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List of Abbreviations

AC	Alternating Current
AHI	Afrikaans Handels Intituut
AHP	Analytic Hierarchical Process
ASSA	Actuarial Society of South Africa
CFL	Centre for Learning (Telkom)
COSATU	Congress of South African Trade Unions
DA	Democratic Alliance
DC	Direct Current
DECT	Digital Enhanced Cordless Telecommunications
DIS	Dialectical inquiry system
EA	Enumeration or Enumerator Area
EMS	Environmental Management System
ESOP	Employee share ownership program
FDI	Foreign Direct Investment
FNB	First National Bank
FRD	Foundation for Research Development
GATT	General Agreement on Tariffs and Trade
Icasa	Independent Communications Authority of South Africa
LDC	Less develop country
MNC	Multi-National Corporation
MRTD	Modified Relevance Tree Diagram
MTN	Mobile Telephone Network
NAFCOC	National African Chamber of Commerce
NIC	Newly industrialized countries
OAU	Organization of African Unity
OPEC	Organization of Petroleum Exporting Countries
PIN	Personal Identification Number
PSDN	Public Switched Data Network
PSTN	Public Switched Telephone Network
PUK	Personal Unblocking Key
R&D	Research and Development
RDP	Reconstruction and Development Program
RFI	Request For Information
RFP	Request For Proposal
Rudasa	Rural Doctors' Association of Southern Africa
SA	South Africa
SAA	South African Airways
SAB	South African Breweries
SABC	South African Broadcasting Commission

SACOB	-	South African Chamber of Business
SADC	-	Southern African Development Community
SAPA	-	South African Press Association
SATRA	-	South African Telecommunications Regulatory Authority
SIM	-	Subscriber Identification Module
SJA	-	Social Judgment Analysis
SMME	-	Small, Medium and Micro Enterprise
SPII	-	Support Project for Industrial Innovation
Stats SA	-	The Statistical department of South Africa
TAH	-	Technology Acquisition Hierarchy
TDMA	-	Time Division Multiple Access
TEFSA	-	Tertiary Education Fund of South Africa
Telkom	-	South African telecommunications service provider
USA	-	Universal Service Agency
VANS	-	Value Added Networks
VAT	-	Value Added Tax
VSAT	-	Very Small Aperture Terminal
WTO	-	World Trade Organization

1. Introduction

This chapter is devoted to inform the reader on the problem facing telecommunication technology transfers into rural South Africa. This includes the research objective and the research approach.

1.1. Research Objective

The objective of this research attempt is to derive a telecommunication technology transfer model into rural areas that might supply advice and guidelines to the telecommunication industry of South Africa on how to improve the situation and conduct action in the future.

The need for a more effective telecommunication technology transfer model can be better understood when one takes a look at the current situation in South Africa and Africa. Aspects that need consideration are:

- The role of telecommunication in development
- Telecommunication Technology Transfer
- Universal Services in South Africa
- Churn Rate Problems in South Africa
- Problems of Sub-Saharan Africa telecommunication firms

1.1.1. Telecommunication and Development

Telecommunication is one of the keys to sustainable development in Africa and South Africa. The telecommunication sector is both a source of economic growth as well as a means to grow in other areas. The sector itself offers opportunities for indigenous innovation and it can assist national development. Access to a telecommunication medium not only serves critical sectors like education, safety and health, but also serves as a stimulant for creating new small businesses to sustain larger business productivity. It forms a backbone for development and the only way some development phases can be accelerated. Telecommunication can furthermore also play an important role in import-substitution through providing the needed infrastructure necessary to stimulate economic activity for the creation of businesses in all sectors.

Telephony also offers a communication channel for the support of participants in the process of democracy in communities on provincial, and national level. The products and services that are made possible through telecommunications can (with the necessary transfer of skills and technology) make a noticeable effort to empower former disadvantaged rural citizens in South Africa.

Usually the donor organizations don’t go through all the trouble to research the LDC’s (Less develop country) situation thoroughly before international financial aid is made available to accelerate the development process. An important factor is often neglected when development aid is made available namely that the development aid can destroy the indigenous market [1]. Telecommunication can improve the situation

through creating sustainable development in LDCs, which will then counteract the problem.

Mobile phones are fulfilling ordinary African's aspirations for voice, as well as a continents desire to bridge the technology gap that stranded it at the margins of the *"Information Age"*. In diamond-rich Botswana, more than one citizen in eight has a cellphone [2]. Mobile phone operators are able to reach people in places were roads, rails, or a stable power supply are absent and where other kinds of public infrastructure had collapsed.

1.1.2. Telecommunication Technology Transfer

Interaction and technology transfer between countries are becoming ever more important with the continuous developing nature of the international telecommunications environment. The successes that this co-operative effort might hold depends to a large extend on the effectiveness of the technology transfer process. Technologies are being transferred between countries at different levels of technological know-how and utilization, often to the advantage of only the technology source. Technology transfer is a complex subject where governmental regulations, social and cultural aspects, financial abilities, and technological capabilities play different major roles. Technology transfer models, which cause ineffective utilization of the technology, often neglect these aspects.

South Africa has a multi-cultural population that already has these problems nationally between the developed (industrialized cities) and the underdeveloped or developing (traditional and rural areas) sector (see Figure 1.1).

