice, data and image functions is improving rapidly and current fixed-line, wireless and mobile telecommunication technologies are already of such a high standard that video quality, even on mobile handsets, is so good that detail can be seen. Media advertisements by GSM operators in South Africa bear testimony to this, the only limitation being the capability of a cellular telephone.

The results of an undated survey by Mbendi, as presented on the Telecom News page of the Africa Logistic Solutions (2006:1) website, revealed that the South African companies Telkom SA, Vodacom and MTN are amongst the top five telecommunication operators in Africa. This survey was based on a number of factors, of which quality of service, speed and bandwidth were the determinants. According to the research conducted by Market and Research: 2008 South Africa Mobile Forecast, 2008-2010 (2008:1), the current number of subscribers to the mobile telephone industry service is estimated at 47.5 million (Vodacom: 24.2 million, MTN: 17 million, Cell C: 5.8 million and Virgin Mobile = 0.4 million). According to the 30 September 2008 data provided on Vodacom SA's website, 73.5% of the company's mobile telecommunication base stations were 2G stations. Vodacom SA also stated that 21.4 million (88.4%) of its subscribers were prepaid subscribers. It is therefore reasonable to assume that the majority of South African mobile telephony users are lower income, prepaid, 2G subscribers who have handsets with good voice capabilities but limited data capabilities.

Modern telecommunication technologies available in Gauteng make an information super-highway in this province a reality, in which residents can communicate with each other from almost anywhere at any time.

2.8 SUMMARY

Telecommuting, in the various forms of its name and its principles are discussed in this chapter. A large quantity of general telecommuting

literature was studied, but the writings of northern hemisphere researchers: Gordon (2003), Nilles (1993), Heinonen (2000), as well as the work of a South African, Van der Merwe (2005), formed a strong base for this study.

The underlying or supporting technologies to tele-business, such as the various fixed line, wireless and mobile telephony systems that were available in Gauteng up to 2008, are mentioned. In addition, reference is made to the generic computer software systems and programs that are used in tele-business.

The purpose of the study has much to do with the utilisation of available telecommunication and supporting technologies to reduce commuting and travelling time. An analysis of the results obtained from the survey will address travelling times and it will be discussed in Chapter 4.

An extensive literature survey was conducted in an effort to find previous research on telecommuting, more specifically in the construction industry. This was presented here. The research methodology applied is addressed in Chapter 3: Research Methodology.

3 RESEARCH METHODOLOGY

3.1 INTRODUCTION

If one looks at the proposed study and the problems posed, as stated in Chapter 1, it can be seen that formal research is required to enable the hypotheses to be understood and to find answers to the questions raised.

After careful consideration of the requirements of the proposed study, the compilation of the Questionnaire was done in accordance with guidelines by Leedy and Ormrod (2005:245), and as guided by the first two study leaders, Messrs Basson and Boshoff. The layout of the Questionnaire used, as described in Section 3.3 below, is such that the data can be grouped in a number of permutations to prove or reprove the hypotheses and find answers to the sub-problems. The nature of the research hypotheses is such that a quantitative survey research by questionnaire methodology is the only method that can be applied to find answers to the sub-problems. Writings, presentations and on telecommuting are also reviewed to determine global trends and the status of telecommuting.

The research base, the structure and review of the Questionnaire, the treatment of bias and details of how the main and sub-problems is addressed in this Chapter 3: Research Methodology.

3.2 THE RESEARCH BASE

At the time the survey was carried out (January to October 2006) and, according to the registrars of the professional built environment bodies in Gauteng, at the time of the survey 8,272 professionals were registered with them. These professionals are grouped according to their respective professional bodies:

- Architecture;
- Engineering;

- Landscape architecture;
- Project and construction management;
- Property valuation;
- Quantity surveying, and
- Facilities management.

This huge potential therefore seemed to be a very good base from which research data could be obtained. Gay and Airasian (2003:113) and Leedy and Ormrod (2005:207) advise that a sample of 400 or more should be used for a base number of 5,000 or more. Since this study addresses all built environment professionals in one small sized province of South Africa, these can be considered as forming a homogeneous group.

Owing to the relatively large size of the target group of the study, the use of a questionnaire to obtain data was necessary.

Although poor returns on a descriptive survey by Questionnaire method are usually expected, it was hoped that the minimum sample size according to research guidelines would be attained. In accordance with the research base recommendations of Leedy and Ormrod (2005), 400 (4.8%) responses from the estimated total number of potential respondents of 8,272 would be required for a valid research. This calculated risk paid off, with 579 (7%) responses being received. However only 504 (6.1% of total estimated potential) of these returns were complete and found to be valid. Most of the 75 invalid returns (13% of total number of returned Questionnaires) were rejected on the ground that the respondents did not reside in Gauteng, with only a few not completing a critical section of the Questionnaire. From the Questionnaire, attached as Annexure B, and its accompanying cover letter, attached as Annexure A, it is clear that the research was restricted to residents of Gauteng. Although the Questionnaire was sent out to all persons registered with Gauteng chapters of the various professional bodies,

some of the professionals registered did not reside or work in Gauteng. Several of these professionals responded with an acknowledgement that they knew that they did not reside or work in Gauteng but nevertheless completed the Questionnaire because they deemed the study important and wanted their voices to be heard.

The research base and the responses received presented the possibility of a reliable study.

3.3 STRUCTURE OF THE QUESTIONNAIRE

A Questionnaire was drawn up with specific needs in mind to address the hypotheses. This Questionnaire was sent out to all persons registered with the professional bodies; either through the bodies themselves or by direct e-mail contact from the e-mail address lists provided by the professional bodies. Many of the e-mails sent to the registered addresses were returned with the message that they were undeliverable or that the e-mail address was invalid and none of these were followed up. No follow-up of unreturned questionnaires was carried out and when the number of returns for a valid study was well exceeded, no further data-gathering took place.

The Questionnaire, as attached in Annexure B, is grouped into five main sections. This was done intentionally as not to create an expectation of what the next question would be. In order to arrange the questions in logical groups, sections and selected sub-sections of the Questionnaire were grouped together.

3.3.1 Sections 1 to 7 required purely personal information that is used to determine group responses to questions in other sections.

- Section 1 deals with the respondent's professional discipline, the options being architecture, engineering, landscape architecture, project and construction management, property valuation and quantity surveying.

- Section 2 deals with the respondent's higher education qualification/s, the options being polytechnics (formerly known as technical colleges) and university, an additional option being the possession of graduate or post-graduate qualifications.
- Section 3 deals with the respondent's registration with professional bodies, the options being not registered, in training, professional and retired/part time.
- Section 4 deals with the respondent's position within the organisation, the options being: junior staff, middle management, senior/top management and self- employed.
- Section 5 deals with the respondent's age group, the options being: 29 years of age or less, 30 to 39 years of age, 40 to 49 years of age, 50 to 59 years of age and 60 years of age and over.
- Section 6 deals with the respondent's gender.
- Section 7, although sometimes controversial, deals with the respondent's population group, the options being black, coloured / Asian and white.

3.3.2 Sections 8 to 12 and 16.1, 16.3 and 16.5 deal with places of residence, work and travelling habits and preferences with regard to travelling.

- Section 8 deals with the area in which the respondent resides and a selection of the following areas, with only the main town in the area mentioned, is given: Pretoria, Johannesburg, Bronkhorstspruit, Vanderbijlpark, Rosslyn, Heidelberg, Germiston, Alberton, Midrand, Kempton Park, Krugersdorp, Roodepoort and Carletonville.
- Section 9 deals with the area in which the respondent's office is located, the areas listed being the same as those defined in Section 8 of the Questionnaire.

- Sub-section 10.1 deals with the respondent's travelling habits and asks for details of the time spent per day, week or month travelling between home and office.
- Sub-section 10.2 deals with the respondent's travelling habits and asks questions on the time spent per day, week or month travelling between work sites and office.
- Sub-section 11.1 deals with the distance between a respondent's home and office.
- Sub-section 11.2 deals with the annual mileage a respondent travels for work purposes only.
- Sub-section 12 deals with whether a respondent receives a vehicle or fuel allowance.
- Sub-section 16.1 deals with whether a respondent would, if possible, work from home.
- Sub-section 16.3 deals with whether a respondent would like to combine working from home and office.
- Sub-section 16.4 deals with whether a respondent would prefer to work flexitime with set performance schedules and/or dates.
- Sub-section 16.5 deals with whether a respondent would like to reduce the time spent travelling to and from work and for work purposes.

3.3.3 Sections 13, 14 and 16.8 are about software packages utilised by the respondent and the frequency of usage.

- Section 13 deals with all the different types of software packages – computer assisted drawing, quantity surveying, contractors' quantities, project management, facilities management and valuation - utilised by the respondent, as well as the frequency of usage.

- Section 14 deals with program compatibility and the usage of dual software packages to comply with clients' requirements.
- Sub-section 16.8 deals with the respondent's choice on whether industry standards should regulate software compatibility.

3.3.4 Sections 15, 16.2, 16.6, 16.7, 16.9 and 16.10 deal with the respondent's knowledge and usage of telecommunication technologies.

- Section 15 deals with the respondent's knowledge of a variety of telecommunication technologies such as Wi-MAX, Wi-Fi, ADSL, ISDN, CDMA, W-LAN, WLL, Metro Ethernet, GSM, video conferencing, video phone and web cam.
- Sub-section 16.2 asks whether the respondent makes use of video conferencing facilities.
- Sub-section 16.6 asks whether the respondent would rely on telecommunication technology or people to be their "on-site" eyes.
- Sub-section 16.7 asks whether the respondent would make use of safe and secure roadside internet cafés on major routes.
- Sub-section 16.9 asks whether the respondent would have meetings with consultants at high-technology stations midway between their offices.
- Sub-section 16.10 asks whether the respondent would have site meetings at high-technology stations midway between office and site.

In summary, a valid sample was obtained, and with the exception of Section 13 (software program usage), the Questionnaire was completed satisfactorily to conduct a reliable study.

3.4 REVIEW OF THE QUESTIONNAIRE

The Questionnaire had a note in the header that a ticked or marked block would be taken as a "Yes" answer to a specific question. Although it was expressly stated in the covering letter attached to the e-mail that the Questionnaire applied solely to built environment professionals in Gauteng, many responses were received from persons residing and working in other provinces, overseas and in neighbouring countries. Some responded that they knew that they did not fall in the research area but still wanted their "voice" to be heard as they considered the Questionnaire to be very relevant and wanted to be part of it. Several respondents requested a copy of the findings for presentation to the management cadres of large companies.

The purpose of the study is to address the sub-problems and some sections in the Questionnaire are critical for addressing the problems raised by the sub-problems. Responses were considered valid if at least one sub-section in each of the following sections had been marked:

- 1. Professional discipline;
- 2. Qualification;
- 3. Registration grade;
- 4. Office hierarchy;
- 5. Age group;
- 8. Area of residence;
- 9. Office area;
- 10. Travelling time;
- 11. Travelling mileage;
- 13. Software usage;
- 15. Telecommunication technology knowledge, and

- 16. Travelling, work and communication preferences.

As far as could be determined, this survey is the first of its kind to be carried out amongst built environment professionals and it was considered prudent to add more questions to facilitate expansion of the study. Sections 6 (Gender) and 7 (Population group) were included in the survey to provide data on demographic information. However, if during the course of the study it was found that Sections 6 and 7 could have an influence on the results, the information contained in these sections would be addressed. If Section 12were left unmarked it was considered that the respondent did not receive a transportation allowance. The five sub-sections of Section 13. (Software usage) was intended to provide a record of which software programs are utilised and to what extent. If one or both sub-sections of Section 14 (General) were left unmarked it was considered that the respondent did not experience problems with program compatibility or utilise more than one type of software to satisfy the clients' needs.

The 504 respondents whose completed Questionnaires were acceptable correctly marked sections 1 to 6.

Initially, the inclusion of Section 7, Population Group, in the Questionnaire was thought to be discriminatory but the researcher is of the opinion that this may help other persons and bodies who may wish to utilise this information in other studies.

With the exception of one respondent who indicated the actual township in which he lived instead of simply marking the area of residence as indicated in the Questionnaire, all the respondents completed Sections 8 and 9 correctly. As the respondent who stated the township in which he lived could be identified and placed in the correct area of residence, his response was therefore accepted as valid.

Provision was made in Section 10 for the time spent travelling on a weekly, monthly and annual basis and, irrespective of whichever was completed, travelling time was calculated to represent travelling time on a weekly basis.

Section 11, Mileage Travelling, was completed fully.

Section 12, Vehicle/Fuel Allowance, was marked as “No” by two self-employed respondents. Since their one-man concerns actually work on an expenditure set off against income basis, it was considered that they actually did get a vehicle/fuel allowance.

Section 13, Software Program Usage, had many questions and selections on software usage and it was not completed satisfactorily. Two possible explanations for this poor response could be offered, namely: There is actually such a wide variety of software available that respondents merely looked at the twenty-four proprietary names listed and considered this to be sufficient. Secondly, the bulk of the Questionnaire merely required ticking of selections but in Section 13 the respondent had to type out names. Any comment on these responses would therefore be speculative and they will not be discussed in detail. However, the many software packages that are in use, as gathered from the responses, will be mentioned and discussed to some extent to illustrate their diverse usage. Not all the respondents stated which software programs they used but the different categories and software packages in use are listed below:

- Computer Assisted Drawing (63) – AutoCAD, Microstation, MS Visio, Photoshop, Prokon, StruCAD, ACGIS, AllyCAD, Aspen+, SCADA, Mine24D, Surpac, Solid Edge, Model+ Roadmaker, Smart Sketch, Maintenance Plant Tool, Power Draft, TechnoCad, Data Mine, Mine Cad, Master Series Design, Solid Works, EdgeCAM, Retic Master, Small World, Pro Engineer, TurboCAD, Cards, Bentley Viewer, U-Station, Mecanica, Unigraphics, Inventor, Autodesk Map 3, Smart Plant P&ID, Coade, Caesar II, Corel Draw, Info Sewer, Info Surge,

Info SWMM, Power Factory, Dig Silent, Cad Key 98, Cad View, Caddie, In Roads, Cards, Volo View, HTFS+, Auto Sketch, Model Maker, Micgrafs Designer, Inventor, Test View, Project Wise, ACAD, Civil Designer, AG132, Smart Draw, VectorCAD, 3D Studio and SIDRA.

- Quantity Surveying and Contractors Quantities (12) – Civilsoft BILL, Civil Designer, Caddie, CCS Candy, Surf Mate, Acrobat 6, Modelmaker, Omicron, Win QS, QS Plus, Micro QS and own software.
- Project Management (13) – MS Project, Aspen, AFT, Site Plan, BST, Primavera, SAP R3, Zenzele, Bill, Project Plus, Deltek Vision, LavaView and PS 8.
- Property Valuation (6) – Arc View, Prop Values, Estate Master, MS Excel Valuations, @Value and Aspen+.
- Facilities Management (4) – Hansen, Fuel FACS, GIS Arcims and Win GEMS.

The questions in Section 14 about software compatibility and dual usage were answered well. Some respondents ticked the question on the dual usage of software programs so as to satisfy clients' needs but did not tick the question on program compatibility problems. This may be a contradiction on the one hand because, if a professional has to use two different software programs of the same group, he most probably experiences compatibility problems. Alternatively, the client prefers to work with a specific software program and the professional merely meets that requirement.

Section 15, pertaining to knowledge about telecommunication technologies, was completed satisfactorily, with only a few telecommunication industry professionals being able to tick some of the lesser known telecommunication technologies in South Africa, such as CDMA and WLL.

Section 16 provided some preferences and possibilities on telecommuniting and was completed satisfactorily, with several respondents ticking all the questions. A few follow-up enquiries on these questions were received, the main theme of these being how this can be achieved. Such questions can only support the hypotheses with regard “want”, in this case meaning “need” for a telecommunication technology. The distribution of the responses from the various age and office hierarchy groups will be evaluated with interest.

To summarise: With the exception of Section 13 pertaining to software usage whose completion did not meet expectations, the Questionnaire was completed satisfactorily and the exercise can be regarded as successful.

3.5 TREATMENT OF BIAS

This research was limited to professionals in the built environment in Gauteng and in this sense bias was applied. Gauteng was selected for the research because it is the smallest, yet most densely populated province in South Africa, in which traffic congestion is an accepted occurrence during the 3½-hour peak periods in the mornings and afternoons. Bias cannot be applied if the hypotheses and purpose of the research are taken into consideration.

Since this was an impersonal Questionnaire sent out by e-mail, the researcher could not have had any influence on the respondents. There is however, a remote chance that bias exists if potential respondents do not have e-mail addresses. However the chances of this are very slim as clients expect modern day professionals to have active e-mail addresses. Questionnaires sent to invalid e-mail addresses should therefore not be considered as a reason for possible bias.

3.6 ADDRESSING THE MAIN PROBLEM AND SUB-PROBLEMS

The main and sub-problems are discussed in Sections 1.3 and 1.4 of this study. The layout of the Questionnaire was compiled in such a manner that

the main and sub-problems could all be addressed by grouping specific data in such a way that answers to the problems could be found. Table 1 in Chapter 4 is provided to control which sections and sub-sections of the Questionnaire address the main problems and sub-problems and to ensure that all problems are adequately addressed.

3.7 SUMMARY

In this chapter the large research base is mentioned, as well as the number of acceptable responses received to the Questionnaire that will justify the findings of the research, with the number of valid responses received exceeding the minimum specified number of 400 responses required for a valid responses required for a potential base of 5,000 or more as per the guidelines set by Leedy and Ormrod (2005:207).

An explanation of the structure of the Questionnaire, as well as a review of responses received on the returned Questionnaires was discussed.

The homogeneity of the research base was discussed, in which the possibility of bias in the research findings was addressed.

Brief reference is made to how the main and sub-problems of the study will be addressed, based on the responses given in the Questionnaire.

The quantitative research method, through the utilisation of a structured Questionnaire, was explained in this chapter and the findings from the data obtained from the valid, returned questionnaires are addressed in Chapter 4: Research Findings.

4 RESEARCH FINDINGS

4.1 INTRODUCTION

The findings from the research are summarised in this chapter in data table format together with explanations of what the data mean. Owing to the large quantity of information received, the extensive use of summarised tables and graphical displays is necessary. Simple, graphical display formats are therefore employed in an effort to emphasise the results of the hypothecated questions proposed in Sections 1.5.1, 1.5.2 and 1.5.3 of Chapter 1.

As discussed in Section 3.3 of Chapter 3, a Questionnaire was drawn up to elicit answers to the hypothecated questions. This is attached as Annexure B. The Questionnaire consists of multiple possibilities to answer a question or to enable the respondent to choose from a selection of possible responses. A section or sub-section of a question is, for example, in which age group the respondent falls or in which area the respondent resides. There are a total of 105 possible selections or preferences in the Questionnaire from which the respondent had to choose 12 for the response to be regarded as valid. These 12 selections are the following:

- Professional discipline: Any one of the seven sub-sections in Section 1. (Qualification: Any one of the four sub-sections in Section 2.
- Registration grade; Any one of the four sub-sections in Section 3.
- Office hierarchy: Any one of the four sub-sections in Section 4.
- Age group: Any one of the six sub-sections in Section 5.
- Area of residence: Any one of the thirteen sub-sections in Section 8.
- Office area: Any one of the thirteen sub-sections in Section 9.
- Travelling time: At least Sub-section 10.1 in Section 10. Travelling mileage: At least Sub-section 11.1 in Section 11.
- Software usage: At least one of the five sub-sections in Section 13.

- Tele-communication technology knowledge: At least one of the twelve sub-sections in Section 15. and
- Travelling, work and communication preferences: At least one of the ten sub-sections in Section 16.

Table 1 below summarises the problems and the sections or sub-sections of the Questionnaire which are utilised to address these problems.

Table 1: Summary of Grouping of Questions to Address Problems

Problem	Description of Problem	Applicable Sections and Sub-sections
Main Problem	Are built environment professionals in the construction industry aware of available telecommunication technologies that can assist them to utilise their time more efficiently by reducing travelling?	1, 2, 3, 4, 5, 8, 9, 10.1, 11.1, 13, 15 and 16
Sub-problem 1.4.1	Is there a prevailing age gap in telecommunication knowledge? (Specific disciplines, qualifications, registration, office hierarchy, age, gender and population group are linked to telecommunication technology knowledge.)	1, 2, 3, 4, 5, 15, 16.2, 16.6, 16.6, 16.9, and 16.10
Sub-problem 1.4.2	What are the travelling habits of professionals in the construction industry? (From and to where do they travel, for what purpose? How many hours do they spend travelling and what would they like to do to reduce their travelling times?)	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 16.1, 16.3, 16.4 and 16.5
Sub-problem 1.4.3	What software programs do they use and what problems do they experience with regard to compatibility?	1, 2, 3, 4, 5, 13, 14, and 16.8

Considering the 504 valid responses, a single datasheet containing 54,936 possible response cells would have to be shown to present all the questions and responses. This is not possible in the study format limitations because an A0 sheet in ISO format would be required to make these readable. Since the unproduced, complete data sheet would be too big to include in this study, in an effort to show some of the data, smaller tables are presented on the following pages. The main data sheet can be made available to other researchers in an unformatted (i.e. without formulae), spreadsheet form if required and where the need for this is motivated. The data obtained to provide answers to the main and sub-problems are therefore summarised in smaller tables as shown and split up into Tables 2.a –- 2.d below. The questions in the Questionnaire are duplicated in Tables 2.a to 2.d, which form the summarised tables of all data for the various professional disciplines.

The purpose of Table 2.a is to show the qualifications, age bands, office hierarchy and other demographic information which will be used in the comparative studies in Chapter 5. The "Total" column is a simple summary of all the professional disciplines and the "Return%" the number of selections or answers to a specific question divided by the 504 valid responses. The responses to Question 2.2 indicate that 157 of the 504 respondents (31.2%) hold undergraduate university of technology/technikon qualifications.