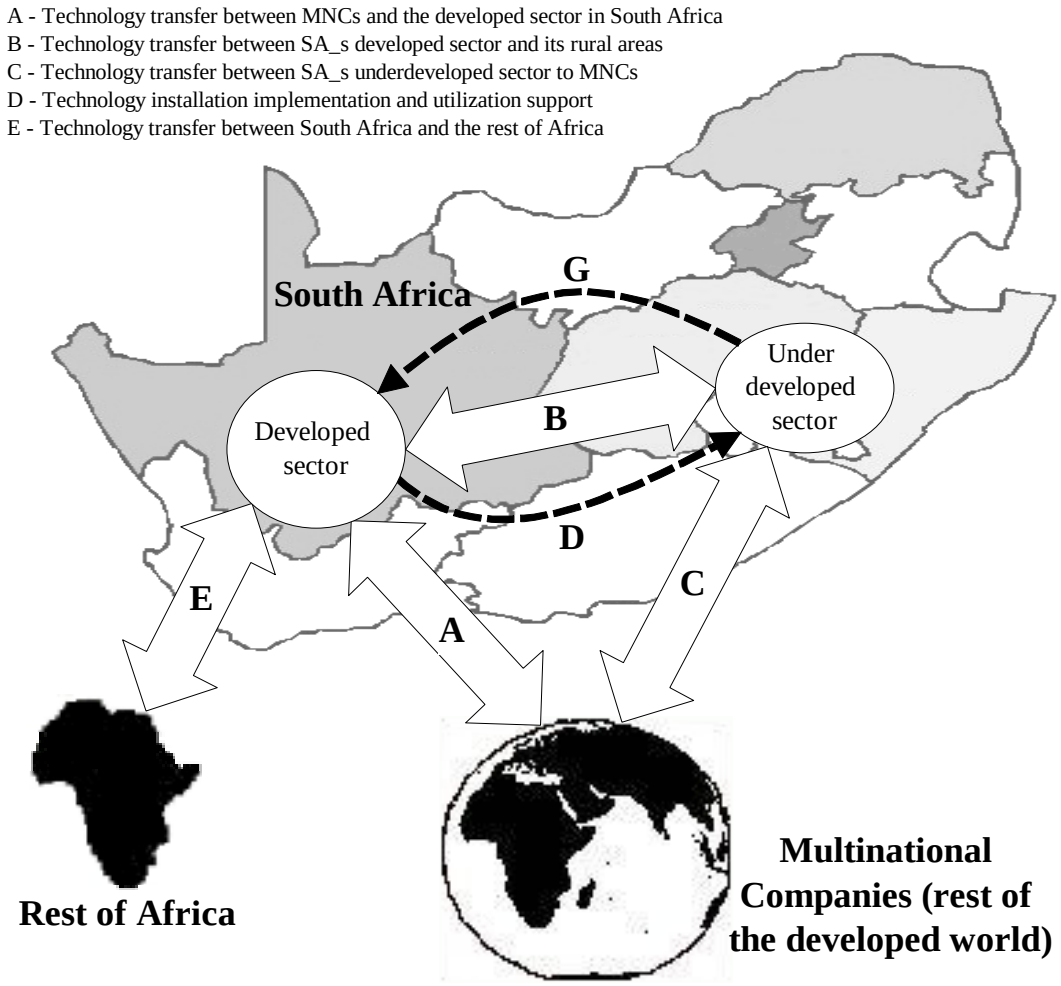


Figure 1.1. The interfacing between South Africa's two sectors (developed and underdeveloped/developing) and international technology suppliers (MNCs-Multi-National Corporation)

Most LDCs' developed sector is non-existing and effectively only has the underdeveloped sector that makes technology transfer very problematic and could easily worsen the independency status of the country. South Africa is in a unique and privileged situation were both the developed and underdeveloped (rural) sectors exists. Figure 1.1 shows the South African situation with interactions between the MNCs and between sectors.

Technology transfer currently occurs fairly successful between the developed sector and MNCs (Path A in Figure 1.1) Technology can then be diffused from the developed sector into the under developed sector (B) if the necessary precautions are taken. The problem with the South African rural areas is that technology cannot be successfully transferred from MNCs to rural regions (C) without the necessary support (D). If this is attempted the rural area will have to make use of foreign staff to implement and maintain the technology because of absent skilled manpower. Technology transfers from the underdeveloped sector outwards to the developed sector (B) and MNCs (C) are for all practical reasons inactive and very little prospects exist to change the situation in the near future. The developed sector should aim, in a

long-term development strategy, for a social and economic profitable diffusion channel (B) to uplift the rural areas and enable them to act as a technology source in paths B and C.

Better communication with African countries will strengthen South Africa's presence in the market by connecting institutions in both the public and private sectors. Many LDCs need basic standard technologies already viewed as old and unproductive by the developed sectors of South Africa. This situation creates an ideal opportunity for South Africa to appear as the *technology source* in the technology transfer process (E).

1.1.3. Universal Services in South Africa

Generally the term "universal service" is taken to mean a telephone in every home or at the office, while "universal access" refers to public access telephones (access to a telephone, but not necessarily one's own personal phone).

The International Telecommunications Union stated: "There is a need for policy-makers to review the objective of universal service. Emphasis would have to be shifted from providing service to everyone or even the majority of people to meeting demands for business customers, administrative needs, and access to telephone services to as many people as possible through pay phones and community phones in a way that allows operators to realize reasonable profit margins."

The Ministry of Communications said in a policy document released in 1997 [3], (entitled Partnership for the Future): "In order to set the initial targets, Telkom (South African telecommunications fixed-line service provider) has taken a monthly household income of R900 per month as the likely threshold for a phone-owning family. Those with incomes of below R900 will be served using an accelerated roll-out of public phones". Presently, unemployment in South Africa stands at 37,6%, and of those employed, 44,7% earn under R1000. The above figure is based on the assumption that people spend 2.9% of their incomes on telephony yet an international norm is that the service should cost no more than 0.7% of a household's total income. These figures demonstrate that private access to a telephone is becoming only a dream for more and more South Africans, unless something drastic is done to facilitate universal service.

Universal service involving a telephone in every home should remain very firmly on South Africa's long-term agenda, but universal access should be strived for as a temporary measure. Universal access should furthermore not be limited to the roll out of pay phones, as this will not facilitate public access to information and communications technologies. Rather, the provision of these services in the context of multi-purpose community communication centres should be encouraged

1.1.4. Churn Rate Problems in South Africa

A serious problem for Telkom, and for most companies in the telecommunications industry, is the problem of churning. Churning is the process of customer turnover. Anderson consulting recently estimated customer churn levels of 30% per year [4] in the cellular telephone markets. Because Telkom soon will no longer enjoy protection

from the state, this is a serious concern for them too. Competition will become fierce in the next years as new companies enter the South African market. Given the increase in customer choice, there has been and will be an increase in churn-rates.

In South Africa, nowadays the main focus is on extending the network into areas currently without any. However, there is a major issue of people who previously had telecommunication services but cancelled it due to high cost (this is referred to as "churn") [3], so affordability is also an important issue to be looked at. In South Africa a further churn related problem has been identified. Telkom, as requested by the South African Government, should install many phones in previously disadvantaged communities and homes. Because the clients in these areas are often not financially self-sufficient, the churn problem is aggravated [4].

Research is needed in churn analysis to perform two key tasks [4]**:**

- Predict whether a particular customer will churn and when it will happen;
- Understand why particular customers churn.

By predicting which customers are likely to churn, the company can reduce the rate of churn by offering customers new incentives to stay. By understanding why customers churn the company can also work on changing their service so as to satisfy these customers pro-actively [4].

In 1996 the churn rate was 16%. Telkom was required in terms of its license conditions to install 250 000 new lines. Instead it had to install 700 000 to reach its target [3]. Questions that might be asked are:

1. Would flexible billing and packages influence affordability, especially in low-income households?

2. Would this positively influence a household's ability to remain on the network?

Vodacom's (one of South Africa's mobile operators) churn rate is below 16%, one of the lowest in the world, and indicates exceptional customer loyalty [5].

Written into its license, Telkom was allowed "the exclusivity period" to have time to re-balance its tariffs. The rationale for re-balancing is that international calls (which have been above cost) have been cross-subsidizing local calls (which have been below cost), and this imbalance needs to be corrected so that services are provided, based on its real cost. The USA (Universal Service Agency) was set up partly to finance the difference between what the services actually cost, and what people could afford. This move will prepare Telkom for competition. Telkom cannot be allowed to use its market power derived from its former monopoly position to cross-subsidize services, as this would undercut the ability of competitors to enter these markets. The problem is that tariff rebalancing is resulting in services becoming more and more unaffordable to ordinary people who make mainly local calls.

Poor churn-rates are a well-recognized problem in developing countries. Even when liberalization may have led to more people coming onto the network, many

discontinued their services shortly after as it proved to be unaffordable. This problem is one of the key challenges facing the USA (Universal Service Agency) at the moment. It is in the public's interest for Telkom to be allowed to cross-subsidize local calls.