In Table 2.a it is interesting to note that 4.4% of the educationally qualified respondents are not registered with professional bodies. Only 59.9% of respondents are professionally registered and thus certified to work independently. Ninety-seven (19.2%) of the respondents fall in the Junior Staff category and 154 (30.6%) of the respondents fall in the $\leq$29 age group, meaning that roughly one third of the youngest group of professionals are already in Middle Management or higher positions. As the built environment professions have traditionally been dominated by men, the percentage of males (84.1%) is therefore no surprise. It is noteworthy that 399 respondents (79.2% of the total) belonged to the "White" population group.

Table 2.a: Summary of All Data from Questionnaire Sheet

QUESTIONS / *RESPONDENTS*	*Arch*	*Eng*	*Land*	*CPM*	*Prop*	*QS*	*FM*	*Total*	*Return (%)*
1. PROFESSIONAL DISCIPLINE									
1.1 Architecture	2	-	-	-	-	-	-	2	100%
1.2 Engineering	-	387	-	-	-	-	-	387	100%
1.3 Landscape Architecture	-	-	8	-	-	-	-	8	100%
1.4 Project and Construction Management	-	-	-	42	-	-	-	42	100%
1.5 Property Valuation	-	-	-	-	15	-	-	15	100%
1.6 Quantity Surveying	-	-	-	-	-	46	-	46	100%
1.7 Facilities Management	-	-	-	-	-	-	4	4	100%
TOTAL	-	-	-	-	-	-	-	504	100%
2. QUALIFICATION	-	-	-	-	-	-	-	-	-
2.1 University of Technology/Technikon	0	121	1	15	10	6	4	157	31.2%
2.2 University	2	266	7	27	5	40	0	347	68.8%
2.3 Undergraduate	2	272	5	26	13	36	3	357	70.8%
2.4 Post-graduate	0	115	3	16	2	10	1	147	29.2%
3. REGISTRATION GRADE	-	-	-	-	-	-	-	-	-
3.1 Not registered	0	14	2	1	1	3	1	22	4.4%
3.2 In Training	0	163	1	7	0	7	0	178	35.3%
3.3 Professional	2	209	5	34	13	36	3	302	59.9%
3.4 Retired	0	1	0	0	1	0	0	2	0.4%
4. OFFICE HIERARCHY	-	-	-	-	-	-	-	-	-
4.1 Junior staff	0	88	2	2	0	5	0	97	19.2%
4.2 Middle management	0	184	1	14	2	16	2	219	43.5%
4.3 Senior/top management	2	88	4	24	8	16	2	144	28.6%
4.4 Self employed *(One-man office)*	0	27	1	2	5	9	0	44	8.7%
5. AGE GROUP	-	-	-	-	-	-	-	-	-
5.1 ≤ 29	0	133	3	5	1	12	0	154	30.6%
5.2 30 - 39	1	101	1	11	0	13	0	127	25.2%
5.3 40 - 49	0	67	2	8	11	11	1	100	19.8%
5.5 50 - 59	1	65	1	13	2	8	2	92	18.3%
5.6 60 +	0	21	1	5	1	2	1	31	6.2%
6. GENDER	-	-	-	-	-	-	-	-	-
6.1 Male	1	326	4	40	13	36	4	424	84.1%
6.2 Female	1	61	4	2	2	10	0	80	15.9%
7. POPULATION GROUP	-	-	-	-	-	-	-	-	-
6.1 Black	0	44	2	3	0	7	0	56	11.1%
6.2 Coloured/Asian	0	44	0	1	0	3	1	49	9.7%
6.3 White	2	299	6	38	15	36	3	399	79.2%

Legend:
Arch = Architect, Eng = Engineer, Land = Landscape Architect, CPM = Construction/Project Manager, Prop = Property Valuator, QS = Qunatity Surveyor and FM = Facilities Manager

Table 2.b: Summary of All Data from Questionnaire Sheet (Continued)

QUESTIONS / RESPONDENTS	Arch	Eng	Land	CPM	Prop	QS	FM	Total	Return (%)
8. IN WHICH AREA DO YOU RESIDE	-	-	-	-	-	-	-	-	-
8.1 Pretoria	1	141	3	15	7	16	2	185	36.7%
8.2 Midrand	0	25	0	1	0	3	0	29	5.8%
8.3 Johannesburg	1	123	3	17	4	21	0	169	33.5%
8.4 Evaton/Vanderbylpark	0	10	0	2	0	0	0	12	2.4%
8.5 Heidelberg/Meyerton/Vereeniging	0	9	0	1	0	1	0	11	2.2%
8.6 Germiston/Daveyton/Springs/Nigel	0	31	0	3	1	1	1	37	7.3%
8.7 Kemptonpark/Bapsfontein/Tembisa	0	15	1	1	1	1	0	19	3.8%
8.8 Cullinan/Rayton/Bronkhorstspruit	0	0	0	0	1	0	0	1	0.2%
8.9 Rosslyn/Ga-Rankuwa/Hammanskraal	0	0	0	0	0	0	0	0	0.0%
8.10 Magaliesburg/Krugersdorp	0	6	0	1	1	2	0	10	2.0%
8.11 Roodepoort/Randfontein/Soweto	0	15	0	1	0	1	1	18	3.6%
8.12 Westonaria/Carletonville	0	1	0	0	0	0	0	1	0.2%
8.13 Alberton/Lenasia/Grasmere	0	11	1	0	0	0	0	12	2.4%
9. IN WHICH AREA IS YOUR OFFICE	-	-	-	-	-	-	-	-	-
9.1 Pretoria	1	108	3	12	5	15	2	146	29.0%
9.2 Midrand	0	34	0	5	0	2	0	41	8.1%
9.3 Johannesburg	1	160	5	17	7	27	2	219	43.5%
9.4 Evaton/Vanderbylpark	0	11	0	0	1	0	0	12	2.4%
9.5 Heidelberg/Meyerton/Vereeniging	0	6	0	2	0	0	0	8	1.6%
9.6 Germiston/Daveyton/Springs/Nigel	0	38	0	4	0	1	0	43	8.5%
9.7 Kemptonpark/Bapsfontein/Tembisa	0	16	0	1	1	0	0	18	3.6%
9.8 Cullinan/Rayton/Bronkhorstspruit	0	0	0	0	0	0	0	0	0.0%
9.9 Rosslyn/Ga-Rankuwa/Hammanskraal	0	1	0	0	0	0	0	1	0.2%
9.10 Magaliesburg/Krugersdorp	0	2	0	0	0	1	0	3	0.6%
9.11 Roodepoort/Randfontein/Soweto	0	8	0	1	1	0	0	10	2.0%
9.12 Westonaria/Carletonville	0	0	0	0	0	0	0	0	0.0%
9.13 Alberton/Lenasia/Grasmere	0	3	0	0	0	0	0	3	0.6%
10. TIME SPENT TRAVELLING	-	-	-	-	-	-	-	-	-
10.1 Between Home and Office per	-	-	-	-	-	-	-	-	-
Week	7.00	2,123.63	26.00	215.50	59.00	208.16	23.50	2,662.79	5.28
10.2 Between Office and Work Sites per	-	-	-	-	-	-	-	-	-
Week	18.00	2,115.50	38.50	235.25	152.50	240.10	20.50	2,820.35	5.60
11. MILEAGE TRAVELLING	-	-	-	-	-	-	-	-	Avg.
11.1 Distance between residence and office	21.0	8,771.3	104.0	968.0	0.0	710.0	0.0	10,574.3	21.0
11.2 Annual mileage for work purposes	50,000	5,486,366	61,340	828,400	0.00	626,840	0.00	7,052,946	13,993.9
12. DO YOU RECEIVE A VEHICLE/FUEL ALLOWANCE	2	299	7	33	0	31	0	372	73.8%

Legend:
Arch = Architect, Eng = Engineer, Land = Landscape Architect, CPM = Construction/Project Manager, Prop = Property Valuator, QS = Qunatity Surveyor and FM = Facilities Manager

The non-percentage numbers in the “Return%” column depicts the average travelling time and distance of all 504 respondents.

Table 2.b deals with the areas of residence and work and travelling habits of all the respondents, which are used in this chapter and in Chapter 5 for analysis and comparison of the responses in Chapter 5.

The late Mr. G.A.J. (Gert) Basson and Mr. C.N. (Nellis) Boshoff assisted in and approved the selection of the main town groupings for areas of residence and work. Outlying areas, such as Bronkhorstspruit, Krugersdorp, Carletonville, Vanderbijlpark and Heidelberg were specifically selected to cover the whole of Gauteng. It was thought that the selection of these areas would possibly emphasise the extent of long-distance travelling by built environment professionals in Gauteng and, although only 6.9% of total number of respondents resided in these areas, this should be noted. Also of note are the single residents from Bronkhorstspruit and Carletonville who work in the Johannesburg area and the single resident from Krugersdorp who works in the Rosslyn area.

It may not be extraordinary for residents of Gauteng to commute an average of 1 hour and 4 minutes daily and to travel to work sites for a further average of 1 hour and 7 minutes, making a total daily travelling time of 2 hours and 11 minutes. If it is considered that the average number of daylight hours in Gauteng is approximately 12 hours and 15 minutes, spending 17.8% of that time in a vehicle might be considered excessive.

Only a handful of those respondents who are self-employed, actually have home offices and indicated a zero distance to office. The average distance between respondents' homes and their places of work is 21 kilometres, which means that the average respondent resides in, for example, Kempton Park and works in central Johannesburg. The reasons for this may be the subject of a study on its own but, from the unproduced, full datasheet, it was noted that the professionals in the youngest age group lived nearer to their places of work than those in the middle age groups of 30-39 and 40-49 years. Possible explanations for this could be that respondents have purchased

their houses, have children at school and have established neighbourhood friendships on which they rely for social and other support and therefore do not wish to uproot themselves.

Table 2.c: Summary of All Data from Questionnaire Sheet (Continued)

QUESTIONS	RESPONDENTS	Arch	Eng	Land	CPM	Prop	QS	FM	Total	Return (%)
13. WHICH SOFTWARE PROGRAMS DO YOU USE		-	-	-	-	-	-	-	-	-
13.1 Computer Assisted Drawing		-	-	-	-	-	-	-	-	-
13.1.1		0	2	0	0	0	0	0	2	0.4%
13.1.2		0	0	0	0	0	0	0	0	0.0%
13.1.3	Usage frequency (converted to Daily)		Man Days	162.4		Usage Percentage	55.6%	of all software usage respondents		
	13.1.3.1 Daily	2	121	7	12	0	6	0	148	50.7%
	13.1.3.2 Weekly	0	53	0	4	0	3	0	60	20.5%
	13.1.3.3 Monthly	0	20	0	2	0	2	0	24	8.2%
	13.1.3.4 Occasionally	0	57	0	3	0	0	0	60	20.5%
13.2 Quantity Surveying & Contractors Quantities		-	-	-	-	-	-	-	-	-
13.2.1		0	0	0	0	0	0	0	0	0.0%
13.2.2		0	0	0	0	0	0	0	0	0.0%
13.2.3	Usage frequency (converted to Daily)		Man Days	74.7		Usage Percentage	53.7%	of all software usage respondents		
	13.2.3.1 Daily	0	31	1	5	0	29	0	66	47.5%
	13.2.3.2 Weekly	0	29	0	2	0	7	0	38	27.3%
	13.3.3.3 Monthly	0	11	0	1	0	0	0	12	8.6%
	13.3.3.4 Occasionally	0	17	0	2	0	4	0	23	16.5%
13.3 Project Management		-	-	-	-	-	-	-	-	-
13.3.1		0	1	0	0	0	0	0	1	0.2%
13.3.2		0	0	0	0	0	0	0	0	0.0%
13.3.3	Usage frequency (converted to Daily)		Man Days	63.5		Usage Percentage	29.2%	of all software usage respondents		
	13.3.3.1 Daily	0	32	0	13	0	2	0	47	21.7%
	13.3.3.2 Weekly	0	50	1	10	0	2	0	63	29.0%
	13.3.3.3 Monthly	1	46	0	6	0	2	0	55	25.3%
	13.3.3.4 Occasionally	0	45	0	4	0	3	0	52	24.0%
13.4 Property Valuation		-	-	-	-	-	-	-	-	-
13.4.1		0	1	0	0	0	0	0	1	0.2%
13.4.2		0	0	0	0	0	0	0	0	0.0%
13.4.3	Usage frequency (converted to Daily)		Man Days	8.0		Usage Percentage	36.5%	of all software usage respondents		
	13.4.3.1 Daily	0	6	0	0	0	1	0	7	31.8%
	13.4.3.2 Weekly	0	2	0	1	0	0	0	3	13.6%
	13.4.3.3 Monthly	0	4	0	2	0	0	0	6	27.3%
	13.4.3.4 Occasionally	0	5	0	0	0	1	0	6	27.3%
13.5 Facilities Management		-	-	-	-	-	-	-	-	-
13.5.1		0	0	0	0	0	0	0	0	0.0%
13.5.2		0	0	0	0	0	0	0	0	0.0%
13.5.3	Usage frequency (converted to Daily)		Man Days	15.9		Usage Percentage	55.0%	of all software usage respondents		
	13.5.3.1 Daily	1	14	0	0	0	0	0	15	51.7%
	13.5.3.2 Weekly	0	2	0	1	0	0	0	3	10.3%
	13.5.3.3 Monthly	0	2	0	1	0	0	1	4	13.8%
	13.5.3.4 Occasionally	0	5	0	0	0	2	0	7	24.1%

Legend:
Arch = Architect, Eng = Engineer, Land = Landscape Architect, CPM = Construction/Project Manager, Prop = Property Valuator, QS = Qunatity Surveyor and FM = Facilities Manager

Table 2.c deals solely with respondents' software usage and is used to analyse and address one of the problems stated in this study.

All the usage frequency responses (Weekly, Monthly and Occasionally) were converted to a "Daily" frequency format by the conversion factors calculated in Section 1.8.9 above and are shown adjacent to the "Usage frequency (converted to Daily)" rows as "Man Days". For example, under sub-section 13.1.3 of the Questionnaire, 148 respondents indicated that they used CAD software on a daily basis, 60 respondents indicated weekly usage, 24 respondents indicated monthly usage and a further 60 indicated occasional usage. The 162.4 "Man Days" are therefore calculated as follows:

Usage	Respondents	Factor	Daily Conversion
Daily	148	1.000	148.000
Weekly	60	0.200	12.000
Monthly	24	0.053	1.272
Occasionally	60	0.018	1.080
Total "Man Days" usage			162.4 (rounded)

It is interesting to note that the 387 engineering discipline respondents, as indicated in Table 2.a, only used CAD software for 34.5% of the time during their daily routine (133.686 Man Days ÷ 387 respondents = 34.54%) or for 2 hours and 46 minutes of a normal 8-hour working day. If one the average daily travelling time of 1 hour and 6 minutes to work sites is added to this, 3 hours and 52 minutes of an average engineer's time per day are accounted for from this survey. The remaining 4 hours and 8 minutes are then most probably spent in attending meetings and discussions and in carrying out other administrative duties.

Table 2.d: Summary of All Data from Questionnaire Sheet (Continued)

QUESTIONS / RESPONDENTS	Arch	Eng	Land	CPM	Prop	QS	FM	Total	Return (%)
14. GENERAL	-	-	-	-	-	-	-	-	-
14.1 Do you experience problems with program compatability	2	87	1	7	0	11	1	109	21.6%
14.2 Do you use more than one of the same program type to satisfy client needs	2	115	1	11	2	9	1	141	28.0%
15. ARE YOU KNOWLEDGEABLE ABOUT WHAT THE FOLLOWING	-	-	-	-	-	-	-	-	-
15.1 WIMAX	0	33	0	3	0	1	0	37	7.3%
15.2 WI-FI	1	153	4	24	2	19	1	204	40.5%
15.3 ADSL	2	258	8	34	13	37	3	355	70.4%
15.4 ISDN	2	234	5	35	9	26	4	315	62.5%
15.5 CDMA	0	26	0	2	0	3	0	31	6.2%
15.6 W-LAN	1	120	3	18	3	11	4	160	31.7%
15.7 WLL	0	12	0	2	0	3	0	17	3.4%
15.8 Metro Ethernet	0	32	0	1	0	2	0	35	6.9%
15.9 GSM (GPRS/G3/WAP)	2	220	5	30	4	23	0	284	56.3%
15.10 Video Conferencing	2	253	8	29	7	32	4	335	66.5%
15.11 Video Phone	1	186	8	24	7	25	4	255	50.6%
15.12 Web Cam	1	211	8	25	4	29	3	281	55.8%
16. IF POSSIBLE, WOULD YOU *(Please mark selections)*	-	-	-	-	-	-	-	-	-
16.1 work from hor	0	250	5	24	10	20	3	312	61.9%
16.2 make use of video conferencir	1	212	5	28	4	20	1	271	53.8%
16.3 combine home and office bound wor	1	269	3	36	9	28	2	348	69.0%
16.4 prefer flexitime with set performance schedules/dates	1	276	6	32	9	28	2	354	70.2%
16.5 reduce time spent travelling for, and to and from work	1	258	4	29	8	27	4	331	65.7%
16.6 rely on knowledgeable people/technologies to be your "on-site eyes"	1	206	4	22	5	15	4	257	51.0%
16.7 appreciate having safe/secure roadside "internet cafés" on major routes	0	116	1	13	4	13	1	148	29.4%
16.8 prefer software "type" compatability to be regulated by industry standards	0	183	1	20	3	21	2	230	45.6%
16.9 have consultant meetings at high technology stations midway between offices	2	144	6	21	1	22	2	198	39.3%
16.10 have site meetings at high technology stations midway between office and site	0	107	3	12	2	14	1	139	27.6%

Legend:
Arch = Architect, Eng = Engineer, Land = Landscape Architect, CPM = Construction/Project Manager, Prop = Property Valuator, QS = Qunatity Surveyor and FM = Facilities Manager

The problems experienced with software usage, telecommunication technology knowledge are summarised in Table 2d, together with some of the question options which are used to analyse respondents' preferences and address all three sub-problems covered in this study.

The answers or options selected in the questions in Section 15 of the Questionnaire are presented fully in Table 3 on page 64 and the findings based on these responses are presented further on. Analyses of these are presented in Chapter 5.

The Engineering discipline is the best represented of all the disciplines, with 387 respondents representing a total of 76.8% of all the respondents. It is therefore interesting to note the responses of such a large group and engineers could be considered as being technologically advanced users of modern computer and telecommunication technologies. This holds true for the 258 respondents who indicated their knowledge of ADSL (66.7%), 234 for ISDN (60.5%) and 253 for Video Conferencing (65.4%). Although engineers are perceived to be knowledgeable about various modern technologies, it is interesting to note that the average telecommunication knowledge of this group is only 37.4%, if the total number of selections made is divided by the 12 telecommunication technologies and by the 387 respondents in the engineering discipline.

Section 16 of the Questionnaire contains 10 preference options, which in essence address all three of the sub-problems and the identified Sub-problems of the study, the response to which are indicative of how professionals in the built environment would prefer to work. This information is used in Chapter 5 for analysis of the data.

The introductory section of this chapter addressed the use of a summary of all data received and some interesting and notable findings. The findings relating to the Main and three Sub-problems described in Chapter 1 are

presented in Sections 4.2 – 4.5 below in the same sequence as the Sub-problems identified in Chapter 1.

4.2 MAIN PROBLEM

The main problem is stated as: “Are built environment professionals in the construction industry aware of available telecommunication technologies that can assist them to utilise time more efficiently and reduce travelling?” As an answer to this question can only be obtained if the sub-problems are answered, the findings on sub-problems are therefore addressed first.

4.3 FINDINGS ON SUB-PROBLEM 1.4.1

The first hypotheses is that younger professionals have greater knowledge of the potential that telecommunication technologies have to assist them in working more efficiently and are more inclined towards using modern telecommunication technologies than their older colleagues. The question: “Is there a prevailing age gap in telecommunication technology knowledge?” therefore needs to be addressed.

The Questionnaire was set up in such a way that the age groups of respondents could be used to group together other responses, such as which respondent’s race group and one or more examples plus what is planned. The responses in Section 15 of the Questionnaire are therefore grouped into those submitted by the five age groups, namely ≤29, 30 - 39, 40 - 49, and 50 - 59 and 60+ years of age as indicated in Sub-section 1.5 of the Questionnaire. These data were then compiled in a large spreadsheet and then summarised in table format to show the responses by the different age groups to each telecommunication technology knowledge question. The results are given in Table 3 below.

Table 3: Telecommunication Technology Knowledge

Telecommunication Technology Knowledge												
Age Groups	≤ 29		30 - 39		40 - 49		50 - 59		60 +		All	
Possible Questions	1848	%	1524	%	1200	%	1104	%	372	%	6048	%
Respondents	154	30.6	127	25.2	100	19.8	92	18.3	31	6.2	504	100
WiMAX	18	11.7	6	4.7	9	9.0	2	2.2	2	6.5	37	7.3
Wi-Fi	70	45.5	52	40.9	37	37.0	35	38.0	10	32.3	204	40.5
ADSL	111	72.1	88	69.3	80	80.0	58	63.0	18	58.1	355	70.4
ISDN	99	64.3	82	64.6	68	68.0	52	56.5	14	45.2	315	62.5
CDMA	14	9.1	6	4.7	6	6.0	3	3.3	2	6.5	31	6.2
W-LAN	53	34.4	41	32.3	37	37.0	24	26.1	5	16.1	160	31.7
WLL	7	4.5	4	3.1	3	3.0	3	3.3	0	0.0	17	3.4
MetroNet	14	9.1	4	3.1	11	11.0	5	5.4	1	3.2	35	6.9
GSM	105	68.2	76	59.8	56	56.0	37	40.2	13	41.9	287	56.9
VidConf	114	74.0	87	68.5	68	68.0	54	58.7	12	38.7	335	66.5
VidPhone	99	64.3	65	51.2	45	45.0	36	39.1	10	32.3	255	50.6
WebCam	113	73.4	68	53.5	51	51.0	38	41.3	11	35.5	281	55.8
Total Responses	817	40.8	579	35.1	471	36.2	347	29.0	98	24.3	2312	38.2

The number adjacent to “Possible Questions” is calculated by multiplying the number adjacent to “Respondents” in each age group by the 12 sub-section questions asked in Section 15.