1.1.5. Problems for Sub-Saharan Africa Telecommunication Firms

The performance of Sub-Saharan Africa institutions in the telecommunications sector has been disappointing because of poor processes and inadequate human resource management. Problems, the telecommunication organizations face include [6]:

- Interface from government and the political institutions.
- Unjustified pressure of suppliers of telecommunication equipment and donor agencies to use technology which is new or even emerging when priority should be to supply basic telephone services.
- Inadequate organizational structure including: management and motivation of human resources, financial management, strategic planning and technology management.

Part of the solution lies in the recognition of the fact that it is people who will bring about improvements [6]. Furthermore, developing and training human resources together with dedication of sufficient resources towards this goal is crucially important. It is thus clear that the need exists for a more effective telecommunication technology transfer/diffusion model to deal with these problems.

1.2. Research Approach

1.2.1. Problem statement

Telecommunication technology transfers between two parties at different hierarchical levels of technology know-how/utilization (between MNCs and LDCs) often occur with limited or no advantages to the LDC. A transfer model is needed to improve the situation and make technology transfers a process from which both parties can benefit simultaneously. To develop such a model the research problem holds the following aspects that need investigation:

1. The determination on available transfer models, ideas and suggestions for effective technology transfer between countries at different hierarchical levels of technology know-how and evaluation to determine their applicability.

2. The determination on the current situation in South Africa's ability to transfer/diffuse technology from the developed sector to the underdeveloped sector and a search for existing technology transfer problems in the South African telecommunication industry (fixed-line & mobile), with suggestions on how the situation can be improved in the future.

3. The development of a telecommunication technology transfer/diffusion model for the South African situation with mutual advantages to the underdeveloped sectors as well as the developed sectors.

4. Identify strengths and weaknesses in the technology triangle "technical aspects" (Appendix A) for both the developed and the developing sectors to find aspects that might first have to be uplifted before interaction can be successful.

1.2.2. Problem Solving Approach

The approach to a solution for this problem involves a background study on the current problem, literature study, research and an analysis conducted on the basis thereof. The problem solving approach is discussed below.

1.2.2.1. Background

The background section (Chapter 2) tries to answer three basic problem-solving questions to clearly understand the problem. They include:

1. ***What?*** What is technology transfer?
   What technologies to transfer?

2. ***Why?*** Why transfer technology?

3. ***With whom?*** Who are involved in the technology transfer problem?

1.2.2.2. Literature Study

A literature study will be needed to determine aspects that will influence the creation of a new technology transfer model. It has the purpose of answering the question on how technology should be transferred (existing thoughts). This include:

- Critical needed factors
- Malfunctions in the technology transfer
- A definition on appropriate technology
- Existing technology transfer methods (models)

1.2.2.3. Field Research/Survey

The research attempt has the purpose of collecting the necessary data that will enable the author to supply useful inputs into the technology transfer process' problem solving techniques. The survey will be done in two parts:

- Interviews with corporate personnel from the telecommunication service providers in South Africa to determine their technology transfer practice and problems.
- A field research will be conducted to determine the magnitude of the problem and to acknowledge the need for drastic improvements in rural South Africa.

Research is useless if an analysis on the gathered data isn't done. Chapter 6 provides the data analysis on the basis of the technology transfer model described in Chapter 4.

2. BACKGROUND

Stringent austerity measures have often been imposed as a corrective measure in LDCs, but these programs often fall short since no substantial productive mechanism is in place to revamp their weak economy. Increasingly, these countries have recognized the need for technology to improve their debilitated conditions. While the development of indigenous technology may be encouraged, technology transfer is still seen as a vital process to improve these poor conditions [7]. Technology transfer is, therefore a frequently sought alternative by LDCs to improve their socio-economic conditions.

During this chapter the author will try to answer four questions (What, Why, Which, and Who) as presented in Figure 2.1. Chapter 3 tries to answer the question on "How".

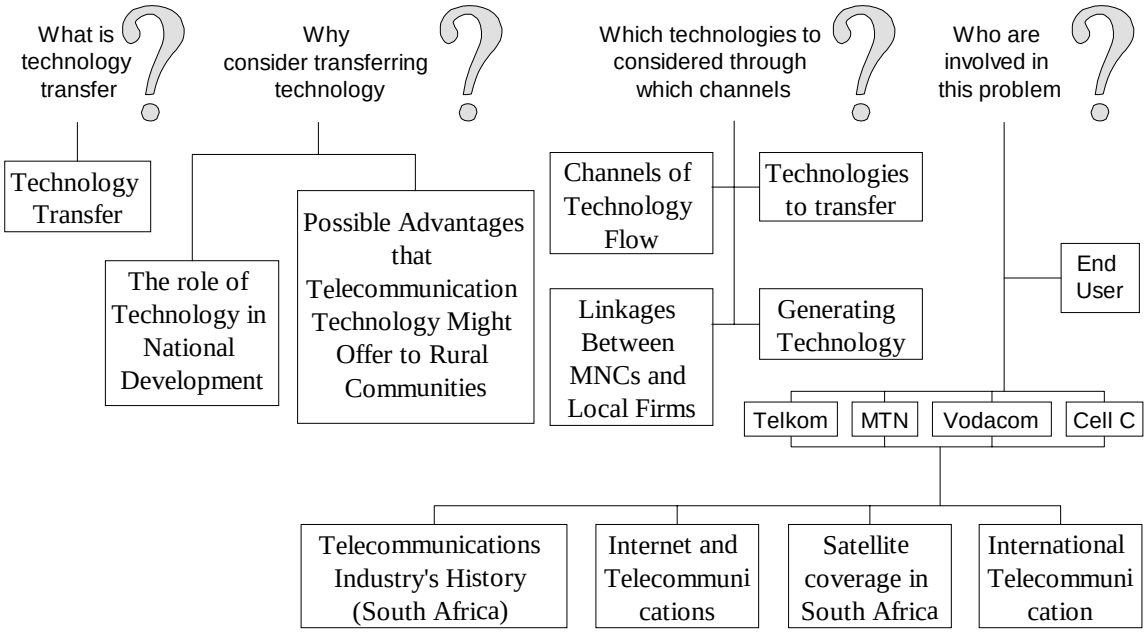


Figure 2.1. A background on technology transfer to LDCs

A background on technology transfer is given by answering these four questions namely:

1. What is technology transfer?

2. Why would anyone consider transferring technology at all? It is costly, it can make the receiving country increasingly dependent upon the supplying country (if one does not have own capability), and it's a confession that the receiver country has no competitive advantage. The only way one can answer this question is through having a look at the role of technology (in general) in national development and by looking at possible advantages, telecommunication technology might offer the rural communities

3. Which technologies should be considered for rural telecommunications and through which channels could they be transferred? The answer to this question can be found by first evaluating possible technologies suited for rural telecommunications. Then one should examine channels of technology flow and linkages between MNCs and

local firms to understand the transfer mediums used. It is also useful to understand why the generation of domestic technologies is important while thinking about this issue.