These figures then provide a base from which calculation of the percentage of respondents with knowledge of a specific telecommunication technology and are explained as follows:

- The 12 questions in Section 15 are multiplied by the 154 respondents in the ≤29 age group, giving a total of 1,848 possible selections.
- Of the 154 respondents in the ≤29 age group, 18 indicated their knowledge of the Wi-MAX telecommunication technology which represents 11.7% with knowledge of this technology.

154 of the total of 504 respondents (30.6 %) are in the ≤29 age group,

The telecommunication technology knowledge of each age group is compared with the total simple average knowledge of all age groups. In Table 3, 11.7% of the ≤29 age group is indicated as having Wi-MAX knowledge, with 7.3% of all respondents having knowledge of this technology. The difference thus indicates that the Wi-MAX knowledge of the ≤29 age group is 4.4% above the total average. The data from Table 3 are used to present the results in a graphical format as depicted in Figure 1 in Chapter 5.

This section addressed correspondents' telecommunication knowledge as revealed in the Questionnaire and summarised the findings thereof. The travelling habits of professionals in the built environment sector are addressed in Section 4.4 below.

4.4 FINDINGS ON SUB-PROBLEM 1.4.2

The second hypothesis is that professionals in the construction industry want to reduce travelling time for various reasons but do not know how to go about it. The question: "What are the travelling habits of professionals in the construction industries?" was therefore asked.

The data for addressing this Sub-problem was drawn from a number of the sections and sub-sections in the Questionnaire, the compilation of which was

rather complex. The raw data was compiled in a large spreadsheet and then split into four tables, namely: Table 4: Morning Commuting between Residence and Office, Table 5: Afternoon Commuting between Office and Residence, Table 6: Travelling Reduction Preferences and Table 7: Travelling Time and Distance. These tables are given below with explanations of how the data in each table were handled.

Morning commuting between area of residence and area of work are summarised in Table 4 below.

Table 4: Morning Commuting between Residence and Office

Residence Area	Respondents	Office Area	Resident Office	Flow	
				Out	In
Pretoria	185	Midrand	135	14	11
		Johannesburg		24	
		Vanderbylpark		1	
		Germiston		5	
		Kemptonpark		5	
		Krugersdorp		1	
Midrand	29	Pretoria	9	3	32
		Johannesburg		10	
		Germiston		3	
		Kemptonpark		3	
		Roodepoort		1	
Johannesburg	169	Pretoria	139	3	80
		Midrand		11	
		Germiston		12	
		Kemptonpark		1	
		Roodepoort		1	
		Alberton		2	
Vanderbylpark	12	Midrand	8	1	4
		Heidelberg		3	
Heidelberg	11	Midrand	4	1	4
		Johannesburg		3	
		Vanderbylpark		3	
Germiston	37	Pretoria	20	2	23
		Midrand		1	
		Johannesburg		10	
		Heidelberg		1	
		Kemptonpark		3	
Kemptonpark	19	Pretoria	5	2	13
		Midrand		1	
		Johannesburg		10	
		Roodepoort		1	
Bronkhorstspruit	1	Johannesburg	0	1	0
Rosslyn	0	Rosslyn	0	0	1
Krugersdorp	10	Midrand	2	2	1
		Johannesburg		4	
		Rosslyn		1	
		Roodepoort		1	
Roodepoort	18	Johannesburg	6	12	4
Carletonville	1	Johannesburg	0	1	0
Alberton	12	Pretoria	1	1	2
		Midrand		1	
		Johannesburg		5	
		Germiston		3	
		Kemptonpark		1	
Total Outflow Commuting		175	Percentage		34.7

The “Residence Area” is the area indicated by the respondent as his place of residence and “Respondents” represents the number of respondents residing in that area. The “Office Area” is the area indicated by respondents as the area in which the office or actual place of work is. “Resident Office” means that the office or place of work of a respondent is in the same area as the place of residence. If a respondent therefore has a resident office, it does not necessarily mean that the respondent does not travel to an actual office. A resident office respondent still travels and stated the distance between residence and office with the only exception those respondents who indicated a zero distance between home and office. Such respondents also did not select the preference to work from home or combine home and office bound work. The “Out” column of the “Flow” section represents the number of respondents moving from their area of residence to another area in which their offices or workplaces are located. The “In” column of the “Flow” section represents the number of respondents moving into the area of their workplace or office from the area in which they live. For example, from Table 4, in which 185 respondents list Pretoria as their place of residence, 135 have their places of work in the same area as their residences. Fifty respondents therefore commute from the Pretoria area to other areas as indicated in the Pretoria row. Eleven respondents residing in other areas commute into the Pretoria area.

As explained in the notes with Table 2.b, the areas of residence and work were selected to cover the outlying areas of Gauteng and it should be noted that none of the respondents lived in the Rosslyn area. It should also be noted that no predictions with regard to any possible number of residents or places of work in an area were made. The object of selecting the areas was to cover Gauteng broadly and possibly to group those areas with the highest population densities into one general area. Rosslyn was selected in order to cover all the areas north-west of Pretoria and Bronkhorstspruit the north-eastern areas.

Afternoon commuting between areas of work and areas of residence is summarised in Table 5 below.

Table 5: Afternoon Commuting between Office and Residence

Office Area	Respondents	Residence Area	Office	Flow	
				Out	In
Pretoria	185	Midrand	146	3	39
		Johannesburg		3	
		Germiston		2	
		Kemptonpark		2	
		Alberton		1	
Midrand	29	Pretoria	41	14	-12
		Johannesburg		11	
		Vanderbylpark		1	
		Heidelberg		1	
		Germiston		1	
		Kemptonpark		1	
		Krugersdorp		2	
		Alberton		1	
Johannesburg	169	Pretoria	219	24	-50
		Midrand		10	
		Heidelberg		3	
		Germiston		10	
		Kemptonpark		10	
		Bronkhorstspruit		1	
		Krugersdorp		4	
		Roodepoort		12	
		Carletonville		1	
Vanderbylpark	12	Pretoria	12	1	0
		Heidelberg		3	
Heidelberg	11	Germiston	8	1	3
		Vanderbylpark		3	
Germiston	37	Pretoria	43	5	-6
		Midrand		3	
		Johannesburg		12	
		Heidelberg		3	
		Kemptonpark		10	
		Alberton		3	
Kemptonpark	19	Pretoria	18	5	1
		Midrand		3	
		Johannesburg		1	
		Germiston		3	
		Alberton		1	
Bronkhorstspruit	1	Johannesburg	1	0	0
Rosslyn	0	Krugersdorp	1	0	-1
Krugersdorp	10	Pretoria	2	1	8
Roodepoort	18	Pretoria	10	1	8
		Midrand		1	
		Kemptonpark		1	
		Krugersdorp		1	
Carletonville	1	Johannesburg	0	0	1
Alberton	12	Johannesburg	3	1	9
Total Outflow Commuting		181	Percentage		35.9

The “Office Area” is the area indicated by the respondents as their place of work and “Respondents” represents the numbers of respondents living in that area. The “Office” is the area by the respondents as the area in which their office or place of work is located. The “Out” column of the “Flow” section indicates the numbers of respondents travelling from the area of their offices to another area in which their homes are is located. The “In” column of the “Flow” section means that the numbers of respondents travelling into their area of residence from another area where their offices or workplace are located. For example, in Table 5, where Pretoria is indicated as place of work for 146 respondents and in Table 4 which indicates that only 135 are resident in the area, there is a net afternoon outflow of 11 office workers who have their homes in other areas. It may therefore erroneously indicate that only 39 residents return to the Pretoria are from other areas of work whereas, in actual fact, Table 4 indicates that 50 residents actually return home from other areas. Care should therefore be taken not to try to balance morning and afternoon commuting figures, as Table 4 deals with area of residence and Table 5 with place of work.

Data on travelling and travelling related preferences were gathered from the answers in Sub-sections 16.1, 16.3, 16.5, 16.6, 16.7, 16.9 and 16.10 of the Questionnaire. The questions in these sub-sections are specifically related to travelling, the full question in Subsection 16.1 reading: “If possible, would you work from home?” This can be construed as meaning a number of things but, if the context within which the Questionnaire is set up is taken into consideration, it is very likely that, if this were selected as a preference, it would mean the respondent would rather not travel. The responses to these questions are summarised in Table 6 below.

Table 6: Travelling Reduction Preferences

Travelling Reduction Preferences												
Age Groups	≤ 29		30 - 39		40 - 49		50 - 59		60 +		All	
Possible Questions	1078	%	889	%	700	%	644	%	217	%	3528	%
Respondents	154	30.6	127	25.2	100	19.8	92	18.3	31	6.2	504	100
Work from Home	95	61.7	78	61.4	63	63.0	57	62.0	19	61.3	312	61.9
Combine Home and Office Work	100	64.9	99	78.0	73	73.0	59	64.1	17	54.8	348	69.0
Reduce Commuting Time	110	71.4	82	64.6	67	67.0	60	65.2	12	38.7	331	65.7
Utilise "on-site eyes"	86	55.8	64	50.4	51	51.0	44	47.8	14	45.2	259	51.4
Utilise i-Cafés on Major Routes	64	41.6	34	26.8	30	30.0	15	16.3	6	19.4	149	29.6
Consultant Meetings at i-Cafés	71	46.1	59	46.5	34	34.0	31	33.7	4	12.9	199	39.5
Site Meetings at i-Cafés	50	32.5	39	30.7	29	29.0	19	20.7	3	9.7	140	27.8
Total Responses	576	53.4	455	51.2	347	49.6	285	44.3	75	34.6	1738	49.3

The number 1,078 adjacent to “Possible Questions” under the ≤29 age group is derived from multiplying the 154 “Respondents” in the age group by the seven applicable Sub-section questions in Section 16.

The 154 respondents in the <29 age group represent a 30.6% of all 504 respondents. The 95 respondents in this age group who indicated that they would prefer to “Work from Home” represent 61.7% of the respondents in this age group.

The data on actual travelling from a respondent’s residence to the office and from office to site are summarised from the raw data table. The data provided on distances between residence and office, between office and work sites and the time spent on for these specific types of travel, as well as whether a respondent receives a fuel/vehicle allowance were also taken from the raw data table. Raw data were given in a variety of daily, weekly or monthly formats and were converted to a weekly format by applying the conversion factors described in Section 1.8.9. Annual travel for work purposes was selected as the response format as respondents could make use of the information provided on their personal income tax vehicle log sheets and copy it onto the Questionnaire.

A summary of all the time- and distance-related travelling habits of the various age groups are presented in Table 7 below and shows the numbers of respondents who receive fuel or travelling allowances. In this table time is given in hours and distances in kilometres. “Time Travel” for all the respondents in the different age groups, is given in hours per week. The totals for each age group were divided by the numbers of respondents in the relevant group so as to arrive a single average figure for each group in the “Each” column. The data in the “Man Work Days” rows are derived by multiplying the weekly travel time by the annual week conversion factor described in Section 1.8.9 and dividing this by eight working hours per day. The “Average Speed” is obtained from dividing the total annual mileages by the converted total annual number of hours spent driving. The fuel/vehicle allowance response is given as the number of respondents receiving this allowance and the percentage of respondents in each age group who receive this allowance.

The findings on the travelling habits, traveling preferences and time and distance spent travelling for commuting and work purposes by professionals in the built environment had beed addressed in this Section. The next Section will address the findings on questions regarding software usage by professionals

4.5 FINDINGS ON SUB-PROBLEM 1.4.3

The third hypotheses is affirmed as stated in Chapter 1, that professionals in the construction industries use a myriad of same type software programs that are sometimes incompatible with each other. The question: “Which software programs are utilised and what problems are experienced with regard compatibility?” is therefore raised and needs to be addressed.

Section 13 of the Questionnaire make provision for a number of options and selections by respondents and as previously stated, not completed sufficiently to provide a reliable analysis. However, raw data can be utilised to provide some answers to the problem. The responses to “Daily”, “Weekly”, and “Monthly” and “Occasionally” selections in Section 13 had been converted to a daily format by the factors provided in Section 1.8.9 of this study. Sub-problem 1.4.1 makes reference to the differences between the age groups and again, the responses by the different age groups would be used to analyse provided data. The responses to Section 14 of the Questionnaire regarding questions on software program compatibility and multiple usage of same program types to satisfy clients needs, is relevant and included in Table 8 and Graph 8 on the ensuing pages. The responses to the question on legislation to control software “type” compatibility in Sub-section 16.8 resorts under the software usage data and is incorporated in the summary in Table 8: Software Program Usage, Problems and Preferences, produced on the next page.

Table 7: Travelling Distance and Time

Travelling Between Residence and Office and Office to Site												
Age Groups	≤ 29		30 - 39		40 - 49		50 - 59		60 +		All	
Respondents	154	Each	127	Each	100	Each	92	Each	31	Each	504	Each
Time Travel Between Res. & Office	806.76	5.24	669.63	5.27	577.40	5.77	490.75	5.33	129.25	4.17	2673.79	5.31
Time Travel Between Office & Site	667.75	4.34	627.10	4.94	787.75	7.88	543.00	5.90	183.75	5.93	2809.35	5.57
Man Work Days Commuting	-	29.87	-	30.06	-	32.92	-	30.41	-	23.77	-	30.25
Man Work Days Travel to Site	-	24.72	-	28.15	-	44.91	-	33.65	-	33.79	-	31.78
Distance from Res. to Office	3157.5	20.50	2838.0	22.35	2418.0	24.18	2072.3	22.52	440.5	14.21	10926.3	21.68
Annual Mileage (km) for Work Purposes	1756874	11408.3	1778503	14004.0	1813106	18131.1	1568614	17050.2	441395	14238.5	7358492	14600.2
Average Speed Between Residence & Office	-	39.14	-	42.38	-	41.88	-	42.23	-	34.08	-	40.86
Average Speed Between Office & Site	-	57.69	-	62.18	-	50.46	-	63.34	-	52.67	-	57.43
Receiving Fuel Allowance	113	73.4%	98	77.2%	83	83.0%	68	73.9%	26	83.9%	388	77.0%

Table 8: Software Program Usage, Problems and Preferences

Software Program Usage, Compatability Problems & Preferences												
Age Groups	≤29		30 - 39		40 - 49		50 - 59		60 +		All	
Respondents	154	30.6%	127	25.2%	100	19.8%	92	18.3%	31	6.2%	504	100.0%
Annual Software Program Usage												
Software Program Usage	Days	Usage	Days	Usage	Days	Usage	Days	Usage	Days	Usage	Days	Usage
Computer Assisted Drawing	68.3	29.9%	36.5	16.0%	24.3	10.6%	24.6	10.8%	10.9	4.8%	164.4	14.4%
Quantity Surveying	23.6	10.3%	20.2	8.9%	17.9	7.9%	8.2	3.6%	4.7	2.1%	74.7	6.5%
Project Management	19.0	8.3%	13.9	6.1%	13.4	5.9%	13.7	6.0%	4.8	2.1%	64.9	5.7%
Property Valuation	4.1	1.8%	1.1	0.5%	6.5	2.8%	0.8	0.3%	0.2	0.1%	12.7	1.1%
Facilities Management	4.1	1.8%	3.5	1.5%	5.1	2.2%	2.4	1.0%	2.0	0.9%	17.1	1.5%
Software Program Usage Problems												
Compatability Problems	44	28.6%	32	25.2%	15	15.0%	12	13.0%	6	19.4%	109	21.6%
Multiple Program Usage	56	36.4%	35	27.6%	25	25.0%	18	19.6%	7	22.6%	141	28.0%
Preference Towards Industry Regulation of Software Programs												
Regulatory Standards	84	54.5%	58	45.7%	43	43.0%	33	35.9%	12	38.7%	230	45.6%

The reader is referred to the explanations provided with Table 2.c for an explanation of how the data in Table 8 are presented. The responses to the questions provided in Table 2.c are summarised in Table 8. Of note is the total average of all specialist software program usages, such as CAD, Project Management, etc. during the normal course of a work day. Overall, program usage problems are fairly low but the response to industry regulatory standards should be noted. The percentages under the “Usage” column are

calculated by dividing the total calculated “Daily” usage data by the total number of Man Work Days. The percentages under the Software Program Usage Problems and Preference Towards Industry Regulation of Software Programs headings are simple percentages calculated by dividing the number of positive responses by the number of Respondents in each Age Group. These age groupings will be used to address the sub-problem on prevailing age gaps.

The use and associated problems and preferences with regard to specialist software programs in use by professionals, was addressed in this section. The findings on the three stated sub-problems are addressed in Section 4.6.

4.6 SUMMARY

At the beginning of this chapter, the sections and sub-sections in the Questionnaire were grouped together in Table 1: Summary of Grouping of Questions to Address Problems in order to address the Main and Sub-problems. This table provided some order to the process of presenting the findings.

The unproduced raw data table from this research and the summarised data depicted in Tables 2.a – 2.d provided the core data for addressing the Main and Sub-problems.

In this chapter, the data obtained from the Questionnaire were summarised and used to prepare further calculations and results. The results were then summarised in tables from which graphs and spider maps were produced to display the results in Chapter 5 and in the Annexures in graphical format. With the exception of Section 13 of the Questionnaire, the questions and problems raised were answered satisfactorily and the data could be used to obtain reliable findings. As stated in Section 3.4 : Review of Questionnaire, Section 13 was not properly completed by the respondents and possible reasons for this were given. Considering that the total response on software

program usage of 45.6%, as derived from converting all the software usage summarised in Table 2.c by applying the conversion factors in Section 1.8.9 , was achieved, the findings will be used with circumspection.

The findings of this chapter will be used in Chapter 5 to analyse and find results.

Note: Some data anomalies may appear. These are the result of the mathematical rounding of two different calculation processes. For example, the 5.28 hour per week "Time Spent Travelling Between Home and Office," as shown in Table 2.b, is derived from rounding of the respondent averages of the different built environment disciplines to the second decimal place. The 5.31 hour per week "Time Travel Between Res. & Office," as shown under "All" in Table ,7 is derived by applying the third decimal conversion factor in Section 1.8.9 to data in the unproduced, full datasheet of all respondents. This 0.03 hour difference translates to a difference of 1.8 minutes per week, which is negligible.

5 RESEARCH RESULTS AND SUMMARY

5.1 INTRODUCTION

The findings of Chapter 4 are presented in this chapter in the same sequence as presented in that chapter. In an effort to track and control the problems, tables, maps and graphs for reference purposes, Table 9 is presented below.

Table 9: Research Results and Summary Control

Problem	Description of Problem	Tables	Maps	Graphs
Main Problem	Are built environment professionals in the construction industry aware of available telecommunication technologies that can assist them to utilise their time more efficiently by reducing travelling?	Tables 2, 3, 4, 5, 6, 7 and 8	Figure 3 and Figures E1 to Q1 in Annexures E-Q	Figures 1, 2, 4, 5, 6 and 7
Sub-problem 1.4.1	Is there a prevailing age gap in telecommunication knowledge? (Specific disciplines, qualifications, registration, office hierarchy, age, gender and population group are linked to telecommunication technology knowledge.)	Tables 2.a, 2.c, 2.d and 3	-	Figure 1
Sub-problem 1.4.2	What are the travelling habits of professionals in the construction industry? (From and to where do they travel, for what purpose? How many hours do they spend travelling and what would they like to do to reduce their travelling times?)	Tables 2.a, 2.b, 2.d, 4, 5, 6 and 7	Figures E1 to Q1 in Annexures E-Q	Figures 2, 4 and 5
Sub-problem 1.4.3	What software programs do they use and what problems do they experience with regard to compatibility?	Tables 2.c, 2,d and 8	-	Figure 6

Sub-problems 1.4.1, 1.4.2 and 1.4.3, based on the findings in Chapter 4 will be addressed in the same sequence and, as stated in Section 4.2, will culminate in addressing the Main Problem.

5.2 RESULTS FOR SUB-PROBLEM 1.4.1

The problem as stated in Chapter 1 is quoted: "The first sub-problem is to establish whether telecommunication technology knowledge differs between different age groups". Questions on specific disciplines, qualifications and registration, office hierarchy, age, gender, and population groups were therefore asked and linked to the responses on telecommunication technology knowledge.

5.2.1 In the Questionnaire, the age groups were placed in 10-year span age groups, with the assumption that the $\leq$29 year age group represented the mostly recently registered professionals in the built environment sector, but were of an age that had been brought up in a rapidly expanding telecommunication technology market and that they would therefore be fairly knowledgeable about what such technologies could offer.

All the responses to the Questionnaire were grouped together in the following Tables as indicated in Chapter 4: Table 1: Summary of Grouping of Questions to Address Problems, and were further detailed and summarised in Table 3: Telecommunication Technology Knowledge. The graph in Figure 1: Telecommunication Technology Knowledge was produced from Table 3 and is shown below.

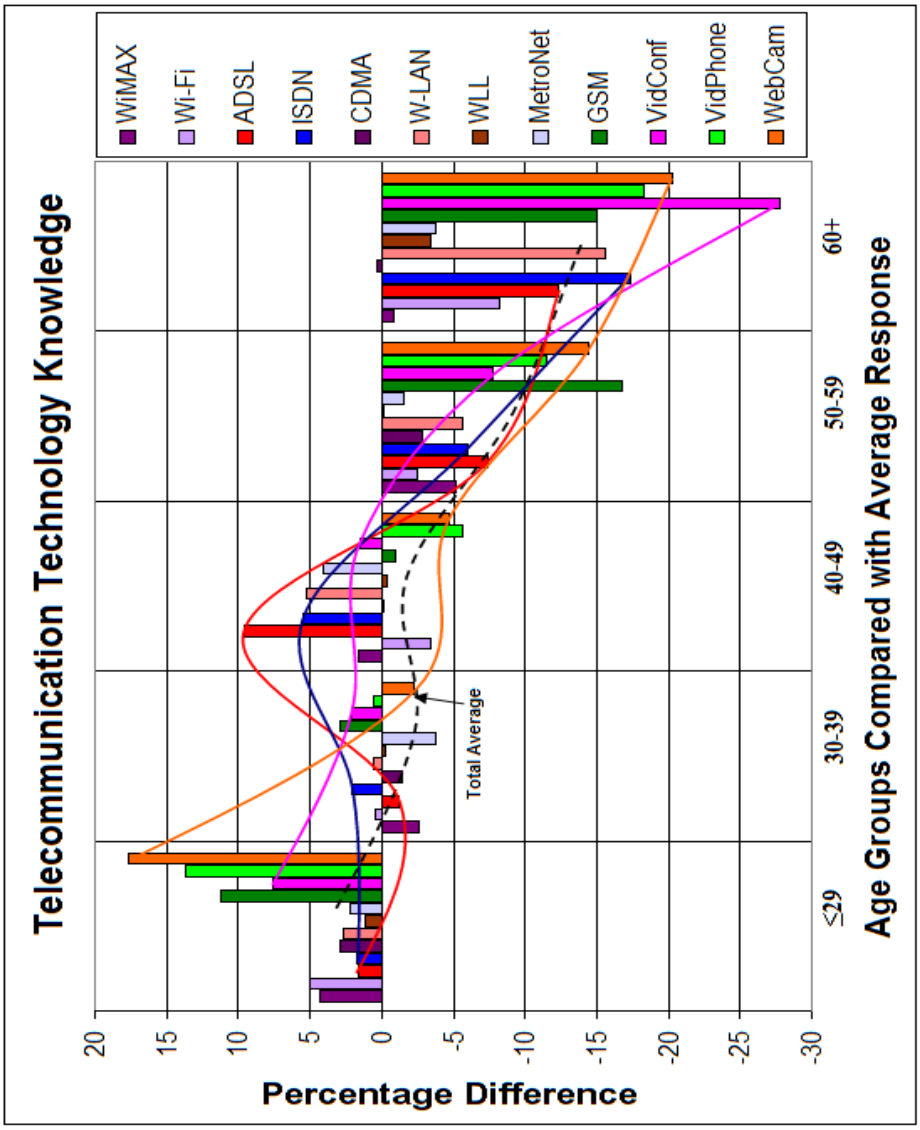

Figure 1: Telecommunication Technology Knowledge

The vertical or Y-axis of the graph indicates the positive and negative percentages from the total average and the horizontal or X-axis indicates the different age groups.

Tendency lines are shown to indicate a possible trend in telecommunication technology knowledge for the different age groups and for all the respondents as a whole. In addition, tendency lines for the responses received from each age group

to a specific telecommunication technology knowledge equal to or greater than 66%, as shown in Table 3, are drawn to illustrate the differences between the different age groups. A total average tendency line is also indicated so as to the differences in overall telecommunication technology knowledge between the various age groups.

The tendency lines in Figure 1 are based on the average responses to the specific telecommunication technology knowledge of each age group and on the overall tendency line from the simple average for all age groups

In Figure 1, it is clear that there is a downward trend from the ≤29 year age group to the 60+ age group, which immediately gives the impression that the hypothesis about prevailing age gaps has been proved. The "Total Average" broken line also indicates that this is true. With reference to Chapter 4 with regard to the knowledge of Wi-MAX by the ≤ 29 year age group In Table 3, 11.7% of the ≤29 year age group are indicated as having Wi-MAX knowledge by comparison with 7.3% of all the respondents with knowledge of this technology. The difference thus indicates that the percentage of the ≤29 age group with knowledge of Wi-Max is 4.4% larger than the percentage of all the respondents with this knowledge. This difference is shown in Figure 1.

5.2.2 As it was considered that any response percentage below the total average of 38.2% of the total number of respondents to a particular telecommunication technology question indicates a general lack of knowledge, these telecommunication technology responses will not be investigated or commented on any further. Wi-Fi is a widely used telecommunication

technology in business-oriented hotels, cafés and airport lounges and there is an almost straight line decline in knowledge from the younger to the older age groups in the percentages with knowledge of this particular technology. With the exception of the 40-49 year age group, this is also true for ADSL. Of interest, however, is the clear indication that the general knowledge of available telecommunication technology knowledge of the 40-49 age group is superior to that of the 30-39 age group but seemingly inferior to that of the ≤29 age group. Based on the overall averages in the unproduced, full datasheet derived from the individual responses, several of the respondents were found to be line managers in the telecommunication industry. These respondents marked all the telecommunication technologies questions presented in Section 15 of the Questionnaire. This may therefore be a viable explanation for the variation in the downward trend line. ISDN is an older generation, fixed line, high-speed telecommunication technology known to all age groups, with the declining trend and a slight variation for the 40-49 age group similar to that relating to the ADSL trend line. GSM, Video Conferencing, Video Phone and Webcam are all newer technologies and the general downward trend in knowledge over the age groups is indicated. If one looks at the telecommunication technology knowledge of an age group as provided in Figure 1, the general downward trend from the youngest to the oldest age groups is clear, the average for the 40-49 age group being just 0.6% above that for the 30-39 age group but still 4.6% below that for the ≤29 age group. The question then remains, why does Figure 1 indicate an upward variation in the extent of telecommunication technology knowledge among the 40-49 age group if Table 3 only indicates minor variations? The graph in Figure 1 is derived from the differences between the average

extent of a specific telecommunication technology knowledge and the extent of this knowledge among a specific age group. This difference thus emphasises any minor difference between the age groups. The responses given in from individual Questionnaires indicated that a number of respondents in the 40-49 age group worked in the telecommunication industry and therefore had superior telecommunication technology knowledge and also explains this upward deviation from the otherwise downward trend for the various age groups

From the above explanations and findings and the clear indication from Figure 1 it is clear that there is a downward trend in telecommunication technology knowledge from the ≤29 age group to the 60+ age and that there is an age gap in telecommunication knowledge.

5.3 RESULTS FOR SUB-PROBLEM 1.4.2

The problem stated in Chapter 1 is quoted here: "The second sub-problem is to establish the travelling habits of professionals in the construction industry, meaning where do the travel from and to, for what purpose, how many hours they spent travelling, as well as what they would like to do in order to reduce travelling time."

All the responses to the Questionnaire were grouped together as indicated in Table 1: Summary of Grouping of Questions to Address Problems and were further detailed and summarised in the tables, graphs and maps, with the data in the tables being used to produce the graphs and maps indicated in Table 10 below.

Table10: Table, Graph and Map Production

Table	Description and Producing >	Graphs	Maps
4	Morning commuting between residence and office	Fig. 2	Figures E1 to Q1 in Annexures E-Q
5	Afternoon commuting between office and residence	Fig. 4	-
6	Travelling reduction preferences	Fig. 5	-
7	Travelling between residence and office and between office and site	Fig. 6	-

5.3.1 Table 4: Morning Commuting between Residence and Office summarises how all respondents travel from their homes to their places of work, which culminates in an average net outflow of 175 respondents, meaning that 34.7% of all respondents do not work in the area in which they live. The 13 areas of residence and work listed in the Questionnaire are in a roughly rectangular area 141 km from east to west by 109 km from north to south. The Pretoria and Johannesburg areas cover a roughly rectangular area of 30 km from east to west by 80 km from north to south if set at an angle parallel to the main road artery (N1 covering Midrand as well) and in which 354 (70.2%) of all the respondents reside. Table 4 indicates that there is an outflow of 50 Pretoria residents to their places of work and an inflow of 11 respondents from other areas of residence. The data on commuting summarised in Table 4 is also used to depict commuting in a graphical format in Figures 2 and 3 below and in Figures E1 to Q1 in Annexures E-Q. These spider maps provide simple graphical views of morning commuting from respondents' areas of residence as listed in Section 8 of

the Questionnaire. For example, the nett morning traffic outflow of 39 for Pretoria is thus indicated in Figure 2 below.

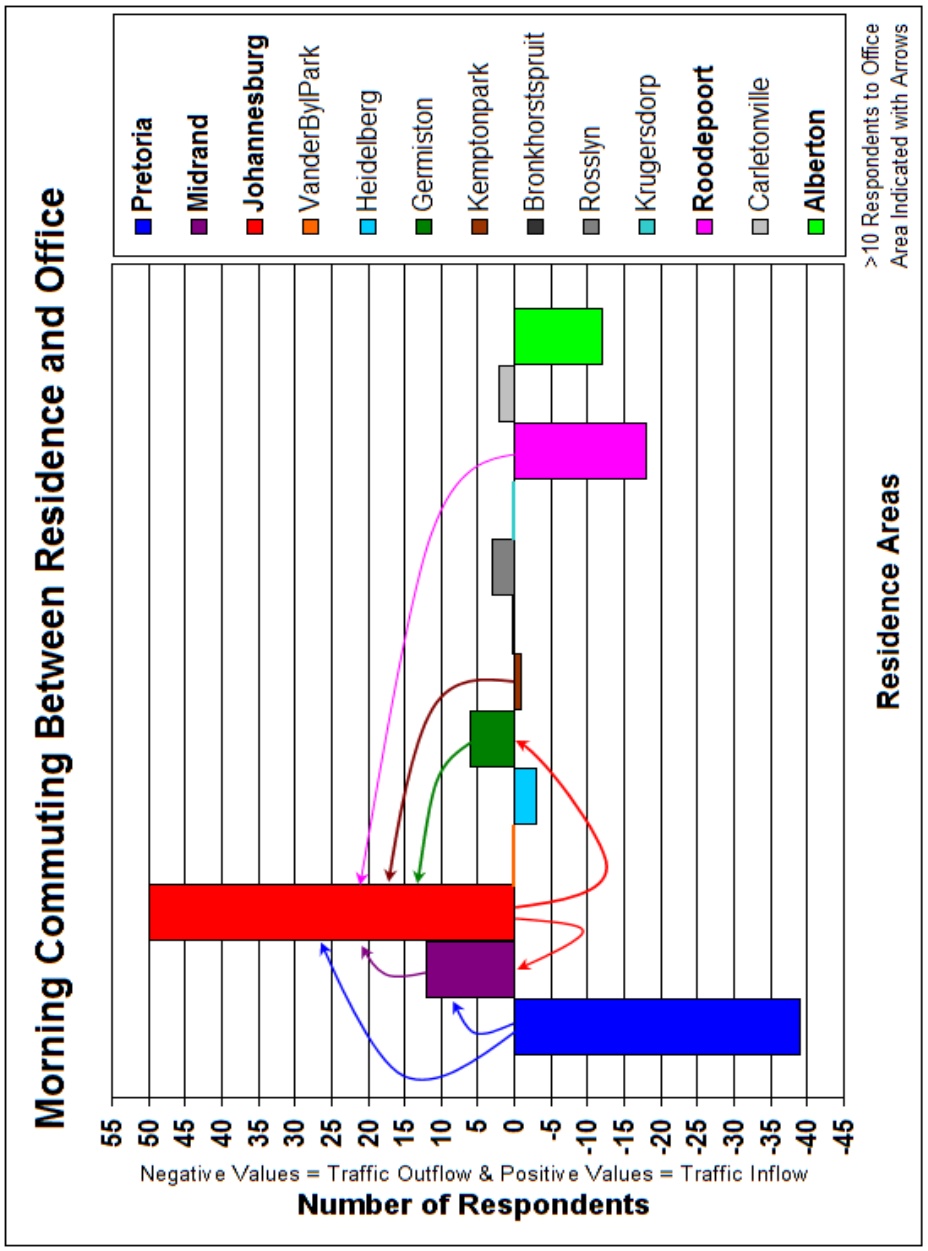

Figure 2: Net Morning Commuting Between Places of Residence and Work

The curved arrow lines indicate the movement of 10 or more commuters from their areas of residence to their places of work. The graph in Figure 2 indicates that the major outflow consists of Pretoria residents who work in the Johannesburg and Midrand areas and of Johannesburg residents who work

in the Midrand and Germiston areas. There is a substantial outflow of respondents from the Germiston, Kempton Park and Roodepoort areas to the Johannesburg area. The six areas of residence from which there are considerable morning outflow of traffic, are Pretoria, Midrand, Johannesburg, Germiston, Kempton Park, Roodepoort and Alberton. Spider maps of the respondents' areas of residence showing their morning commuting to their places of work are produced below in order to present a graphical view of morning commuting. Spider maps of all 13 areas of residence including the summaries of all morning commuting are shown in Figures E1 to Q1 in Annexures E-Q in larger format. Figure 3 which is a graphical display of the morning commuting of all the respondents from their homes to their places of work is shown below. The outflow is shown by arrows of different thicknesses to depict the number of commuters leaving the area of residence. A thicker line indicates a larger number of commuters from an area of residence.

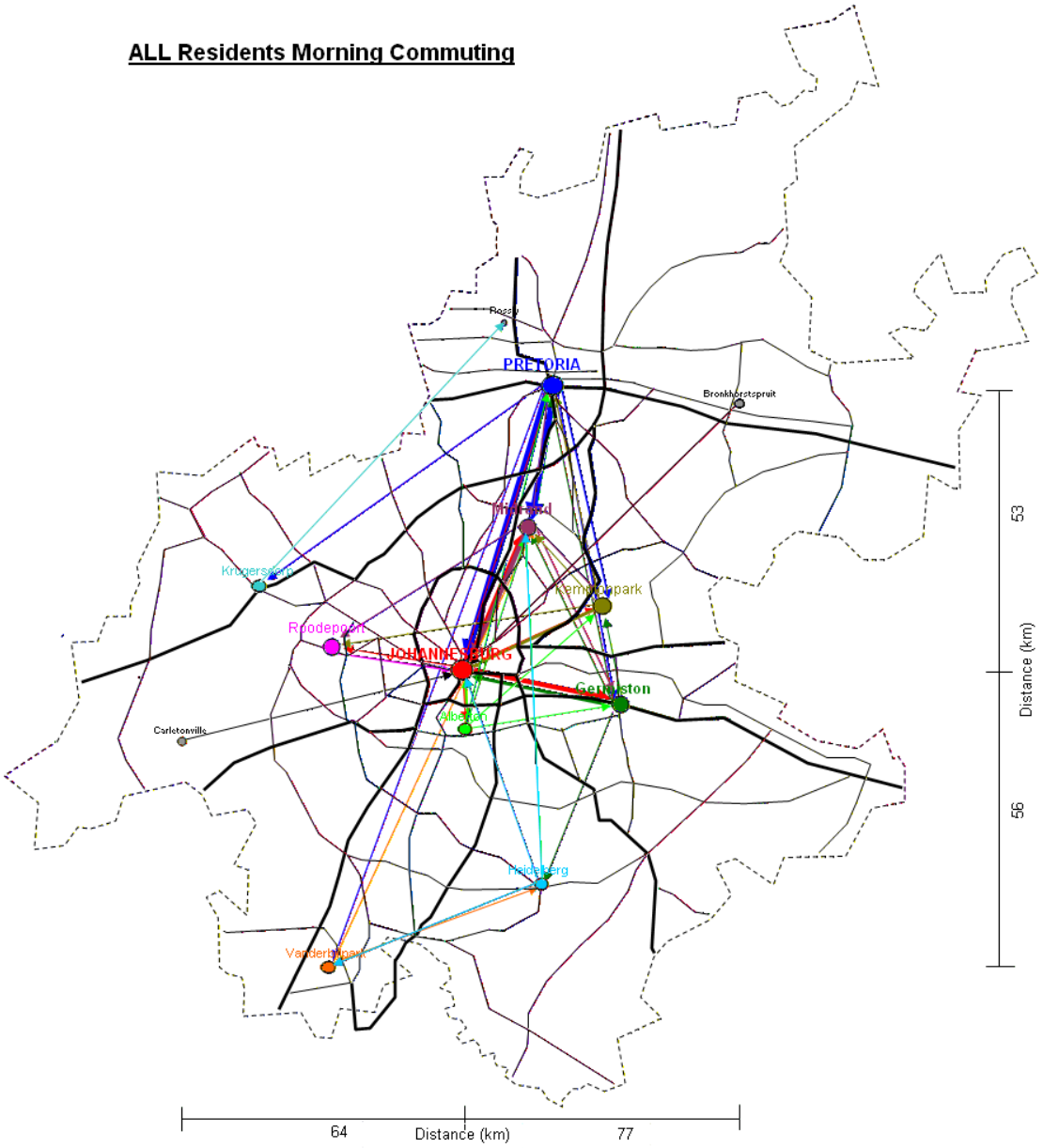

Figure 3: Gauteng Morning Commuting

It is clear from Figure 3 that the majority of morning commuting falls within the triangular area bordered by Pretoria, Germiston and Johannesburg, with a slight off-set to Roodepoort.

The movements between the areas of residence and areas of work indicate the travelling habits of respondents. These were summarised in Table 5: Afternoon Commuting between Office

and Residence. Table 5 indicates that there was a net outflow of 181 respondents (35.9% of all respondents) from areas of work to their residences. The Johannesburg, Midrand and Germiston areas are all indicated as major nett outflow areas. These data are graphically depicted in Figure 4: Home/Remote Area Office below, which shows the total number of respondents in an area, with home office areas being indicated in green and remote area offices in red. This clearly indicates that there is considerable movement from residence to place of work. However, the majority of respondents still travel between home and office in the same main area.

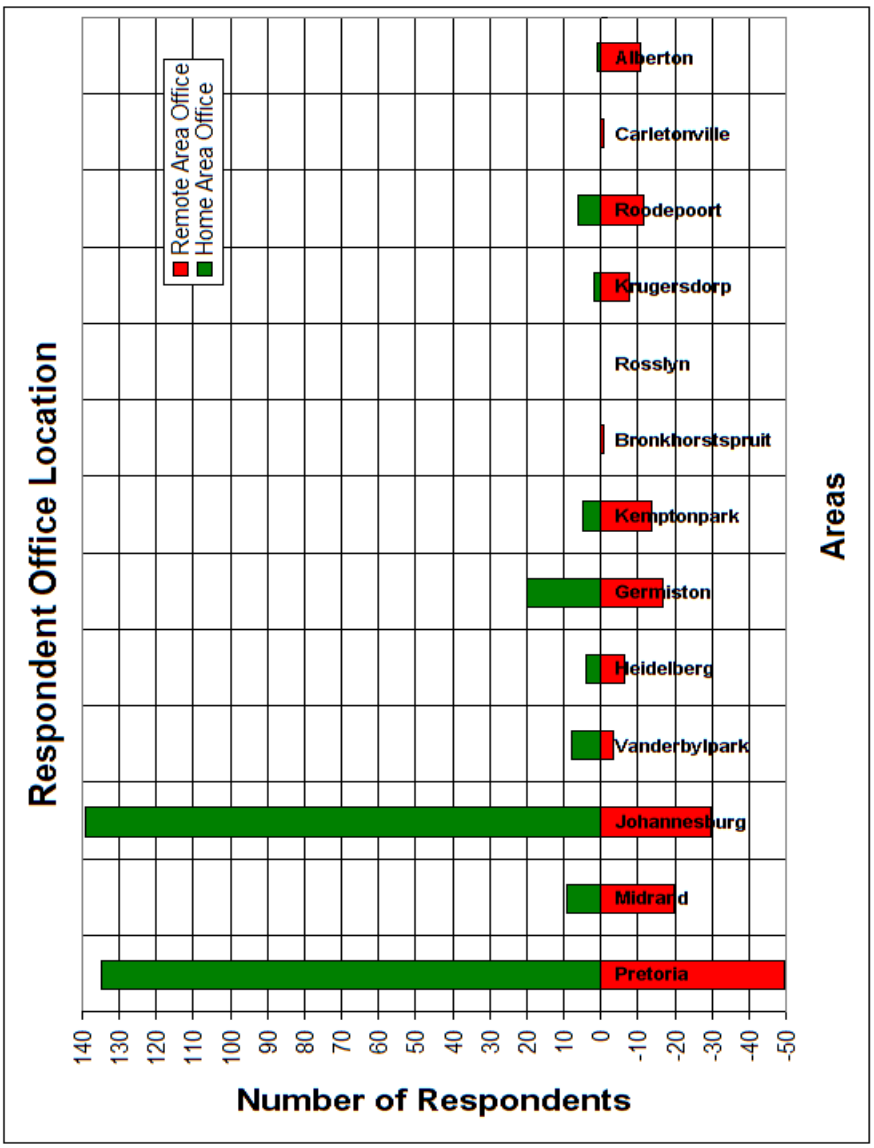

Figure 4: Home/Remote Area Office

5.3.2 The findings in Section 5.2.1 are further enhanced by the summarised data in Table 7: Travelling between Residence and Office and Office and Site. The average travelling time between respondents' homes and places of work is 5.31 hours per week, during which they travel an average distance of 216.8 km. This in itself should not be problematic as it does not affect the "normal" working time perception. However, a further 5.57 hours per week are spent driving between the office and a work site, during which respondents travel an average of 320.1

km if the Week factor, as determined in Section 1.8.9 of this treatise, is applied. This total of 5.57 hours travelling time per week effectively means that a professional in the built environment spends 13.9% of a 40-hour work week "unproductively", but which is billable to the client or to the cost of a contract. If it is considered that 388 respondents (77.0%) receive a fuel or travelling allowance, this cost is also chargeable to the client or contract in one way or another.

On average, a built environment professional spends a total of 30.25 man work days per annum commuting and a further 31.78 man work days travelling for work purposes per annum if the Day factor, as calculated in Section 1.8.9, is applied to the weekly travel hours. Figure 5 below graphically represents the number the man work days per annum spent driving between residence and office and between office and work sites, the broken lines representing the annual simple average for all age groups.