4. Who are involved in this problem of telecommunication technology transfer in South Africa? Part of the answer involves the end user, which was included but will only be discussed later during the model analysis in Chapter 6. The question furthermore involves the South African telecommunication industry (both fixed-line and mobile) and it will be overviewed on the basis of:

    - History of South Africa's Telecommunications Industry
    - Internet and Telecommunications
    - Satellite coverage in South Africa
    - International Telecommunication

2.1. Technology Transfer

Definition of Technology Transfer [7]***:*** The acquisition, development and utilization of technological knowledge by a firm/industry/country other than the one in which this knowledge originated. Technology transfer involves the acquisition of "inventive activity" by secondary users. Technology involves a hardware and software component. Hardware refers to the physical systems such as production systems, whilst software refers to the knowledge base that is essential in the smooth running of the hardware. Knowledge can be transferred through training and education, which could include training on how to effectively manage the technological processes and changes. A more complete definition for technology is given in Appendix A.

Transfer of technology often encounters serious problems, which makes it difficult to realize the goals of socio-economic development. Subsequent unproductive conflicts between the transferor and the transferee can further hinder the technology transfer process [7]. These difficulties, if not resolved before the implementation of the technology, may further delay the process of socio development in the LDC. Thus, a technology that is presumably unsuitable for the LDC's socio-economic growth, given its goals, strengths and weaknesses, may nevertheless be transferred.

The lack of linkages between the LDC's development strategies and their policies are a major reason for the transfer of inappropriate technology [7]. LDC's planners often view technology as constant and rarely consider it as a planning variable. Thus, technology, an important strategic variable for socio-economic development, is rarely integrated into the national development planning process.

The issue is not whether or not to transfer technology, but rather how to transfer appropriate technology. Appropriate technology is discussed in detail in Chapter 3. In short, appropriate technology refers to [7]:

- A technology that will make effective use of the LDC's limited resources and capabilities
- A technology that is sensitive towards the LDC's environment
- A technology that is capable of helping the LDC to further develop their resources

LDCs have many problems with information and information management. The focus of information technology in developing countries has to be on many targets such as population, information to the villages, farmers, researchers, and decision makers [6]. A part of the development problem is the question: "How is it possible to provide greater access to scientific and other development information of the LDC's population [6]. Socio-economic, cultural, educational, technical, and environmental conditions differ from country to country. Three assumptions concerning technology transfer that could be made for LDCs are [6]:

1. Resources in poor countries are not sufficient enough to implement independent information systems, services, and networks.

2. The necessary donor sources must target the creation of services containing indigenous sources of information.

3. The creation and production of independent and unconnected information services may lead to duplication and overlap. Co-operation will reduce waste and make the use of indigenous information optimal.

It is very important to appropriately tailor information technologies to local conditions if its adoption is to be effective [6]. The increased complexity of technology is such that no individual firm or country can hope to satisfy all its needs. Japan and Asia's experience [8] showed that industrial development in the latter half of the twentieth century and beyond has as one of its key requirements the upgrading of technology in production and infrastructures.

2.2. The Role of Technology in National Development

Policy makers and planners must consider technology as an important variable in national development. Technology is a variable that needs to be modified to satisfy changing societal needs [7]. The concentration of planners should not only be focussed on the advantages but also on how to possibly control and manage the negative impacts of technology. Figure 2.2 illustrates the advantages that technology may have to offer the LDC. The fact that these advantages are not guaranteed with technology needs to be stressed because only an appropriate technology, when effectively transferred and managed, will have these advantages.

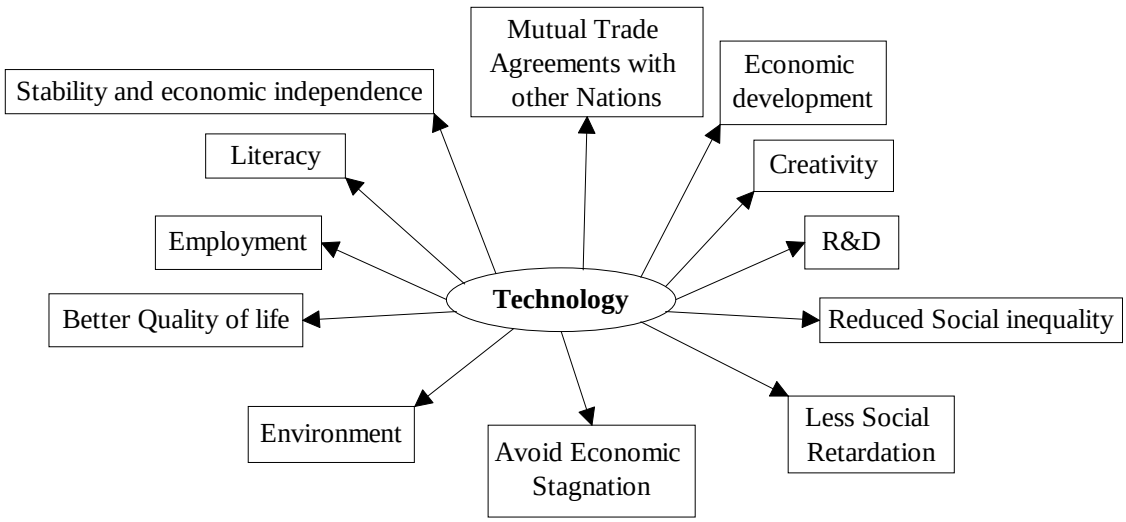


Figure 2.2. Advantages that technology has to offer in National Development

2.2.1. Employment

Appropriate technology transfer leads to employment opportunities for the population of the receiving country. The technology has to be able to utilize the available workforce and not subject the nation to the use of expatriates. Before technology can be successfully transferred, the required labour force must be adequately trained.

Technology is seen as a means of improving the deliberating economy of the LDCs. One way this aim can be achieved is through the creation of jobs. Generally, assembly line operations are more likely to use direct labour than highly automated systems [7]. Automated systems also require the use of integrated computer systems. Even though productivity has been shown to be significantly higher using such advanced systems, their demand for more advanced personnel, (computer programmers and system analysts), make them impractical for the LDC lacking people with such skills. This may include the training of skilled manpower and management needed for the smooth and effective utilization of the technology. The present focus should be on the use of present capabilities of the country rather than dependence on the transferor for a productive workforce.

The development of related and supporting industries leads to the creation of new jobs and may also lead to the development of new skills that may be necessary to satisfy changing industrial needs. Competitiveness and innovation also encourage the development of new products and services, leading to further increased employment.

2.2.2. Improved Quality of Life

In the LDCs, quality of life will imply developing preventive measures against some of the diseases that incapacitate their labour force, provision of social services, especially for children and the elderly, and enacting environmental protection laws [7]. Policy makers have roles to play to ensure that they are not dragged into a technology race that disregards the quality of life. It is imperative that technology will lead to the creation of jobs. The labour force absorbed as a result of this may contribute positively to society.

In the extended family systems that exist in most of the LDCs, such increased [7] self-esteem often translates into family pride, role models, and eventually continuity in the development of a skilled labour force by means of emulation and imitation.

2.2.3. Environmental Pollution

Environmentalists complain about the destruction of the ozone layer, acid rain, destruction of forestry, poor air quality, and the contamination of drinking water. One has to come to terms with industrial wastes. Recently, some of the industrialized countries have attempted to dump nuclear waste in LDCs [7]. In some countries, development has often meant the exclusive destruction of the habitat of other species, an act that eventually leads to their extinction.

2.2.4. Economic Stagnation

A country may acquire an inappropriate technology that may end up eroding its competitive advantage in other sectors such as agriculture and tourism. Agreements that virtually guarantee absolute monopoly to some of the investors limit foreign investments, increase inflation and unemployment, and reduce corporate tax revenues.