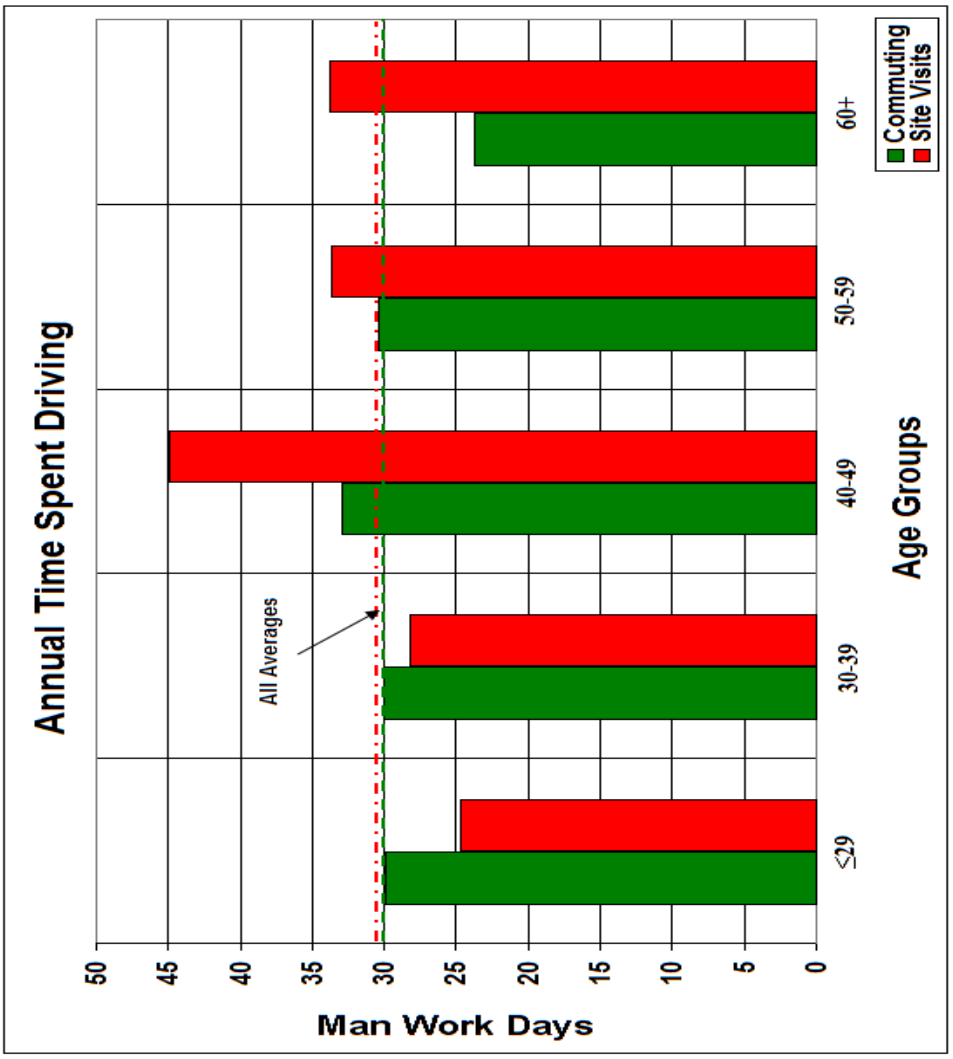

Figure 5: Annual Number of Man Work Days Spent Driving

It can therefore be concluded that travelling times (and costs) are considerable if the time spent by built environment professionals travelling to and from the office and between office and work sites totals 62.03 man work days per annum.

5.3.3 Table 6: Travelling Reduction Preferences summarises the data in those sections and sub-sections of the Questionnaire pertaining to the travelling preferences of the respondents. These data are graphically presented in Figure 6: Travelling Reduction Preferences.

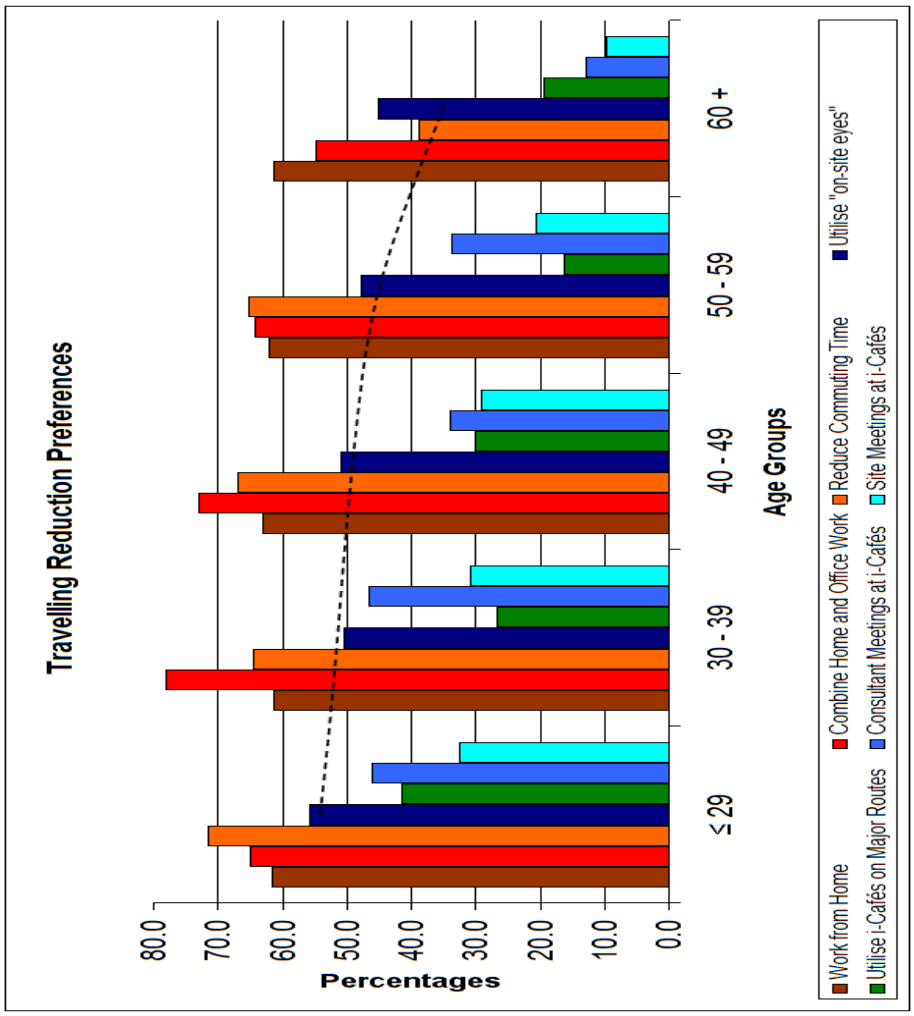

Figure 6: Travelling Reduction Preferences

The tendency line is a simple average of all responses from each age group.

A total of 49.3% of all the respondents selected one or other form of reducing their travelling time, the gradual decline in the trend curve from the youngest to the oldest age groups being similar to that indicated in the responses to the questions pertaining to prevailing age gaps in telecommunication technology knowledge (Figure 1).

The questions on preferences with regard to working from home, combining home and office work and reducing

commuting time all drew very strong responses, ranging from 61.9% to 69.0% of all respondents. Some specific responses need to be highlighted of which the 78.0% response by the 30-39 age group preferring working from home is one. The 40-49 age group response of 73.0% is not far behind. Both these responses, representing 45.0% of all the respondents, are of great interest and appropriate recommendations will be made in Chapter 6. The 71.4% of the ≤29 age group who favoured reducing their commuting time, coupled with the 65.7%, of all the respondents in favour of reducing their commuting time, indicates that there is a definite need to reduce commuting time.

Sub-section 16.6 of the Questionnaire reads: “If possible, would you rely on knowledgeable people/technologies to be your on-site eyes”. that the purpose of this is to ask whether a professional would accept a person or visual image to accurately explain or show a situation or condition on a site through utilising modern telecommunication technologies, thereby enabling him to take a decision or to make a ruling remotely. The total positive response of 51.4% to this question is noteworthy. The three questions on utilising internet cafés drew an average response range of 27.8% to 39.5%. The 46.5% positive response from the 30-39 age group regarding the use of consultant meetings at internet cafés is closely followed by the 46.1% positive response from the ≤29 age group. It therefore appears that the younger generation is more favourable to the use of internet cafés than the 60+ age group, only 12.9% of whom were in favour of this.

It can therefore be concluded that much time is spent travelling to and from places of work and for work and, based on the

responses to the questions in Section 16 of the Questionnaire, it is clear that almost of the respondents would favour reducing their travelling time by working in a different way.

5.4 RESULTS FOR SUB-PROBLEM 1.4.3

The problem as stated in Chapter 1 is quoted here: "The third sub-problem is to determine which software programs are utilised and what problems professionals experience with it with regard to compatibility."

5.4.1 All the data summarised in Tables 2.a, 2.c and 2.d are further detailed in Table 8: Software Program Usage, Problems and Preferences and graphically represented in Figure 7: Software Program Usage, Compatibility Problems & Preferences.

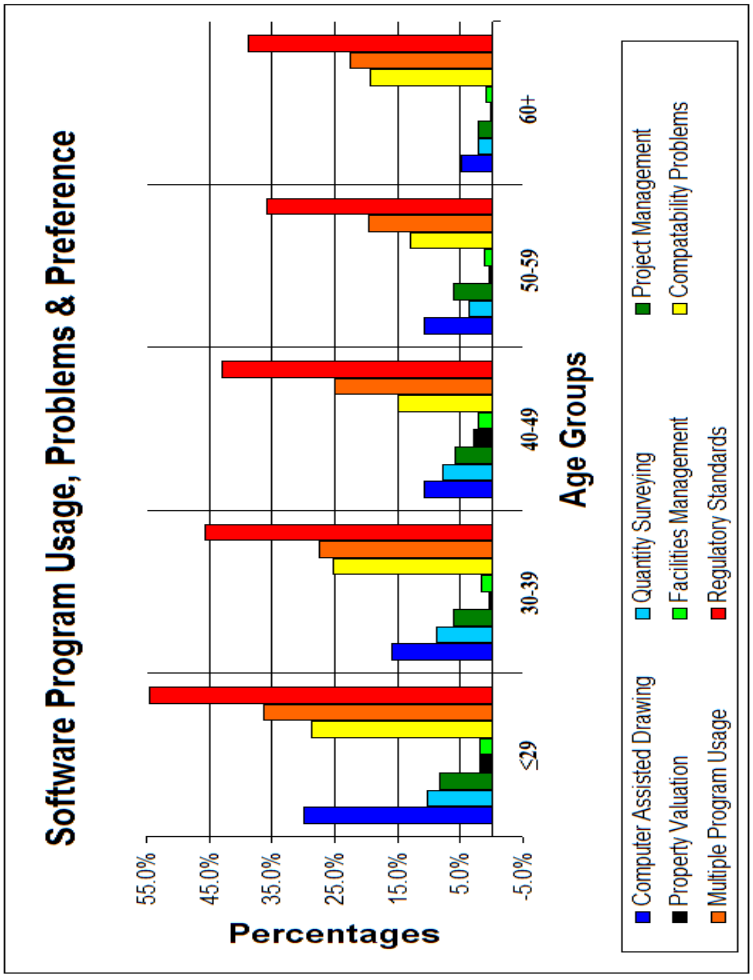

Figure 7: Software Program Usage, Compatability Problems and

The Y-axis shows the percentage responses and the X-axis the different age groups.

The first part of Table 8 shows the data on annual usage of the five specialist software program groups generally used by built environment professionals, excluding general office suite software packages such as Microsoft Office, Lotus Smart Suite and Open Office.

It was noted above that Section 13 of the Questionnaire, as shown in Anexxure B, especially Sub-sections 13.1 to 13.5 pertaining to specialist software program usage, were not completed satisfactorily. However, the data obtained highlight some tendencies, namely that the general usage of specialist software programs is reasonable, with the 154 respondents the $\leq$29 age group using these in 52.2% of their annual work time but that the usage of these programs by the 31 respondents in the 60+ age group is low, being as little as 9.9% of their annual work time. The engineers, being the largest response discipline group of 387 and generally associated with Computer Assisted Drawing software, utilises the for 58.4% of their annual work time if the converted 133.1 man work days is used. The average man work day usage by all the respondents of all specialist software programs available is only 66.8 days, or 29.3% and is thus very low.

A list of all the software programs in use is attached as Annexure C. The 98 different specialist software programs as indicated as being used by the 504 respondents is a clear indication that a large number of software programs is in use. If the Computer Assisted Drawing software programs are

associated with the 387 engineers, this means that a single software program is used by an average of 5.95 engineers.

From the above it is therefore clear that many specialist software programs are utilised by built environment professionals.

5.4.2 The second part of Table 8: Software Program Usage, Problems and Preferences addresses the question on software usage problems.
A total of 109 respondents (21.6% of all the respondents) indicated that they experienced compatibility problems with programs of the same type or with specialist group software programs. Although this figure may be considered low and insignificant, it is a clear indication that problems are being experienced.

144 respondents (28.0% of all the respondents) indicated that they had to utilise multiple software packages of the same type or specialist group of software programs. Having indicated that an average of 5.95 engineers utilise each Computer Assisted Drawing software program, this becomes a problem if 1.67 engineers indicate that they have to use multiple programs to satisfy clients' needs.

In both instances it is significant that respondents in the $\leq$29 age group, who generally fall in the lower hierarchies of built environment professional offices and usually work with software programs regularly as previously indicated, experience the greatest problems related to program compatibility and to the multiple usage of programs. 44 (28.6%) of the respondents in

this group experience compatibility problems and 56 (36.4%) experience problems with multiple program usage.

Having reduced the responses on software program usage problems and multiple program usage almost to individual level, it is clear that problems of this nature are valid and need to be addressed.

5.4.3 The third and last part of Table 8: Software Program Usage, Problems and Preferences addresses the question on software program regulatory standards.

A total of 230 respondents, or 45.6% of all the respondents, indicated that they would prefer software "type" compatibility to be regulated by industry standards. The group indicating the greatest preference for regulation of the software program industry was the ≤29 age group, 84 (54.5%) of whom indicated that they were in favour of this. A general declining trend line through the age groups is evident, with 38.7% of the 60+ age group slightly exceeding percentage of the respondents in the 50-59 age group. However, if it is considered that the 60+ age group is very small and that a swing in the preferences of one member of this group would result in a 35.5% preference, the gradual decline in the preference for regulation from youngest to oldest is evident.

In conclusion, the preference for an industry standard regulation of software program type by 45.6% of all respondents is an indication that a major group of software users is dissatisfied with the present state of affairs in which multiple software type programs have to be utilised to effect the same end product.

5.5 RESULTS FOR THE MAIN PROBLEM

In Chapter 1, the Main Problem is quoted as “Are built environment professionals in the construction industries aware of available telecommunication technologies that can assist them to utilise time more efficiently by reducing travelling?”

5.5.1 In Section 1.5.1 the first hypothesis is stated as “Younger professionals have a greater knowledge of the potential telecommunication technologies have to assist them in working smarter and are more inclined towards using modern telecommunication technologies.” The variation of the 40-49 age group from the declining trend through the age groups was investigated carefully. After an investigation proved that this variance was caused by the uncommon circumstance of a number of respondents working in the telecommunication industry and thus having greater knowledge of these technologies than their colleagues, the results in Section 5.2 show that there is an age gap in telecommunication technology knowledge, from the younger to the older groups, prevails. This hypothesis is therefore proved to be correct.

5.5.2 In Section 1.5.2 the second hypothesis is stated as “Professionals in the construction industry want to reduce travelling time for various reasons but they do not know how to or go about it.”

This hypothesis is complex as the responses to questions on travelling habits and preferences have to be directed towards addressing the hypotheses. The 31.78 man work days spent travelling for work purposes, as indicated in Sub-section 5.3.2, results in a built environment professional being “unproductive”

for 13.9% of a working year. If this is combined with the 30.25 man work days spent commuting plus leisure and holiday travel, it adds up to a substantial amount of travelling undertaken annually by built environment professionals. As shown in Table 7, the average speeds for the respective types of travelling are 40.86 and 57.43 kilometres per hour, which may be frustratingly slow going for highly paid professionals who are aware of the value of their time. The number of respondents (over 60% of the total) who indicated their preferences for working from home, combining home and office work and reducing commuting time is an indication of the need to reduce travelling time. The result presented in Section 5.3 shows that a large number of built environment professionals work outside the areas in which they live and have to travel long distances from their homes to their places of work. This result, together with their favouring a reduction in travelling, proves correctness of this hypothesis.

5.5.3 The third and final hypothesis, that "Professionals in the construction industry use a myriad of same type software programs that are sometimes incompatible with each other" is stated in Section 1.5.3.

The somewhat poor response to Section 13 of the Questionnaire raises doubts on the acceptability of the responses given, but the 62 Computer Assisted Drawing software programs indicated as being in use and listed in Annexure C, strongly demonstrates the existence of the "myriad" same type software programs as stated in the hypothesis. The 230 respondents (45.6% of the total) who favoured industry regulation of same type software programs do not constitute a clear majority but indicate that there is a

strong preference for industry regulation in this sphere. The 109 respondents (21.6%) who indicated that they experienced software compatibility problems and the 141 respondents (28.0%) who indicated that they had to utilise software programs of the same type to satisfy clients' needs represent somewhat of a contradiction to their use of the current 98 specialist software programs. Section 5.4 shows that a major group of software users is dissatisfied with having to use multiple types of software type programs on account of their incompatibility. In addition, the fact that 45.6% of all the respondents would prefer industry regulation of software standards clearly proves the correctness of this hypothesis.

5.6 SUMMARY

The title of this treatise is stated as "Telecommuting in the Construction Industries: An Investigation into the Want of Utilising Available Telecommunication Technologies".

In an effort to give substance to the title of this treatise, three hypotheses were stated in Section 1.5 and the main problem was reduced to three sub-problems, as stated in Sections 1.3 and 1.4. Data from the 504 valid responses were analysed and detailed in the findings presented in Chapter 4. The results based on these findings were presented in this chapter and evaluated against the three hypotheses, the three Sub-problems and the Main Problem. Based on the conclusions drawn the hypotheses have been proved to be correct and the Sub-problems and Main Problem have been answered.

The definition of "want" as stated in Section 1.7, the three meanings of the word as used in the title of the treatise and how these relate to the outcome of this study, are addressed in Chapter 6: Recommendations.

6 RECOMMENDATIONS

6.1 INTRODUCTION

It should be noted that modern telecommunication technologies are changing rapidly and that the survey was conducted during the first semester of 2006. Care should therefore be taken to place this study within the context of the telecommunication technology available at the time of the survey.

The purpose of this chapter is to highlight some of the questions, findings and conclusions of this study, as well as some noteworthy tendencies in the unproduced master data sheet. These are then summarised in the form of a recommendation, which may possibly offer some solutions to resolving the problems experienced.

Based on the results of the study, as stated in Section 5.5, it is clear that problems are being experienced in the way professionals in the built environment sector carry on their business, and that a need to improve this has been expressed.

Before a recommendation can be made, there first has to be a need for such a recommendation. Both the conclusions in Chapter 5 and in Subsections 1.9.1 to 1.9.4 of this treatise, which are repeated below, justify this need:

- This study will draw attention to the time spent by professionals in the construction industry in Gauteng, South Africa travelling between their homes and work and between their offices and construction sites, that otherwise could possibly have been spent more productively. Do professionals realise this and is there a need to address this?
- A wide variety of telecommunication technologies is available that could substantially reduce the time spent on travelling. Are professionals in the construction industry aware of this?

- A very wide range of available software to produce the same end results is utilised, but software of the same type is mostly incompatible or is only compatible to a limited extent. The various CAD software programs currently available are not completely interchangeable, resulting in loss of data or detail. General office use programs, such as word processing and spreadsheet packages, also suffer loss of detail if their export facilities are used to make them compatible with competitive packages. Is there a need for full compatibility?
- Telework and telecommuting are modern ways of increasing productivity but the construction industry is slow to adapt to modern ways of working. Are built environment professionals aware of the possibilities offered by telecommuting and are they ready to embrace and implement it?

The good response to the Questionnaire resulted in the conducting of a reliable study. However a further step has to be taken if one reads and understands the concept title of the treatise. For the purpose of this study, the word “want” was explained in Section 1.2 as having a threefold meaning, which is repeated below:

- a lack of knowledge of telecommunication technologies, meaning that professionals do not know about available technologies;
- a need for telecommunication technologies, meaning that professionals have a need for a technology but do not necessarily know how to go about meeting that need, and
- a requirement for telecommunication technologies, meaning that professionals are aware of the required technology, need it to resolve their way of working problem and therefore desires it.

The meanings of the words “lack”, “need” and “requirement” were discussed in the hypothecated questions and problems and were answered and proven successfully. The statements on the words “lack”, “need” and “requirement”

now need to be addressed in a recommendation to possibly resolve the problems experienced by professionals in the construction industry.

6.2 ADDRESSING "WANT" IN THE TITLE OF THE TREATISE

The results from Chapter 5 will be used to compile some recommendations on how to possibly resolve the telecommunication problems experienced by professionals in the construction industry.

6.2.1 In Table 3 it was indicated that, of the 12 telecommunication technologies listed, only 38.2% of all the built environment professionals had some knowledge of these, the highest average percentage (40.8%) of those familiar with these being in the ≤29 age group and the lowest average percentage (24.3%) being in the 60+ age group. This effectively means that the average built environment professional is familiar with less than five of the twelve telecommunication technologies. CDMA can be accepted as not being known commonly but the reasons for the poor knowledge of Wi-MAX, W-LAN, WLL and Metronet telecommunication technologies, may possibly require some investigation by telecommunication service providers. The importance of the findings of the literature survey on the works of Boshoff (2004), Smith (2003) and Wadiwalla (2003), as discussed in Section 1.9, needs to be noted.

6.2.2 The question: "If possible, would you rely on knowledgeable people/technologies to be your 'on-site eyes?'" as stated in Sub-section 16.6 of the Questionnaire, received a total positive response of 51.4%. This means that a greater number of respondents realised that telecommunication technologies that do not necessitate travelling to a site are available. However, the three options on utilising internet cafés received a poor average response of 27.8% to 39.5%, which means that professionals actually do not understand the advantages offered by such services or do not appreciate their value.

Taking into consideration the time at which the survey was carried out and the fact that professionals in the built environment sector may since have adapted to and adopted modern telecommunication technologies, it is nevertheless recommended that:

- further studies on the reasons why the full potential of modern telecommunication technologies is not utilised by professionals in the built environment, be carried out, and
- another study on modern telecommunication technology utilisation by built environment professionals be conducted in 2011 to determine whether the professionals are better educated and whether there has been an increase in the utilisation of such technologies.

These recommendations are concluded with the statement by Boshoff (2004: slide 10): “If the uptake of technology by the construction industry is a measure of responsiveness to change, we have little chance of survival.”

The travelling habits of the professionals in the built environment are addressed in Section 6.3.