2.2.5. Social Inequality

Inappropriate technology refers to technology, which is socially irresponsible and insensitive to the needs, capabilities, aspirations, and expectations of the receiver. As aesthetic quality of these products continue to improve, we develop increasing needs and tend to demand more and more. Wealth becomes a necessary instrument with which to satisfy this unending urge. Social crimes in society are often associated with economic inequalities [7] or mal-distribution of incomes.

2.2.6. Research and Development (R&D)

R&D is necessary in order for the transferred technology to survive. Differences between developed countries and LDCs are shaped by the environment and people's career experiences. As a result, the way people conceptualise, analyse, and solve problems differs. These psychological attributes play a major role in determining the right types of products and services to provide to the people of all cultures, and understanding these attributes requires the participation of indigenous people in technological decisions.

The participation of supporting and related businesses in R&D not only leads to innovation and change but also generates synergistic benefits. The major manufacturers benefit from the redistribution of their resources to other R&D activities. Moreover, the cost of R&D is reduced as the manufacturer utilizes the efforts of other companies without necessarily being directly involved.

2.2.7. Enhanced Creativity

Innovativeness and creativity can be developed through the assimilation of new technology. Technologies are at times mutually dependant on each other. People become more innovative as they seek to relate existing technology to local conditions and other

technological and social problems. It is through innovative activities such as these that new technologies and new industries can be further developed [7].

2.2.8. Economic development

Many economies benefits derive the successful transfer of technology. More employment opportunities, increased GNP as a result of improved productivity, direct foreign investments, and increased gold reserves are all signs of economic development. LDCs should be able to develop, modify, and enhance the transferred technology if they intend to achieve long-term economic growth [7]. From the perspective of the LDCs, it is absolutely necessary that economic development be achieved if they are to be able to sustain their growing population and continue to provide social services for them.

2.2.9. Mutual Trade Agreements With Other Nations

Although many continue to serve as a major supplier of raw material to the world, the LDC's products are often devalued since buyers, rather than sellers, determine prices. Mutual trade agreements can assist the LDCs in reducing debts by exchanging technology for some of their raw materials. A fair price mechanism will help ensure that the transferred technology doesn't create an additional financial burden to the receiver of technology. Mutual trade agreements should also allow the LDC to export products of that technology to external markets. The availability of technology may help them limit the export of their replenishable and non-reusable raw materials.

2.2.10. Stability and Economic Independence

Stability cannot be achieved without economic prosperity and some economic independence. It is well understood that neither of these can be achieved without technology. Thus, stability is indirectly linked to technology [7].

2.2.11. Literacy

There is a need to be able to read technical manuals and instructions, to understand signals and symbols, to communicate with fellow workers and management, and even to understand quality control measures in the LDCs. Governments are also likely to emphasis education as the only means of sustaining technological progress [7]. Activities such as R&D, technological innovation, and management of technology are only possible and achievable if there is trained manpower able to relate the local conditions to the technology.

2.3. Possible Advantages that Telecommunication Might Offer Rural Communities

To many people, living in rural areas, telecommunication will stay a distant luxury, which they know nothing about and that is only allotted for the rich and fortunate living in the big civilized cities. It is not always the case that traditional communities don't afford telecom services, they often don't understand most of the terminology used and cannot grasp the advantages that it might have to offer them. A simple and easy to implement solution that comes to mind might be to launch an awareness campaign and inform people of all the advantages. This is unfortunately a much worse problem than is often believed and is rooted high up in the governmental authority. The government must first understand the

advantages that the telecommunication sector has to offer them before they will participate in any awareness campaign to have this message filtered through to the rural communities. It is thus important to focus on advantages that telecommunications can have to offer the LDC's governments and rural communities.

General Advantages of Telecommunications in Development

Modern telecommunications systems have the potential to lower cultural barriers, overcome economic inequalities and provide education opportunities [6]. Information processing and telecommunications are vital technologies for sustainable development [10]. These are the foundation for LDCs to participate in the global business arena. Through information processing and telecommunications, companies furthermore gain access to essential domestic as well as worldwide databases of information on available and alternative sources of technologies. This will increase the frequency and quality of technology transfer decisions.

Telecommunications are part of the infrastructure, which is essential for economic and commercial operation of a healthy economy. Without a solid backbone for telecommunication infrastructure, the efficiency of the LDC's private sector would decrease even further compared to the more industrialized nations of the North [6]. These major trading economies view information- and communication technologies as significant tools to improve domestic and international competitiveness.

Figure 2.3 illustrate the advantages, which affect the rural area people directly.

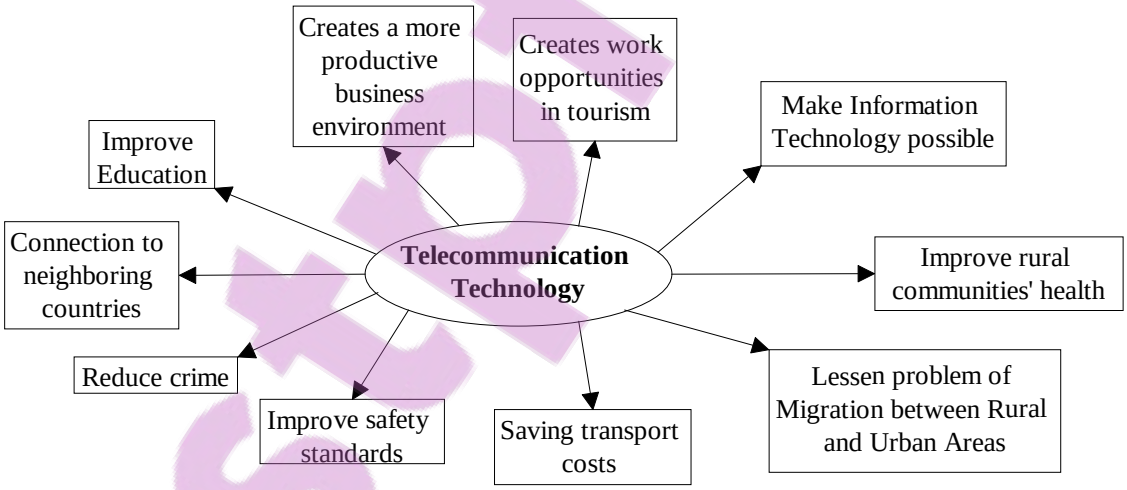


Figure 2.3. Advantages that telecommunication technology has to offer to rural communities

2.3.1. Telecommunication Creates a More Productive Business Environment

Studies in Kenya [6] have shown that efficiency of business is greater when access to telecommunication services is more reliable. The improvement affect aspects like: inventory levels, vehicle usage, managerial and labour time, lower distribution costs and higher sales prices. Lack of good telecommunication has caused constraints of service

industries in Sub-Saharan Africa including banking, accounting, advertising, and other areas, which relay heavily on efficient data collection, storage or dissemination.

2.3.2. Telecommunication Creates Work Opportunities In Tourism

Tourism (the most important growth industry in LDCs) relies heavily on a good telecommunication infrastructure. It brings 40 000 visitors [6] a year with much hard currency to Zimbabwe alone. Young entrepreneurs can also transform their primitive situation into a business opportunity but also need a means to telecommunication to advertise the new venture.

2.3.3. Telecommunication Makes Information Technology Possible

Information Technology and Development

Technology transfer is an ongoing process that is continually dependent on information flow on the performance of existing technology [6]. This is why some time has to be devoted on the influences that information technology can have on development.

Definition of Information Technology (IT) [6]***:*** Information technology is various technologies, which are used in the creation, acquisition, storage, dissemination, retrieval, manipulation, and transmission of information. IT includes computers, various telecommunication devises, media, broadcasting, press, micro-graphics, audio, visuals, and ext.

In the circumstances of a particular development context three groups of persons will need information. They are [6]:

1. People that are part of the development process, and in the process of development.

2. People involved with the operational side of development. Developers need information on what takes place in other development fields. Their particular activities cannot occur in isolation from progress in other fields such as education or community development.

3. People who participate in the management of development projects need strategic and managerial information, which will facilitate decision-making.

Information technology utilization in Africa has not reached its full potential. The problems are: under-utilization of equipment, lack of indigenous maintenance capability, and the fact that equipment is mainly foreign.

Trained staff and informed people are at the core of the infrastructure required for development. In LDCs, part of the developing process should be to organize data in ways meaningful to the local environment [6]. The availability of valuable indigenous information is a necessity for development. LDCs in Sub-Sahara Africa should therefore facilitate the training and emergence of effective and skilled producers and users of information. General characteristics, which should be present when the development role of information resources is optimal, are [6]:

- Ease of use. Information systems must have user-friendly interfaces and be able to adapt to specific user patterns and to different literacy levels.

- Accessibility to relevant information. The systems should intentionally withhold non-relevant information but not deny access or omit information of value.

- High quality of information. Information and information-systems should be reliable, accurate, current, and valid.

- Adaptability. Systems should communicate the content and meaning of information in ways easy to understand and easy to use.

- Time and cost effective.

2.3.4. Telecommunication's Might Improve Rural Communities' Health

A very pressingly important issue of concern is that a high proportion of doctors head overseas each year after their year of Community service (CS) in South Africa in which they got trained on the job. Rudasa (the Rural Doctors' Association of Southern Africa) said: "CS had improved the situation in some provinces, but the scheme had two serious shortcomings [11]:

1. A lack of senior doctors to supervise CS doctors, and

2. The fact that only a quarter of CS doctors actually went to rural hospitals".

The Eastern Cape which desperately needs more staff, for example, have no CS doctors for 2001 [11]. The provinces should make special efforts to recruit South African-qualified doctors back from Canada and the United Kingdom, to work in rural hospitals. A big part of the CS doctors' unwillingness comes from the poor safety standards and infrastructure in the rural areas. This is a field in which the telecommunications sector can play a role.

2.3.5. Telecommunication Helps to Lessen The Problem of Migration Between Rural and Urban Areas

Many people lack the skill to be accommodated in urban industries. As quickly as the rural population flooded the cities, urban slums were created. The government was unable to meet the increasing demand in social services, and consequently there were food shortages and skyrocketing inflation [7]. The crime rate increased as a result of the failing attempt to survive the greater pressures of urban cities. White-collar crime such as bribery and corruption rose to an all time high.

Today even the LDCs have a small modern sector with an urban bias, consisting of mainly manufacturing and services industries, foreign commerce, transport, and a few modern agricultural farms. On the other hand, the dominant sector of the economy, which includes vast traditional agricultural and allied activities, handicrafts, cottage industries, and local commerce, is backward not only in term of technology but also in terms of the general outlook. The modern sector can assist the traditional sector in two ways and the net outcome depends on the relative strengths of the two effects [8]. These are:

- ***"Spread effects"***
  Operating through both the supply of new ideas and the pull of demand.

- ***"Backwash effect"***
  Operating through the flow of capital and skilled labour.

The modern sector in the Eastern LDCs, cluster mainly around the urban cities. People living in these areas are culturally distant from the rest of the population and, therefore, become ineffective as vehicles of innovative ideas. So the characteristic commercial attitude cannot penetrate the indigenous sector, which is left more or less unaffected. It becomes a kind of static coexistence [8] and not a process of dynamic interaction.

The modern sector might also have a destructive [8] effect as a result. Cottage industries have been destroyed in the face of stiff competition from the modern sector. A further negative effect is that the expansion of the factory industries has not been fast enough to absorb the entire labour force. The traditional sector has become sick (unproductive and dependant on the formal sector) as a result of being faced with the problem of underemployment and disguised unemployment. A part of the surplus labour force keep migrating into towns and cities, and the modern sector's rate of capital accumulation is not rapid enough.

Migration on a large scale from rural area to big cities is generally acknowledged to be one of the more difficult problems facing LDCs [12]. Singapore's Prime Minister Lee Quan Yu said [10] (during the African Leadership Meeting held in Singapore in 1993) that family projects and local industry should be encouraged to create economic opportunities, and that people should be kept from emigrating to large cities. If the population flow were slowed down, the cities would be better able to absorb and generate employment for new immigrants and to cope with internal development problems [12]. Investment in rural infrastructure, including roads, water supply, and telephone links, has been suggested as one way to slow rural to urban migration because these improvements can reduce some of the basic disadvantages of living in a rural location. Rapid information in time of medical need or natural disasters (through telecommunication) could improve conditions in rural areas of LDCs and may in fact create additional employment opportunities [12].

On the other hand it might be argued that a rural telephone program could encourage migration [12] since the migrants could more easily keep in touch with their home village and family and would not have to endure long periods of "family information blackouts".

Migration however, depends greatly on the flow of information about job opportunities, living standards, and so forth. Without alternative communication sources rural migrants tend to follow the migration patterns of kin and friends [12] rather than risk the uncertainty of going to other places, which, in fact, may have potentially greater opportunities. If rural communities are better able to call or to receive telephone calls or call-relayed messages from friends, relatives, and acquaintances throughout a region or in other regions, better information could be received. This could ultimately bring about "a higher proportion of successful (permanent and well-paid) migrations [12], a redirection of migration towards secondary and more distant urban centres, and an increase in the overall efficiency of migration in the region.

Migration from rural area to big cities causes an army of urban unemployed, which brings about socio-political tension. There is an inevitable clash between the modern sector and the traditional sector with conflicting social and economic interests. It is however possible to reduce this negative effect, which the two sectors have on each other. This is done through adaptation of foreign technology [8] (not neglecting modernization of indigenous technology), and growth of intermediate towns.

- **Adaptation of Technology**
  In economies with surplus labour, in the process of modernization of the traditional sector there is considerable room for the development of intermediate technology, which may turn out to be the most appropriate technology [8] under the current socio-economic conditions.

- **Intermediate Towns.**
  There should be a hierarchical structure of urban development in LDCs. At the centre of a number of villages there should be intermediate towns [8] or cities. Again, for a number of intermediate towns or cities there should be a large city. These intermediate towns or cities could act as a bridge between the villages and the metropolis.

2.3.6. Telecommunication's Saves Transport Costs In Rural Areas

Telecommunications can reduce costs of transport in LDCs. A perfect example of this fact is an experience of two rural factories situated in Bangladesh [12] where radiophones made huge cost savings possible.