6.3 ADDRESSING THE TRAVELLING HABITS OF BUILT ENVIRONMENT PROFESSIONALS

A major part of the findings in Chapter 4 and of the conclusions in Chapter 5 addressed the travelling habits and preferences of professionals in the built environment. During the longer than three hour peak traffic times, normal work day travelling in the metropolis area of Gauteng is a time consuming necessity. The cliché “time is money” is a reality for built environment professionals because it either means that the professional has to bill unproductive hours or is losing productive time through travelling. Standard building and construction contracts have a “time is of the essence” clause, which emphasises the value of time in the construction industry.

From the conclusions drawn in Chapter 5 it is clear that professionals in the built environment are sorely in need of reducing their travelling times. This is addressed with by means of a discussion followed by a recommendation

6.3.1 It can be seen in Table 7 that the average professional in the built environment sector literally spends a total of 30.25 man work days per annum commuting and a further 31.78 man work days travelling for work purposes, totalling 62.03 man work days per annum. The average annual distance driven by a professional in the built environment sector solely for work purposes totals about 24,488 kilometres. If one then adds travelling time and distances travelled for other purposes and for leisure, a total distance of 40,000 kilometres per annum or more is not unreasonable.

6.3.2 Table 5 and Figures 2, 3 and 4 clearly indicate that 35.9% of built environment professionals do not work in the areas in which they reside but commute to other areas. Those in the $\leq$29 age group live an average 20.5 kilometres from their places of work whereas those in the 40-49 age group live an average 24.2 kilometres from their work places. From the data on the unproduced master data sheet, it was noticed that a larger percentage of the respondents in the $\leq$29 age group worked in their areas of residence than did those in the 30-39 and 40-49 age groups. This may be attributed to a number of factors, such as that those on the youngest age group do not yet own their own residences and are more flexible as regards travelling to their places of work. Those in the older age groups have established homes and social support groups and have children at school. These and other factors restrict them from relocating nearer to their places of work when new jobs are taken up.

6.3.3 Table 6 and Figure 6 show definite indications that professionals in the built environment sector are strongly in

favour of reducing travelling in general. Preferences of more than 61.9% of the respondents to work from home, to combine working at home and office and to reduce commuting time were recorded. 78% and 73% of the respondents in the 30-39 and 40-49 age groups respectively indicated that they would prefer to combine working from home and at the office. This is very much in line with the findings of other authors on the subject of telecommuting and as mentioned in the literature survey. Attendance to school-going children may be a major reason for such work practices and arrangements. It is clear that built environment professionals have a sincere desire to reduce their travelling time and it is quite astonishing that concerted efforts have not yet been made to do something about this.

It is therefore recommended that further studies be carried out to determine:

- whether built environment professionals have changed or are in the process of changing their way of work with regard to travelling,
- why built environment professionals still travel extensively, and
- why built environment professionals cannot or do not combine working from home and office and change other travelling habits.

Software usage and related problems are addressed in Section 6.4 below.

6.4 ADDRESSING SOFTWARE USAGE AND PROBLEMS

Section 13 of the Questionnaire was completed so comprehensively that there is no doubt that a myriad of specialist programs are in use to address the needs of the built environment professionals and their clients. The existence of no less than 63 CAD software programs, as listed in Annexure C, is a clear indication of this.

6.4.1 It is noteworthy that professionals only utilise specialist software programs to a limited extent, most probably because specialist draught persons do the bulk of their drawing work.

6.4.2 Table 8 and Figure 7 show that respondents have definite problems with program compatibility.

6.4.3 Of interest is the fact that 45.6% of the respondents felt that the software program industry should have regulatory standards on compatibility.

In his survey on software usage by quantity surveying companies, Smith (2003:6), states that more than half the firms had developed their own software and that these were mostly based on spreadsheet systems.

It is therefore recommended that:

- the reasons why such a wide variety of specialist software programs are in use by built environment professionals, be studied;
- the reasons why there is no movement towards standardisation and full compatibility of specialist programs be investigated, and
- the reasons why a wide variety of programs, especially CAD-type programs, are still in use and are specified by clients, be investigated.

6.5 RECOMMENDATIONS

Although this study addresses and deals with the preferences and needs of professionally registered persons in built environment sector only, some indirectly related issues are of interest.

Several meteorological offices, websites and calendars indicate that the winter and summer daylight times in Gauteng differ by approximately one and three-quarter hours. The sun rises at about 07:00 in mid-winter and sets at about 17:30 and in mid-summer it rises at about 05:15 and sets at about 19:00 with dawn and dusk periods of about half an hour each. There is thus at least a one-hour to two-hour scope for different winter and summer

working hours so as to maximise daylight time, specifically in the construction industry. Construction workers sometimes have to travel long distances to get to their sites and often have to work in a harsh and cold environment during the winter months. Productivity during winter time can be expected to be lower than that in summer. However this aspect would form the subject of a study on its own.

It is therefore recommended that:

- Professional bodies, representatives of civil engineering and building contractors and labour union representatives carry out research into the possibility of an 8-hour workday during the winter months and a 10-hour work day during summer, as opposed to the current standard 9-hour work day.

A short summary of the notes and recommendations of this chapter to conclude this study is given in Section 6.6.

6.6 SUMMARY

The notes and recommendations in this chapter are neither prescriptive nor exhaustive but represent a sincere effort to address the needs of the built environment professionals as expressed in the questionnaires returned.

It is the author's sincere wish that the time spent by the built environment professionals in completing the Questionnaire to the best of their abilities, knowledge and preferences, would not have be in vain and that:

- the literature surveys, findings, conclusions, notes, expressions and recommendations of this study will be attended to,
- the family and social life of built environment professionals will be improved,
- the travelling related work stresses of built environment professionals be reduced, and

by embracing the advantages modern telecommunication technologies have to offer they can thereby help to improve these technologies even further.

As telecommuting is a relatively unknown concept in South Africa, the advantages it offers built environment professionals through the utilisation of the full capabilities of modern telecommunication technologies has yet to be seen.

Traffic congestion in metropolitan areas may soon cause this industry to direct its attention towards changing its way of working and to recognition of the fact that the current utilisation of telecommunication technologies is merely scratching the surface. An awakening is required if the construction industry is to prevent stagnation in the use of telecommunication technology.

6.7 CONCLUSION

The origin of this study was formed in the mind of the author when, whilst driving he noted the congested roads in central Gauteng province and started to wonder what can be done to reduce traffic. Some ideas were formed that may lead to an interesting research and the journey of investigation begun with the submission of a study assignment on the same subject, but with reference to studies by mostly American and European researchers.

The outline of the study was formed with the purpose to investigate the travelling habits of built environment professionals, their knowledge of telecommunication technologies and their preferences with regards telecommuting. This outline led to the compilation of a questionnaire in which it was endeavoured to address the hypotheses. The author is of the opinion that telecommuting is not a well-known concept in South Africa and was faced with a problem on how to ask questions on telecommuting without actually stating what it was about. Telecommuting was hinted to in the Cover Letter but not repeated in the Questionnaire.

The study could have been expanded to include more detailed questions, options, preferences to allow more permutations for analysis but the whole purpose was to address a few core issues based on the response of an average built environment professional for an average work day.

From the findings and results of the study the three hypotheses are proved as correct with some alarming results on especially the utilisation of telecommunication technologies and the preferences expressed on telecommuting practises. It definitely appears that built environment professionals want to reduce travelling but they actually do not know how to achieve it. This therefore leaves scope for a further investigation on what possibly can be done to address it.

Extracts from Boshoff's (2004) class notes had been quoted in the study but the author wants to emphasise one statement made by Boshoff, namely:

> "If the uptake of technology by the construction industry is a measure of responsiveness to change, we have little chance of survival."

A question then remains:

> "Are the built environment professionals in Gauteng province telecommuting or not or are they on a self-destructing route as warned against by Boshoff?"

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ANNEXURES

Annexure A: Cover Letter

Annexure B: Questionnaire

Annexure C: Specialist Software Programs in Use

Annexure D: Questia Journal Article Excerpt

Annexure E: Pretoria Residents Morning Commuting

Annexure F: Midrand Residents Morning Commuting

Annexure G: Johannesburg Residents Morning Commuting

Annexure H: Vanderbijlpark Residents Morning Commuting

Annexure I: Heidelberg Residents Morning Commuting

Annexure J: Germiston Residents Morning Commuting

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Annexure M: Krugersdorp Residents Morning Commuting

Annexure N: Roodepoort Residents Morning Commuting

Annexure O: Carletonville Residents Morning Commuting

Annexure P: Alberton Residents Morning Commuting

Annexure Q: ALL Residents Morning Commuting

ANNEXURE A

Cover Letter

DEPARTMENT OF CONSTRUCTION ECONOMICS

Tel: (012) 420-2554
Fax: (012) 420-3598
E-mail : alta.lotz@up.ac.za

24 November 2005

University of Pretoria

Pretoria 0002 Republic of South Africa
Faculty of Engineering, Built Environment and Information Technology

Dear Sir / Madam

Questionnaire: Telecommuting in the Construction Industries; An Investigation into the Want of Utilising Available Telecommunication Technologies

Members of your Organization are considered valuable sources of information on the above-mentioned topic, which is researched to form part of a treatise for a master's degree in project management at the University of Pretoria.

You are therefore kindly requested to provide contact details (postal and/or street addresses, telephone and/or e-mail addresses) of all candidates and professionals registered with you or of your members and working and/or residing in Gauteng Province only. Alternatively, could you advise as to whom the questionnaire should be e-mailed to for distribution by yourselves.

Questions posed will generally be about:

- Discipline, age group, gender, etc., of a respondent,
- time spent commuting,
- knowledge of telework/telecommuting,
- knowledge of and usage of telecommunication technologies,
- compatibility and transportability of documents and knowledge of software, and
- any other relevant information of importance to the topic.

Kindly avail the researcher with the required information in soft format.

Should you wish to enquire about the proposed research, please contact Pierré de Wet at 09-264-201-2327 and 09-264-81-127-1508 during day time or at dewet.fam@iway.na and pdewet@telecom.na

All information will be treated as strictly confidential as to the person it was obtained from. The respondent and organization will be provided with a summary of the results from the questionnaires, if requested.

Thanking you in anticipation.

Gert Basson
Study and Programme Leader
for MSc (Project Management)

Pierré de Wet
Researcher

ANNEXURE B

Questionnaire

TELECOMMUNICATION AND TECHNOLOGY QUESTIONNAIRE FOR PROFESSIONALLY QUALIFIED INDIVIDUALS WORKING IN THE BUILT ENVIRONMENT

Note: Please mark, tick (considered as "Yes") or fill in appropriate blocks electronically and the questionnaire will take you less than five minutes to complete

1. PROFESSIONAL DISCIPLINE (One only)

- 1.1 Architecture
- 1.2 Engineering
- 1.3 Landscape Architecture
- 1.4 Project and Construction Management
- 1.5 Property Valuation
- 1.6 Quantity Surveying
- 1.7 Facilities Management

2. QUALIFICATION *(Institution and degree)*

- 2.1 University of Technology/Technikon
- 2.2 University
- 2.3 Undergraduate
- 2.4 Post-graduate

3. REGISTRATION GRADE *(With recognised professional body)*

- 3.1 Not registered
- 3.2 In Training
- 3.3 Professional
- 3.3 Retired

4. OFFICE HIERARCHY *(Status in your Office)*

- 4.1 Junior staff
- 4.2 Middle management
- 4.3 Senior/top management
- 4.4 Self employed *(One-man office)*

5. AGE GROUP

- 5.1 ≤ 29
- 5.2 30 - 39
- 5.3 40 - 49
- 5.5 50 - 59
- 5.6 60 +

6. GENDER

- 6.1 Male
- 6.2 Female

7. POPULATION GROUP

- 6.1 Black
- 6.2 Coloured/Asian
- 6.3 White

8. IN WHICH AREA DO YOU RESIDE (Gauteng Province only)

- 8.1 Pretoria
- 8.2 Midrand
- 8.3 Johannesburg
- 8.4 Evaton/Vanderbylpark
- 8.5 Heidelberg/Meyerton/Vereeniging
- 8.6 Germiston/Daveyton/Springs/Nigel
- 8.7 Kemptonpark/Bapsfontein/Tembisa
- 8.8 Cullinan/Rayton/Bronkhorstspruit
- 8.9 Rosslyn/Ga-Rankuwa/Hammanskraal
- 8.10 Magaliesburg/Krugersdorp
- 8.11 Roodepoort/Randfontein/Soweto
- 8.12 Westonaria/Carletonville
- 8.13 Alberton/Lenasia/Grasmere

9. IN WHICH AREA IS YOUR OFFICE (Gauteng Province only)

- 9.1 Pretoria
- 9.2 Midrand
- 9.3 Johannesburg
- 9.4 Evaton/Vanderbylpark
- 9.5 Heidelberg/Meyerton/Vereeniging
- 9.6 Germiston/Daveyton/Springs/Nigel
- 9.7 Kemptonpark/Bapsfontein/Tembisa
- 9.8 Cullinan/Rayton/Bronkhorstspruit
- 9.9 Rosslyn/Ga-Rankuwa/Hammanskraal
- 9.10 Magaliesburg/Krugersdorp
- 9.11 Roodepoort/Randfontein/Soweto
- 9.12 Westonaria/Carletonville
- 9.13 Alberton/Lenasia/Grasmere

10. TIME SPENT TRAVELLING (Average - fill in one)

	Hours
10.1 Between Home and Office per Week	
Month	
Year	
10.2 Between Office and Work Sites per Week	
Month	
Year	

11. MILEAGE TRAVELLING

	Km
11.1 Distance between residence and office	
11.2 Annual mileage for work purposes	

12. DO YOU RECEIVE A VEHICLE/FUEL ALLOWANCE

13. WHICH SOFTWARE PROGRAMS DO YOU USE *(Please mark selections)*

Please Note: The software programming industry offers a wide selection of programs for different types of applications. Please state maximum two software programs per category YOU mostly use - NOT your Office in general. (General software such as MS Office, Smart Office and Lotus SmartSuite excluded and the list of software below is not exhaustive)

AutoCAD, Caddie, TurboCAD, SmartDraw, VectorCAD, 3D Studio, ArcView, Win QS, QS Plus, Micro QS, BillCost, CCS Candy, MS Project, Project Plus, PS 8, Primavera, LavaVIEW, PropValues, EstateMaster, MS Excel Valuations, @Value

13.1 Computer Assisted Drawing

- 13.1.1 ..... : One
- 13.1.2 ..... : Two
- 13.1.3 Usage frequency
  - 13.1.3.1 Daily
  - 13.1.3.2 Weekly
  - 13.1.3.3 Monthly
  - 13.1.3.4 Occasionally

13.2 Quantity Surveying & Contractors Quantities

- 13.2.1 ..... : One
- 13.2.2 ..... : Two
- 13.2.3 Usage frequency
  - 13.2.3.1 Daily
  - 13.2.3.2 Weekly
  - 13.3.3.3 Monthly
  - 13.3.3.4 Occasionally

13.3 Project Management

- 13.3.1 ..... : One
- 13.3.2 ..... : Two
- 13.3.3 Usage frequency
  - 13.3.3.1 Daily
  - 13.3.3.2 Weekly
  - 13.3.3.3 Monthly
  - 13.3.3.4 Occasionally

13.4 Property Valuation

- 13.4.1 ..... : One
- 13.4.2 ..... : Two
- 13.4.3 Usage frequency
  - 13.4.3.1 Daily
  - 13.4.3.2 Weekly
  - 13.4.3.3 Monthly
  - 13.4.3.4 Occasionally

13.5 Facilities Management

- 13.5.1 ..... : One
- 13.5.2 ..... : Two
- 13.5.3 Usage frequency
  - 13.5.3.1 Daily
  - 13.5.3.2 Weekly
  - 13.5.3.3 Monthly
  - 13.5.3.4 Occasionally

14. GENERAL

- 14.1 Do you experience problems with program compatability
- 14.2 Do you use more than one of the same program type to satisfy client needs

15. ARE YOU KNOWLEDGEABLE ABOUT WHAT THE FOLLOWING TELECOMMUNICATION TECHNOLOGIES OFFER *(Please mark selections)*

- 15.1 WIMAX
- 15.2 WI-FI
- 15.3 ADSL
- 15.4 ISDN
- 15.5 CDMA
- 15.6 W-LAN
- 15.7 WLL
- 15.8 Metro Ethernet
- 15.9 GSM (GPRS/G3/WAP)
- 15.10 Video Conferencing
- 15.11 Video Phone
- 15.12 Web Cam

16. IF POSSIBLE, WOULD YOU *(Please mark selections)*

- 16.1 work from home
- 16.2 make use of video conferencing
- 16.3 combine home and office bound work
- 16.4 prefer flexitime with set performance schedules/dates
- 16.5 reduce time spent travelling for, and to and from work
- 16.6 rely on knowledgeable people/technologies to be your "on-site eyes"
- 16.7 appreciate having safe/secure roadside "internet cafés" on major routes
- 16.8 prefer software "type" compatability to be regulated by industry standards
- 16.9 have consultant meetings at high technology stations midway between offices
- 16.10 have site meetings at high technology stations midway between office and site

ANNEXURE C

Specialist Software Programs in Use

Section	Type	Software Programs in Use
13.1	Computer Assisted Drawing	AutoCAD, Microstation, MS Viso, Prokon, StruCAD, Photoshop, ACGIS, Aspen+, SCADA, Mine24D, Surpac, Solid Edge, Model + Roadmaker, Smart Sketch, Maintenance Plant Tool, Power Draft, TechnoCad, Data Mine, Mine Cad, Master Series Design, Solid Works, EdgeCAM, Retic Master, Small World, Pro Engineer, TurbaCAD, Cards, Bentley Viewer, U-Station, Mecanica, Unigraphics, Inventor, Autodesk Map3, Smart Plant P&ID, Coade Caesar II, Corel Draw, Info Sewer, Info Surge, Info SWMM, Power Factory, Dig Silent, Cad Key 98, Cad View, Caddie, In Roads, Volo View, HTFS+, Auto Sketch, Model Maker, Micgrafs Designer, Lab View, Test View, Project Wise, ACAD, AllyCAD, Civil Designer, AG132, SIDRA, Cad Key, Solid Works
13.2	Quantity Surveying & Contractors Quantities	Own, Civilsoft Bill, Civil Designer, Caddie, CCS Candy, Surf Mate, Acrobat 6, Modelmaker, Omicron, Cart V8, MSC Patran, MSC Adams, Pro Engineer
13.3	Project Management	MS Project, Aspen, AFT, Site Plan, BST, Primavera, MS Excel, SAP R3, Zenzele, PS 8, Bill, Project Plus, Deltek Vision
13.4	Property Valuation	Arc View, Aspen+
13.5	Facilities Management	Hansen, Fuel FACS, Win GEMS, GIS Arcims

ANNEXURE D

Questia Journal Article Excerpt

2009/06/24 Telecommuting's Impact on Corp...

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Telecommuting's Impact on Corporate Culture and Individual Workers: Examining the Effect of Employee Isolation

Journal article by Thomas W. Gainey, Donald E. Kelley, Joseph A. Hill; SAM Advanced Management Journal, Vol. 64, 1999

Journal Article Excerpt

Telecommuting's Impact on Corporate Culture and Individual Workers: Examining the Effect of Employee Isolation

by Thomas W. Gainey , Donald E. Kelley , Joseph A. Hill

The Increasing Significance of Telecommuting

The profile of the U.S. workforce is changing dramatically (Fierman, 1994). Employees who ordinarily commute to the office each morning and spend eight hours behind a desk are being transformed into more technologically savvy, flexible workers who are no longer bound by the confines of office walls (Mason, 1993). In fact, estimates project that the number of remote workers, or telecommuters, will increase at a rate of 20% each year and that by 2000 more than 25 million employees will have joined the telecommuting ranks (Barnes, 1994).

Telecommuting is the practice of working from one's home, or at a satellite location near one's home, where employees use communication and computer technology to interface with internal and external stakeholders (Cooper, 1996). Most reports on telecommuting suggest that this alternative has been positively received by both employees and managers (McNemey, 1995). Employees view telecommuting as a way to better balance the demands of work and family (Boyett & Boyett, 1995), and managers regard it as an opportunity to gain a number of benefits for their organization (Cooper, 1996). For example, telecommuting has been found to dramatically increase productivity (McNemey, 1995). Studies have shown that employees can be expected to produce 20% to 30% more when they telecommute (Weiss, 1994).

Telecommuting also provides an avenue for companies to respond to the 1990 Clean Air Act (Baig, 1995). This act requires organizations employing more than 100 individuals, in one location, to r...