In early 1980 a radiotelephone was installed at both the Nabaran Jute Mill (NJM) and at the Ghorasal Fertilizer Factory (GFF) outside Dhaka. The initial data and expenditure savings estimates are presented in Table 2.1. [12]. A more complete calculation would however include savings in vehicle capital, other operation and maintenance costs, and other direct and indirect expenditures. The use of the telephones will reduce the number of trips to Dhaka for both companies in which a driver and two managers are occupied.

Benefits for both companies NJM & GFF			
Radiotelephone cost	190,000.00	Taka	
Installation	10,000.00	Taka	
Maintenance beginning after one year of operation	20,000.00	Taka/year	
Calls per week	96	Calls/week	
Assumed number of working weeks	48	Weeks/year	
Calls per year	4,608	Calls/year	
Call charge	0.75	Taka/call	
Telephone operations cost	3,456.00	Taka/call	
Costs occurred during first year	203,456.00	Taka/call	
Costs occurred during second & succeeding years	23,456.00	Taka/call	
Costs for companies			
Item	**NJM**	**GFF**	**Units**
Appropriate distance from Dhaka	20	40	Miles
Average number of round trips to Dhaka per week:			
Before installation of telephone	18	11	Trips/week
After installation of telephone	2	1.50	Trips/week
Assumed number of working weeks	48	48	Weeks/year
Average road-trip gasoline cost	350.00	650.00	Taka/trip
Average trip-trip time	4	7	Hours/trip
Average number of staff making trip (including driver)	3	3	People
Average wage of management staff making trip	1,000.00	1,200.00	Taka/month
Average number of working hours	42	42	Hours/week
Gasoline expenditure savings	268,800.00	296,400.00	Taka/year
Reduced wage expenditure for two management staff	36,571.43	45,600.00	Taka/year
Total expenditure difference	305,371.43	342,000.00	Taka/year
Cost benefit ratios	**NJM**	**GFF**	
Savings exceeds cost during year 1 by	150.09%	168.10%	
Savings exceeds cost during year 2, 3, 4... by	1301.89%	1458.05%	

Table 2.1. Factory Expenditure Savings Data from Bangladesh 1981 [12]

Respectively, in the first year direct communication expenditure exceeded costs by about 1.5 times at NJM and 1.68 times at GFF [12]. During the second and each succeeding year direct savings exceeded costs by about 13 times at NJM and 14.5 times at GFF.

2.3.7. Telecommunication Can Improve Safety Standards

Mobile telephony hold the opportunity to provide the user with a network that will enable him/her to get a hold of emergency services while outside big cities. Cellphone technology can also be applied to help find stolen vehicles. Another way that the service provider can improve safety is to offer the user a toll free emergency number that is linked to rescue-

units country wide or even worldwide. The fixed line provider can also participate in this manner.

2.3.8. Telecommunication Can Reduce Crime

A significant proportion of crime in LDCs is often within the telecommunication companies in the form of theft and corruption. Better management and control together with prosecution of criminals is the only answer to this problem. When a person commits a crime internal to a company in most LDCs, he stands a chance of losing his job but the case is rarely taken up in court and criminal charges aren't filed against that person. This causes a workforce containing bad elements, which might influence the majority and worsen the problem. Another way in which mobile telecommunication companies may help prevent crime is by blacklisting cellphones.

2.3.9. Connect to Neighbouring Countries Through Telecommunications

Through telecommunication, interaction is made easier between countries and the surrounding countries should be seen as an unexploited market segment that might bring further job opportunities.

2.3.10. Education Through the Telecommunication Industry

Education must probably be the most important area in which telecommunication can play a crucial role in LDCs. They can get involved through a number of ways for example:

- Bursary- and scholarship programs
- Practical training and exposure to new technology
- Training, skills transfer, and human resource development
- Donations to schools in the form of funds or hardware and the necessary training to utilize these technologies to a maximum
- Promote physical development programs in sports, health, and fitness.

By loans, gifts, and bilateral development contracts, opportunities have been generated to the LDCs whom cant afford high technology microcomputer systems. They obtained the equipment and some people were trained to use it, but after their training these people moved to better jobs in the organization, and the skills are seldom passed on to other employees [13]. As a result, equipment that might accelerate the development of these LDCs when used in the correct way stood unused and became non-profitable.

Telecommunications Makes Remote Education Possible

The infrastructure for adequate training and education is dramatically lacking in many African countries. It is in this area that modern telecommunication and information technologies can have one of their greatest impacts on the development of South Africa [6]. The basic process of instruction is demonstrated in Figure 2.4.

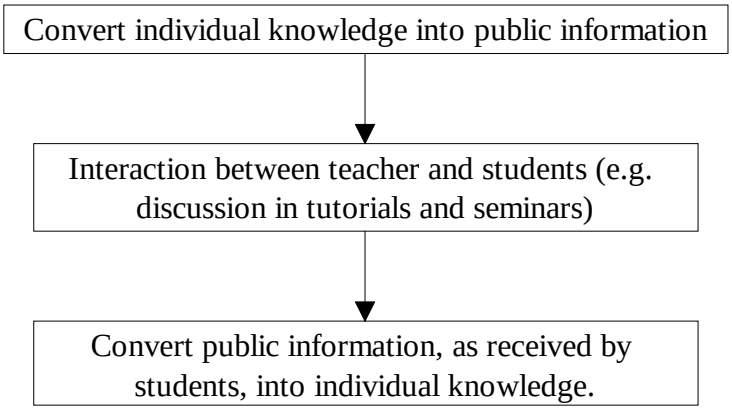


Figure 2.4. Basic process of instruction

Opportunities exist to use development (in ATM technology) to build a new environment for long-distance education, which takes advantage of multimedia documents to enhance the learning process. Two prominent considerations led to the selection of ATM technology. There is a need for multiple video streams along with high-resolution images (10^s of Megabytes each). ATM high-speed networks however supply bandwidth from 155Mbps to 2.4Gbps and have the capacity to distribute images in real time [6]. ATM has become the standard for future broadband integrated services digital network (B-ISDN) applications.

'Tele-presence' of students in the classroom is crucial to make their active involvement possible and allow instructors to gauge their success in transmitting information and knowledge. It must be possible to view the material at different times. It must be reusable. This necessitates the capture of class sessions and of the material displayed to allow playback at a later time. Distance education must be accessible to users, both students and instructors [6]. This is true in terms of physical access and ease of use, as well as minimal amount of training by using the available technology.

2.4. Technologies to transfer

A combination of technologies based on: computers, microelectronics, telecommunications and space technology [6] allow for the mechanical collection, collation, storage, retrieving and dissemination of information. These technologies are widely in use in more industrialized countries. Not all however carry immediate value for the less developed world.

Rural Telecommunications

Digital personal radio-communication systems and mobile cellular systems can facilitate and accelerate access to world networks. Low orbit satellite systems can also translate into a sensible price reduction of remote area telecommunications. The following technologies however are currently available for rural telecommunications [6]:

- Analogue and digital radio-telecommunication systems
- Mobile or fixed cellular radio-communication systems

- Satellite communication systems including micro stations, mobile satellite communication systems, national satellites, etc.

- Small mobile ground stations such as those provided by INMARSAT.