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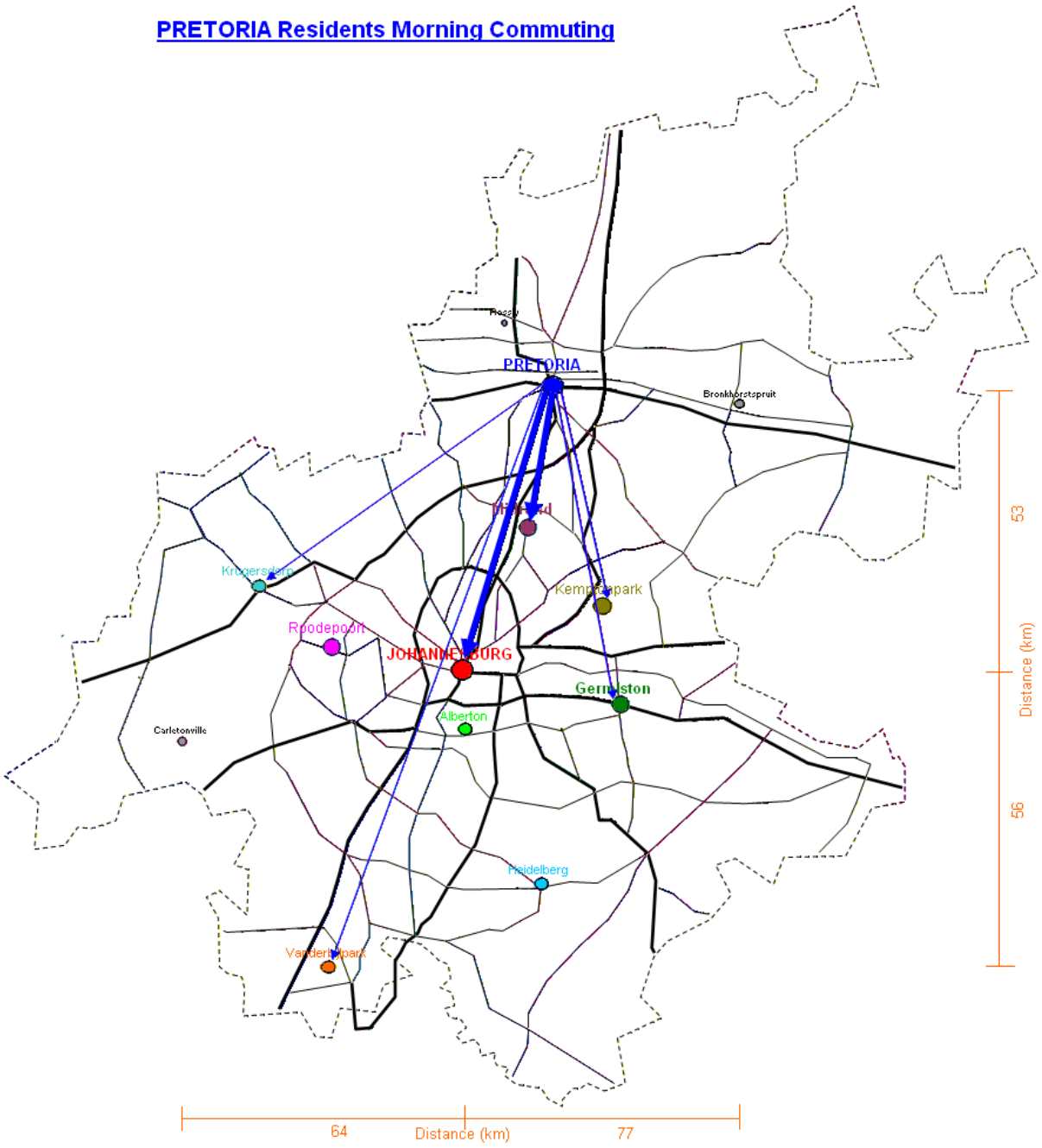
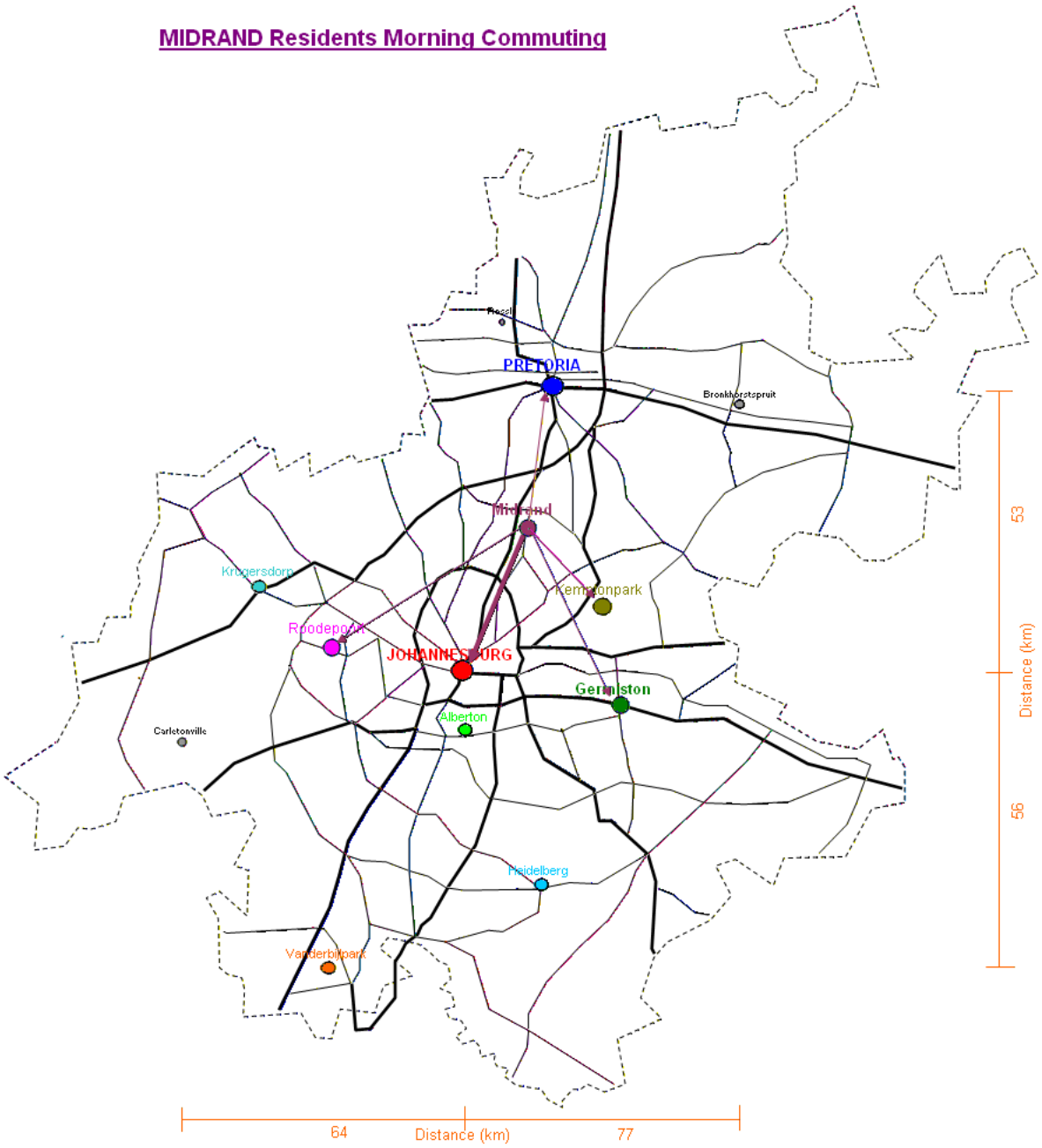
ANNEXURE E

Figure E1



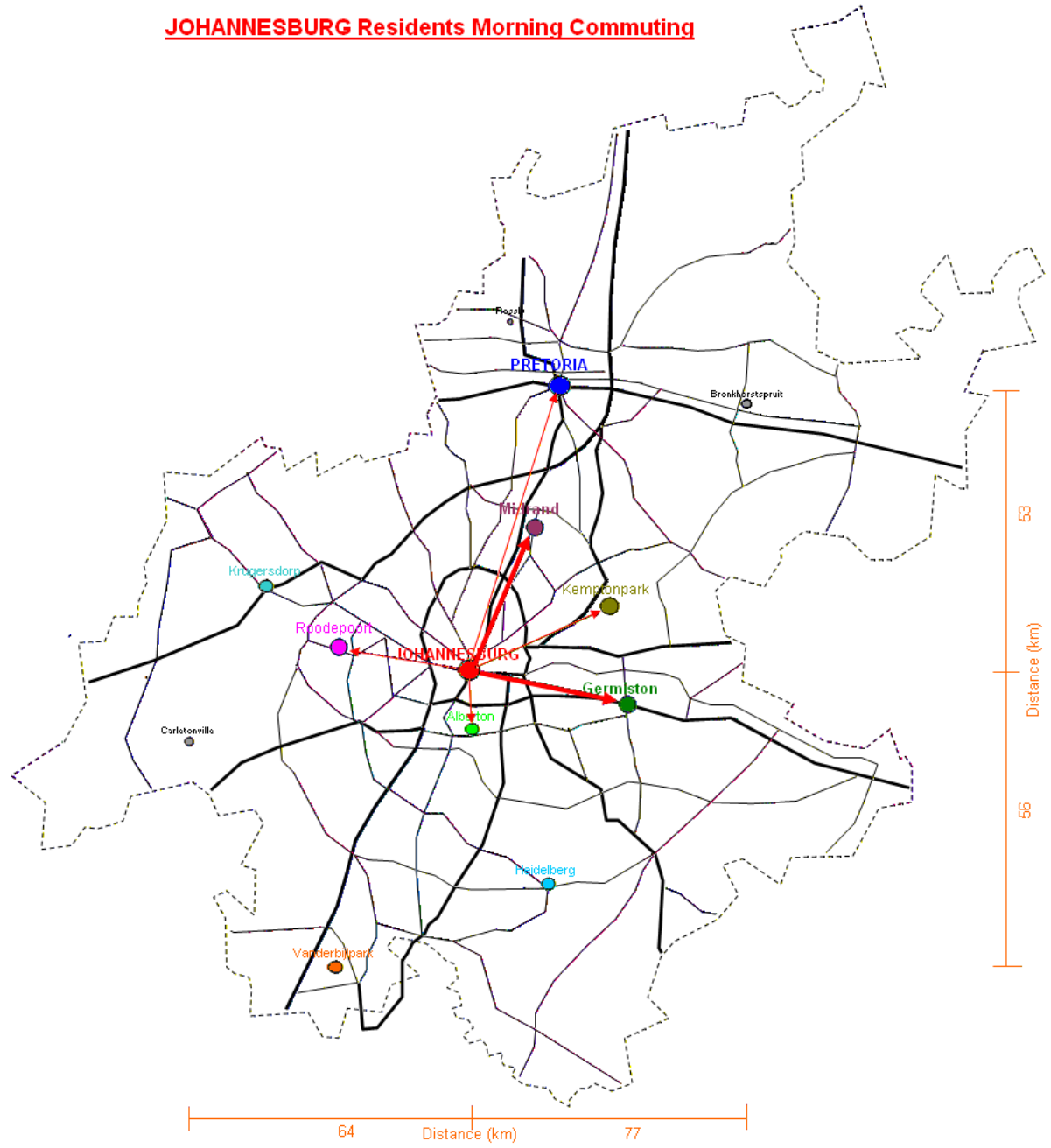
ANNEXURE F

Figure F1



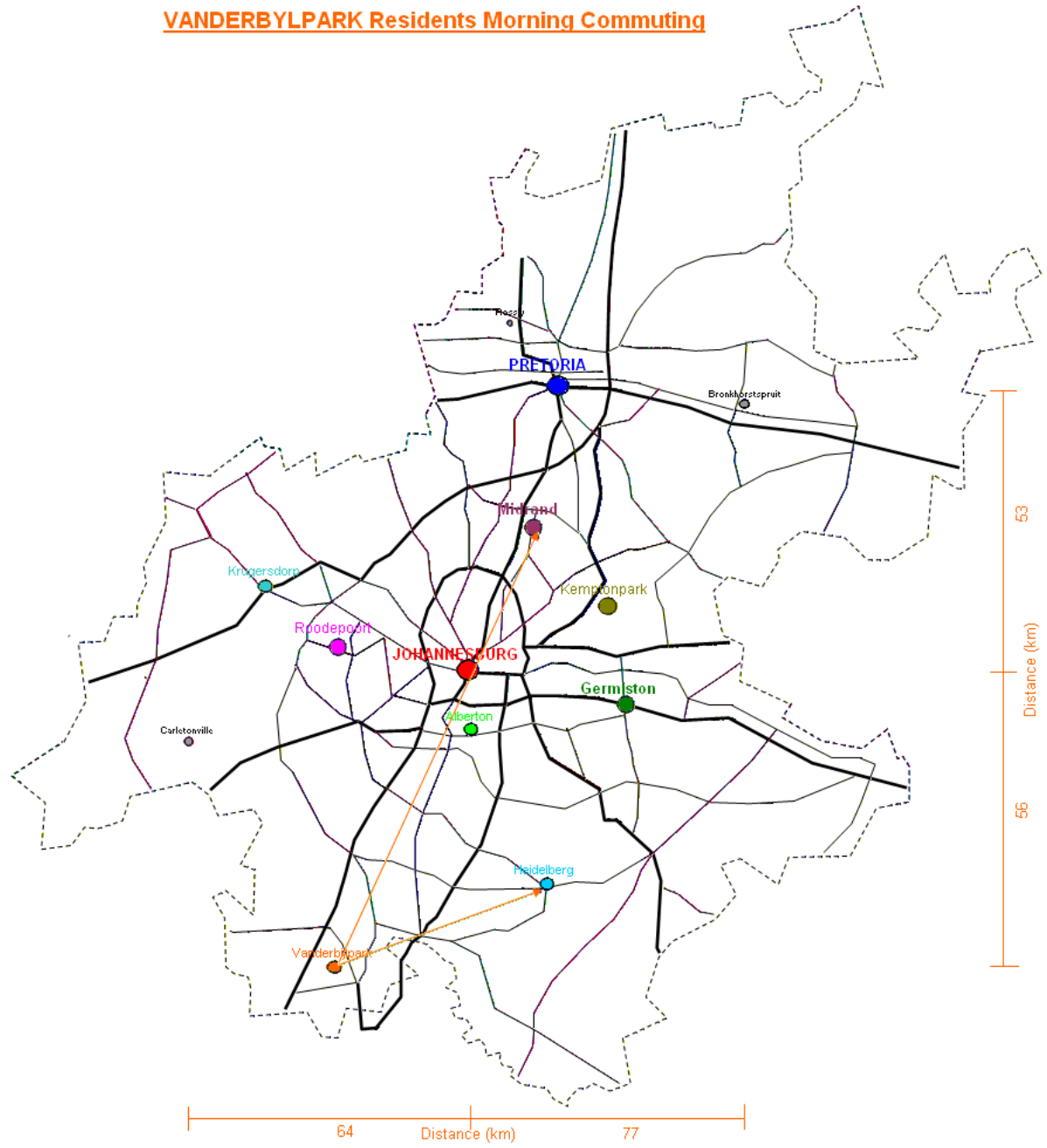
ANNEXURE G

Figure G1



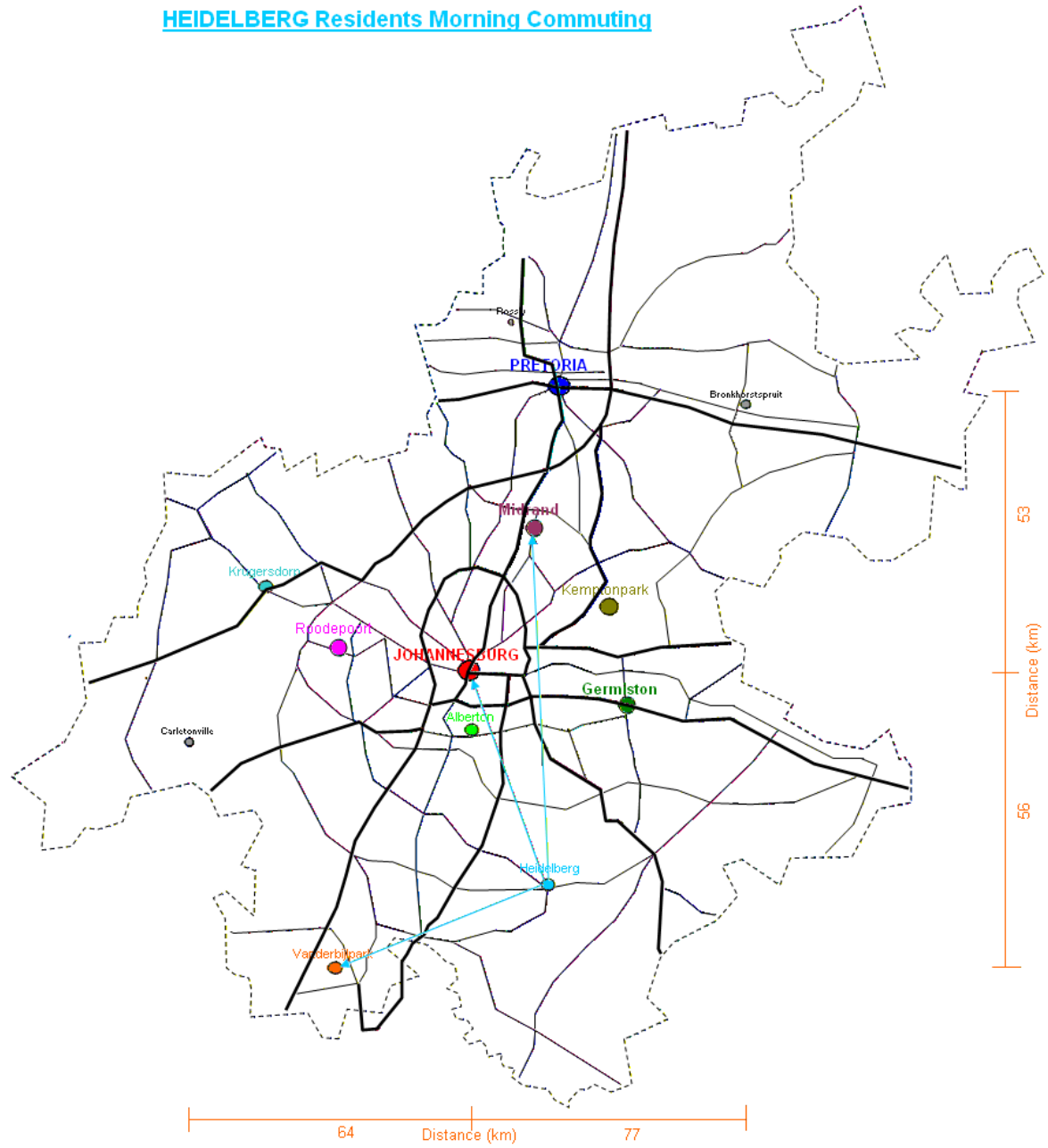
ANNEXURE H

Figure H1



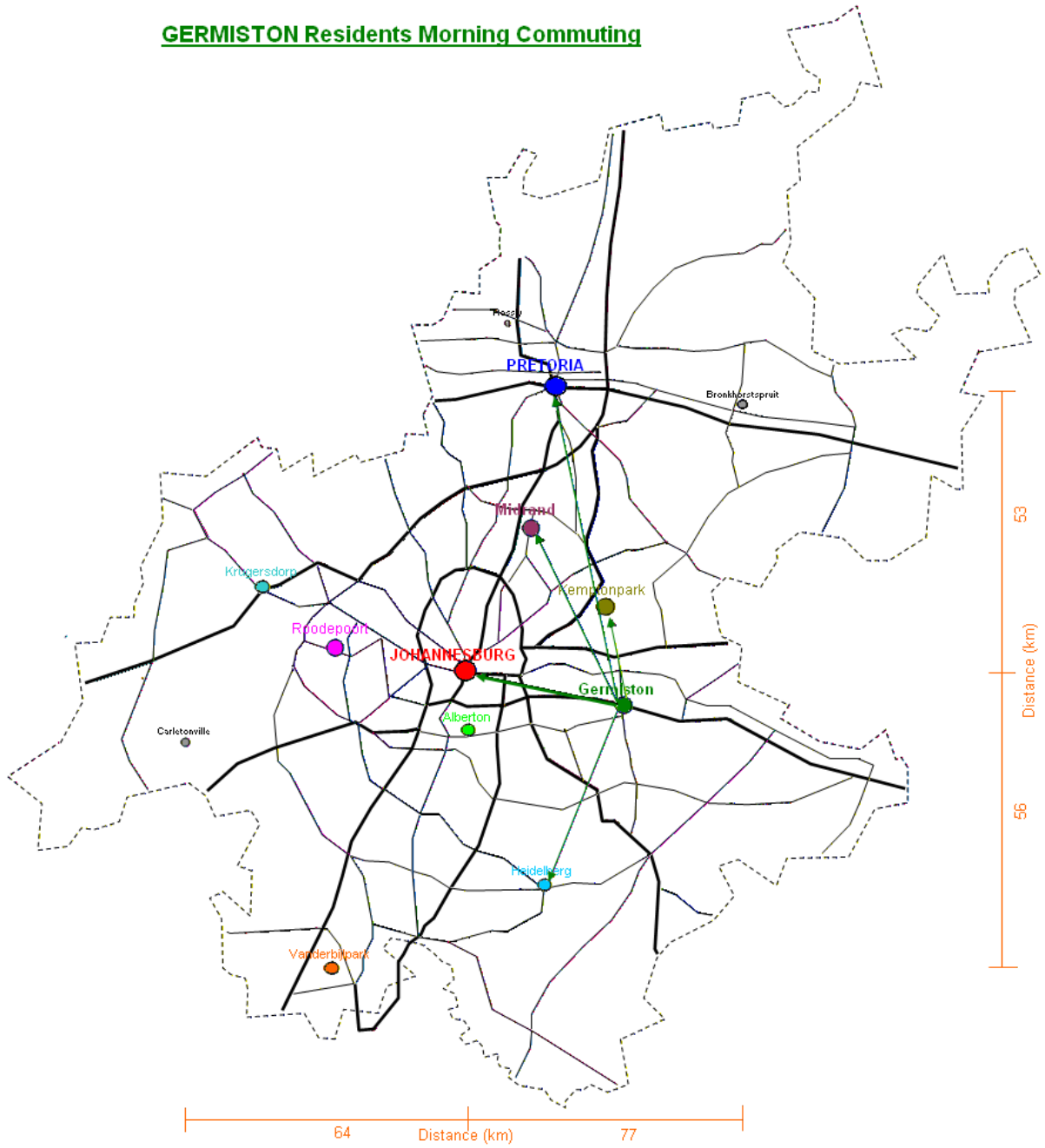
ANNEXURE I

Figure I1



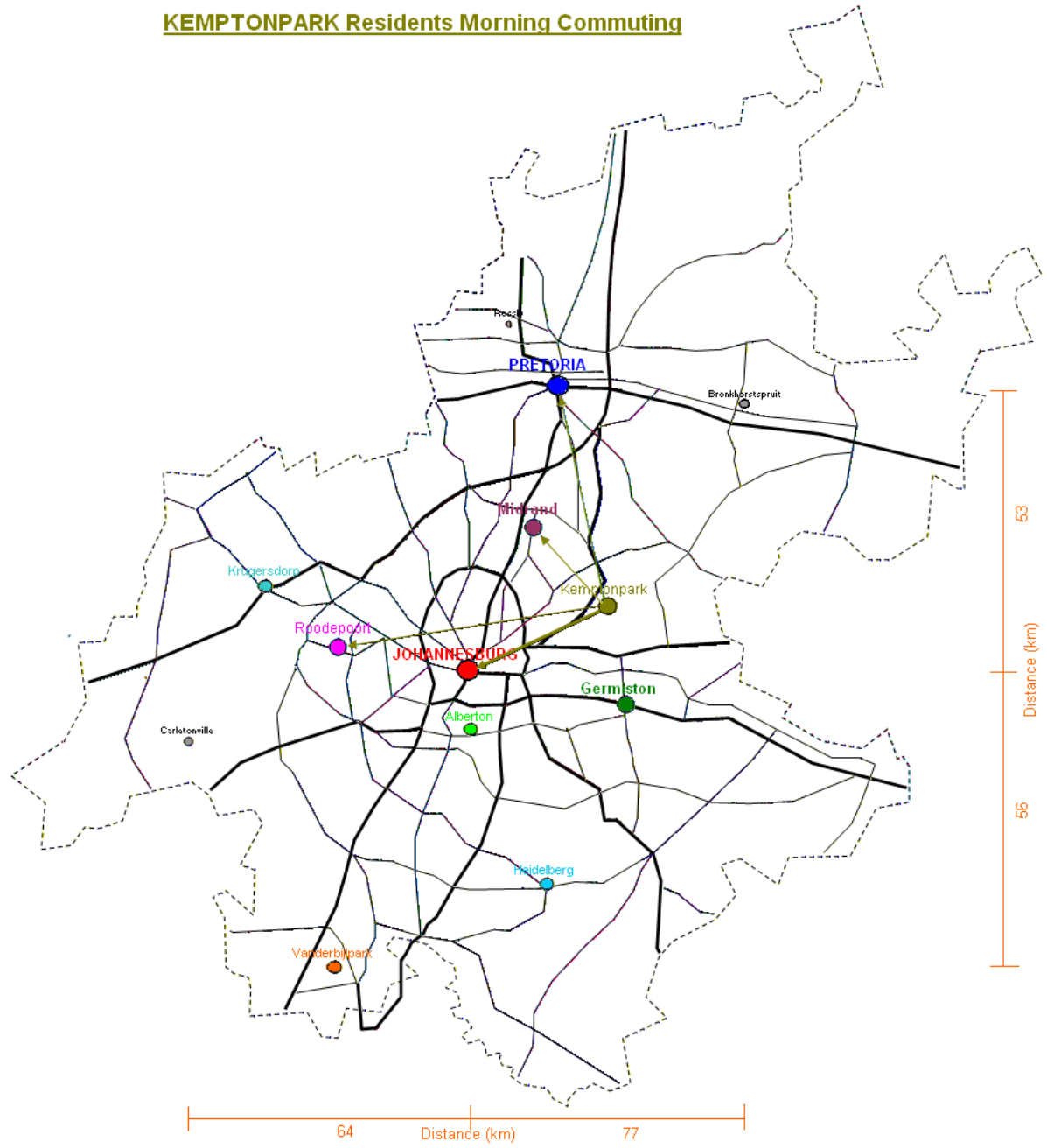
ANNEXURE J

Figure J1



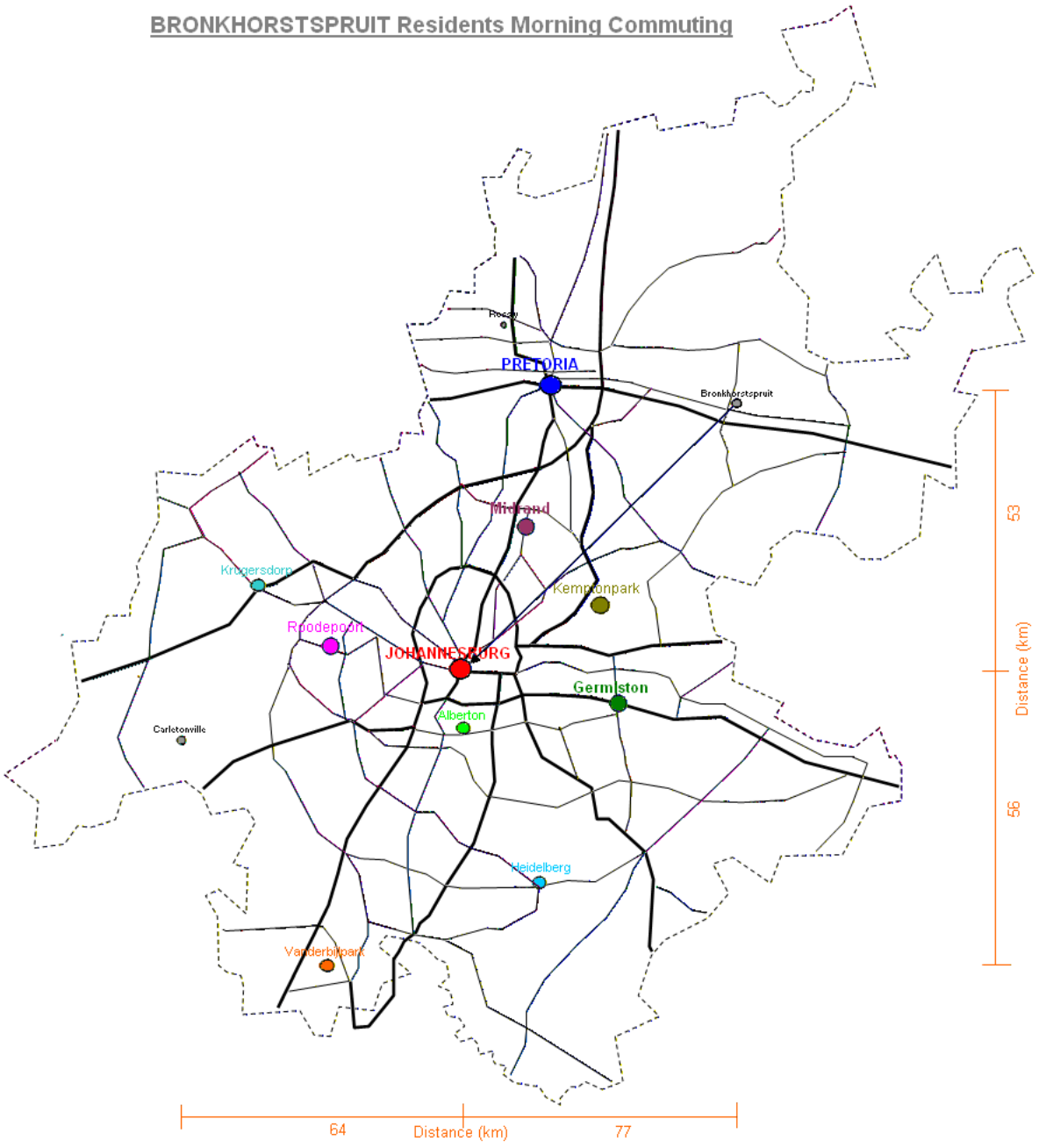
ANNEXURE K

Figure K1



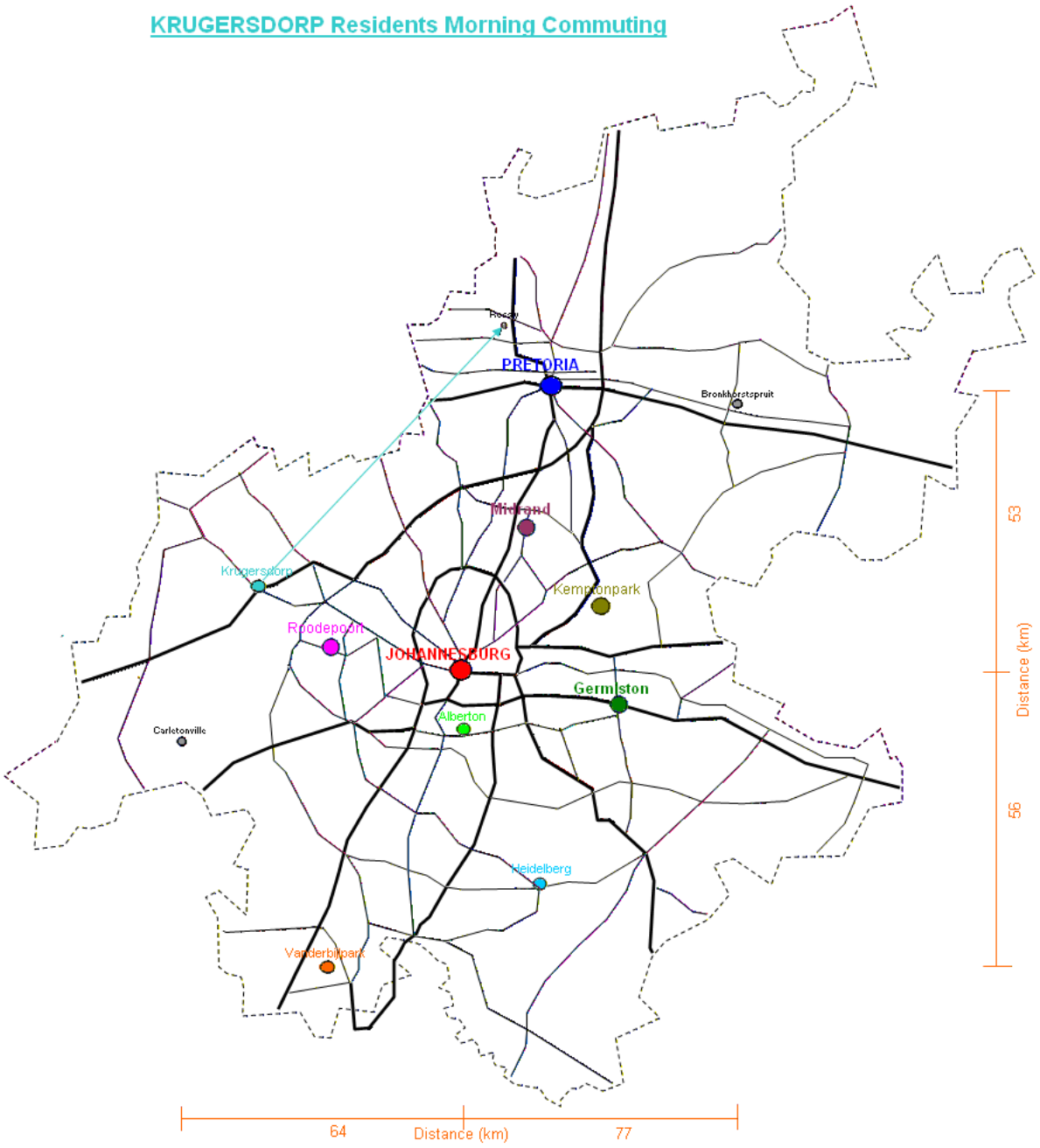
ANNEXURE L

Figure L1



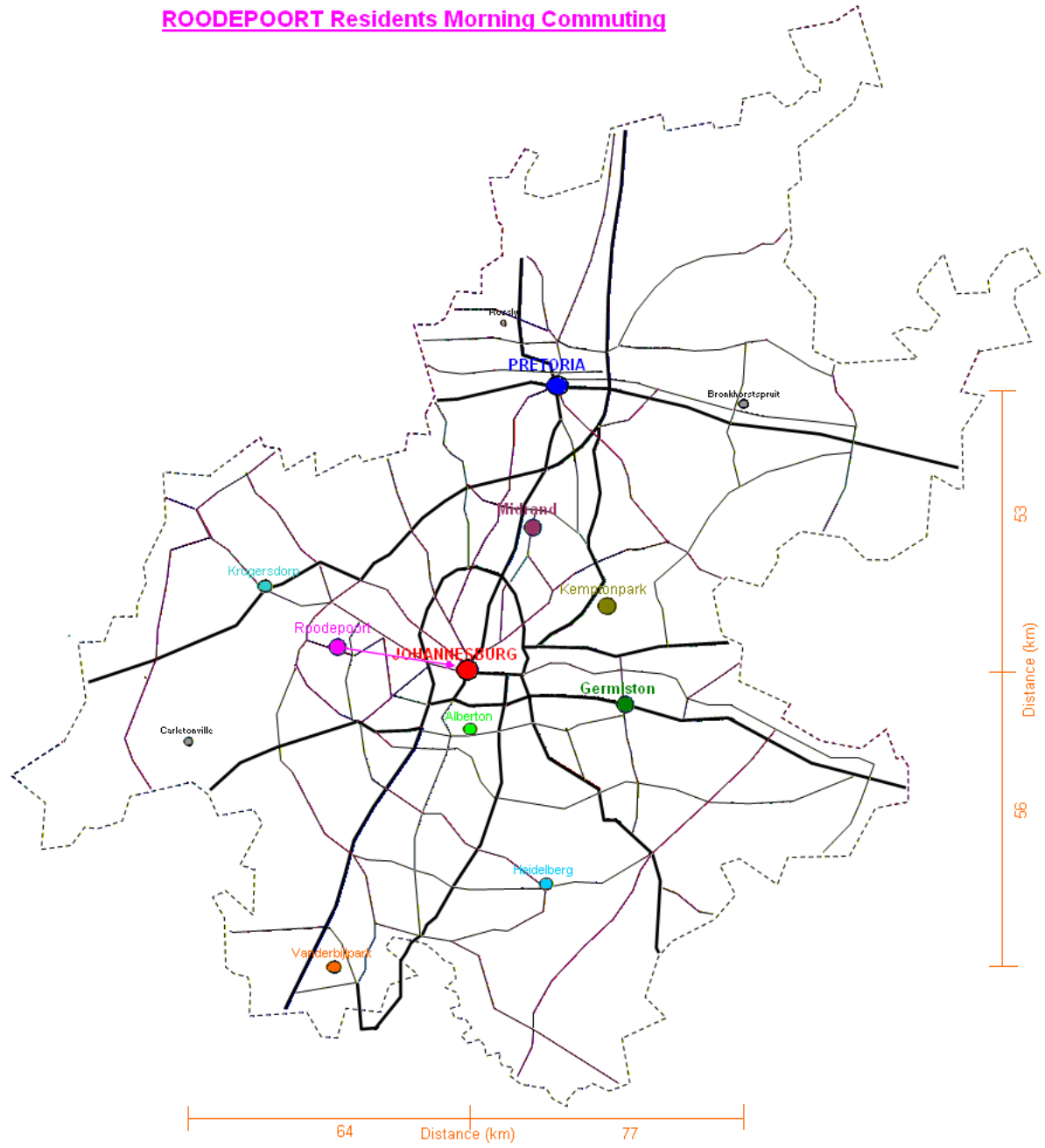
ANNEXURE M

Figure M1



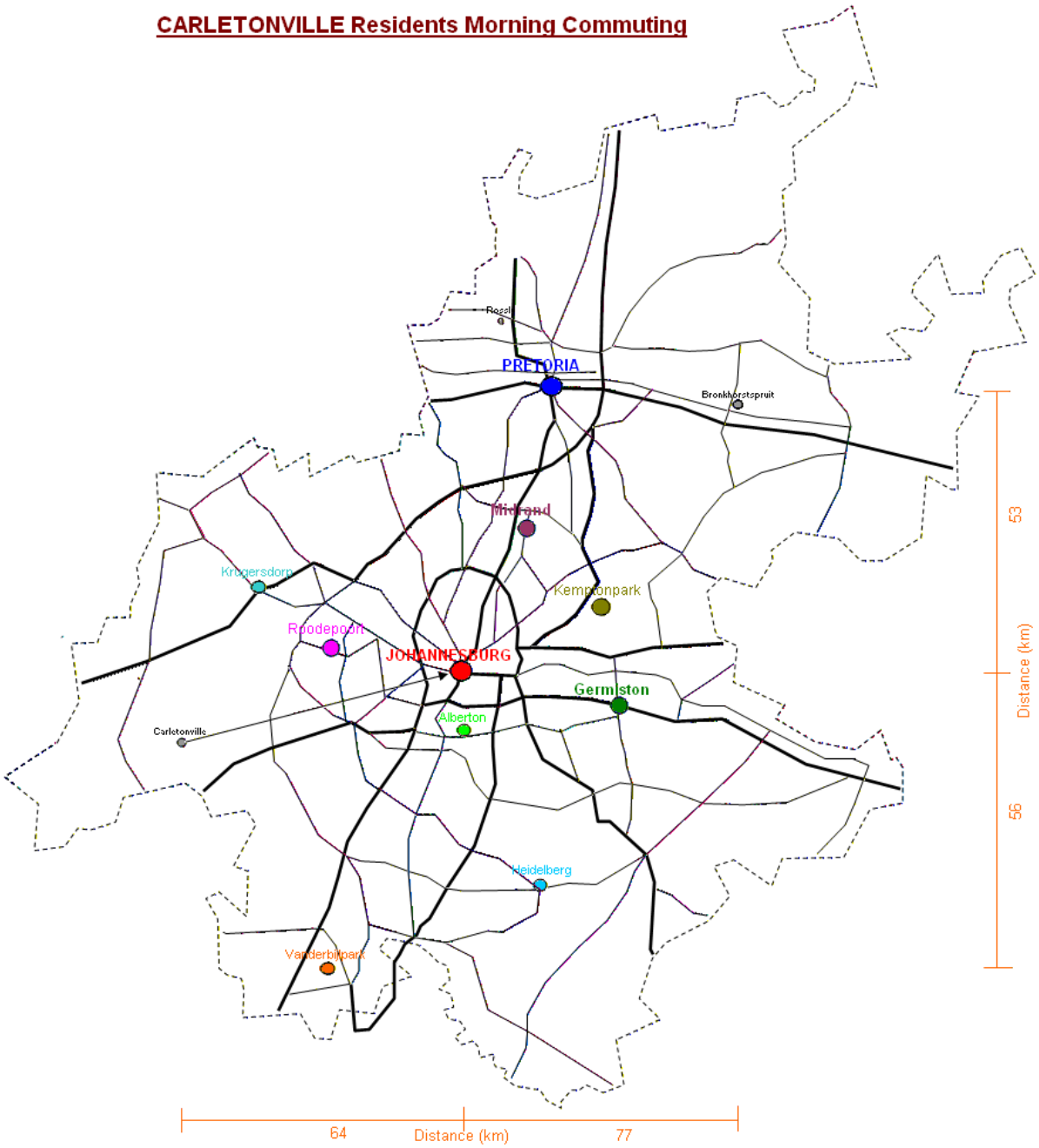
ANNEXURE N

Figure N1



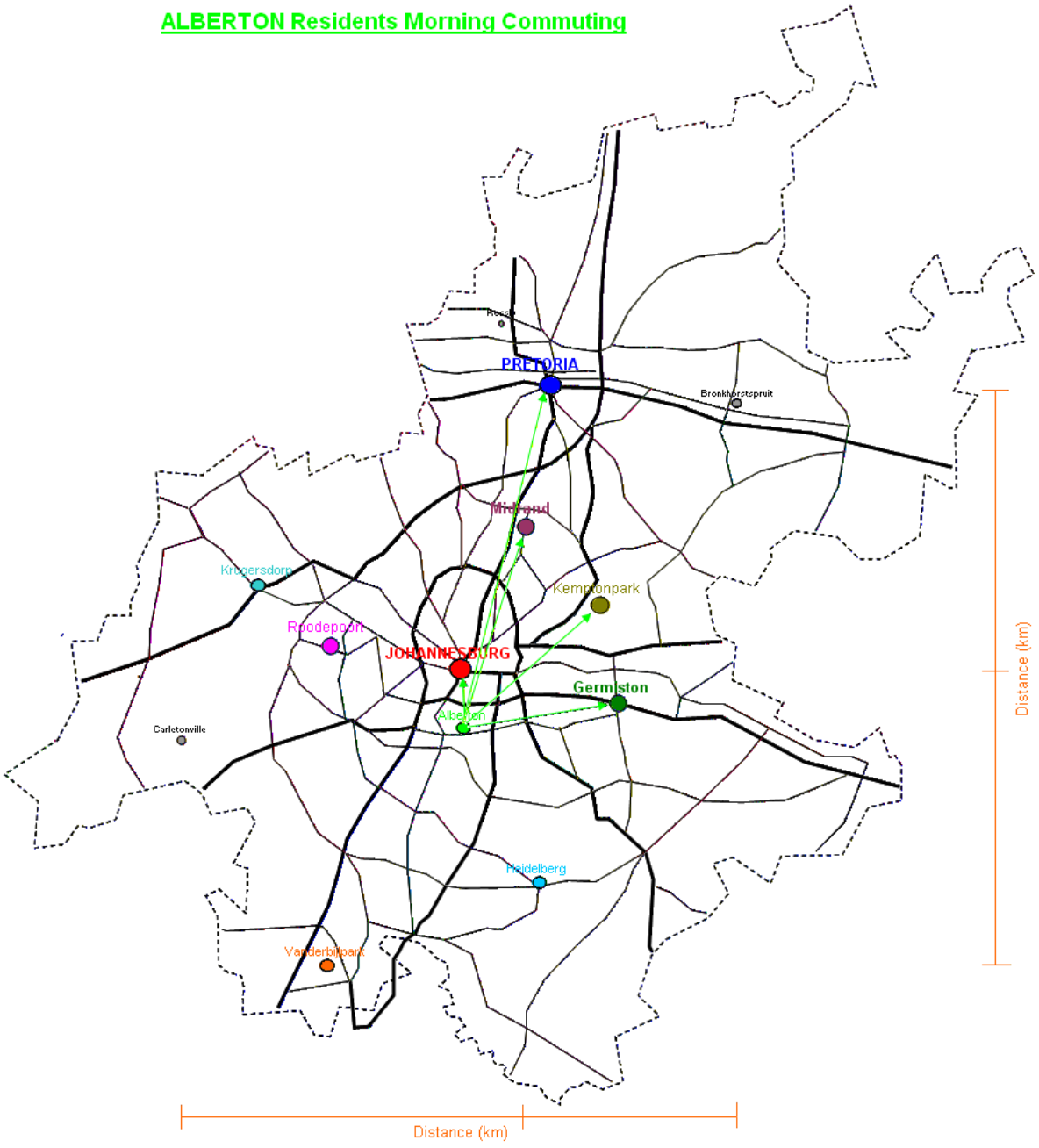
ANNEXURE O

Figure O1



ANNEXURE P

Figure P1



ANNEXURE Q

Figure Q1