Although LDCs are not using high technology to develop, they try to benefit from a combination of information technology and telecommunication [13]. It includes aspects such as information gathering, processing, handling, storage, retrieval, and communication by machines.

Features supporting computerization in urban and regional LDC planning are [13]:

1. Fast increase in population figures.

2. Problematic housing conditions for the urban poor masses.

3. Lag between the increase of population and housing, and the realization of technical infrastructure and facilities.

4. Unbalanced land use developments in urbanized areas.

2.5. Channels of Technology Flow

Technology flows easily across boundaries of countries, industries, departments or individuals, provided that the right channels of flow exist. Three types [7] of channels can allow effective technology flow. These are:

2.5.1. General Channels

General channels refer to education, training, books, journals and other published materials, conferences, study missions, and exchange of visits [7]. Technology flows unintentionally when information is made available with limited restrictions in the public domain. Users are then free to apply the technology for their purpose.

2.5.2. Reverse Engineering Channels

Reverse engineering is another channel that allows technology to be transferred without the contribution from the source. The host, or the traditional receiver is capable of developing the capability to duplicate it in some fashion. This is feasible provided that the host has the technology to reverse engineer [7] and that there is no legal violation of intellectual or property rights. These channels are usually the most difficult ones to establish in developing countries because of the absence of knowledge that was not able to flow through the general channels.

2.5.3. Planned Channels

Technology transfer is done intentionally with the consent of the technology owner. Several types then permit access to, and use of, technology know-how. These are:

2.5.3.1. Foreign Direct Investment (FDI)

A MNC or the transferor establishes a wholly owned secondary business in the LDC. The technology remains between the boundaries of the MNC to be controlled. Through FDI the investor gains access to a labour force, natural resources, and markets, while the host country receives technology know-how, employment opportunities for its people, training of the workforce, investment capital that adds to the development of the infrastructure, and a tax advantage since most employees will be contributing to the local economy [10].

Spillovers of MNC Technology

The most significant channel for the distribution of modern, advanced technology are external effects or "Spillovers" [14] from foreign direct investment (FDI), rather than formal technology arrangements.

When firms establish affiliates abroad and become multinational, they are distinguished from the already established firms in the host country for two reasons [14]:

1. They bring with them some amount of the patented technology that constitutes their firm-specific advantage and allows them to compete successfully with local firms who have superior knowledge of local markets, consumer preferences, and business practices.

2. The MNC affiliate further disturbs the existing equilibrium in the market and forces local firms to take action to protect their market share and profit, which leads to productivity increases.

The simplest example of a Spillover is perhaps the case where a local firm improves its productivity by copying some technology used by MNC affiliates operation in the local market. Spillover also occur if the entry of the affiliate leads to more severe competition in the host economy, so that local firms are forced to use existing technology and resources more effectively. Another form of spillover takes place if the competition forces local forms to search for new, more efficient technologies. These effects may take place either in the foreign affiliate's own industry, or in other industries, among the affiliate's suppliers and customers.

MNCs have three alternative ways to exploit its technological advantages internationally. They could produce for export in the home country, sell technology to foreigners, or can establish an affiliate abroad and control foreign production directly. A technology that is exploited through FDI will probably not be licensed to the local competitors in the host country. This implies that the local firms' only chances to gain access to the technology is through reverse engineering or hiring the former MNC employees whom already have the special necessary skills.

"Spillovers" is not the answer to all development problems and could also become a drawback if not managed correctly. The entry of MNCs into monopolistic industries is likely to raise the level of competition and force existing firms to become more efficient. Foreign entry may, of course, also lead to the downfall of firms within the industry when the least efficient companies are forced out of business. This raises the fear that MNC affiliates may out-compete all local firms and establish monopolies, which are even worse

than the domestic ones they replaced [14]. The policy-maker has a definite role to play in avoiding this scenario from occurring.

2.5.3.2. Licensing

Two types of licensing can be identified [7] namely:

Multiple Licensing: The transferor licenses its technology to more than one licensee in the LDC.

Exclusive Licensing: The technology is licensed to a single licensee in the LDC.

2.5.3.3. Joint Venture

The transferor shares ownership of its venture in the LDC with a local partner and also licenses its technology to the local partner. They combine their interests by sharing resources, technology know-how and knowledge on local conditions to complement one another [10]. International joint ventures are often used by recipients to acquire technology and by sources of technology to gain access to local markets and distribution skills.

2.5.3.4. Turnkey Project

A country buys a complete project and the project is designed, implemented, and delivered to operate. It sometimes includes training and continual operation support. Engaging in a turnkey project is equivalent to buying a complete plant, which most innovative firms wouldn't sell if they plan on exploiting the market themselves.

2.5.3.5. Technical Consortium and Joint R&D Project

Two parties collaborate on a large venture because the resources of one are inadequate to affect the direction of technological change. This typically takes place between two countries because of the size of the investment which are involved [10]. On a smaller scale, Co production can also be viewed as a type of a planned channel. Here, the transferor produces part of the product components in the LDC.

Some argue that locating abroad may decrease the growth in the developed country's exports, thereby widening their trade deficit. To the country business executives counter that these factories abroad do not cost jobs in the developed country and that the potential markets abroad may be lost if production is not carried out locally.

2.6. Linkages Between MNCs and Local Firms

Some of the spillovers from FDI operate via linkages between the MNC's foreign affiliate and its local suppliers or customers. Backward linkages arise from MNC affiliates' relationships with suppliers, while forward linkages stem from contact with local customers [14].

2.6.1. Backward Linkages

MNCs may contribute to raise the productivity and efficiency in other firms as they:

- Help suppliers (domestic as well as foreign) to set up production facilities.
- Provide technical assistance or information to raise the quality of the suppliers' products or to facilitate innovation.
- Provide or assist in purchasing of raw materials and intermediaries.
- Provide training and help in management and organization.
- Assist suppliers to diversify by finding additional customers.

2.6.2. Forward Linkages

There is much less evidence of forward linkages than backward linkages. Forward linkages occur when firms contribute significantly to the development of local distributors and sales organizations [14]. The growing technical complexity in many industries causes that only MNCs can afford the necessarily R&D to develop and manufacture modern products, and causes that industrial applications might require expertise from the manufacturers. This would contribute to increasing the role of MNC-customer interactions.

Some of the characteristics of the host country, which may influence the extent of linkages, are market size, local content regulations, and the size of the technological capability of local firms. Linkages are likely to increase over time, as skill level of the local entrepreneurs grows, new suppliers are identified, and local content increases [14]. This constitutes circumstantial evidence for spillovers.

The transfer of technology from MNC parents to affiliates is not only embodied in machinery, equipment, and patent rights, but also realized through the training [14] of the affiliates' local employees.

2.7. Generating Technology

Any technology policy must have as one of its prime objectives the task of moving to the generation of technology, even if this is in restrictive areas of activity. In technologically dependant developing economies it may also be the only way to obtain which is appropriate to local conditions. Ignoring countries rich in high-value raw materials, the countries with the highest per capita incomes are those with the greatest relative strength in generation of technology [8].

It may be thought that LDCs have no prospect of ever moving to the edge of world technology. This may be true at an aggregate level but there remain narrow niches for specialization in which developing countries can compete with the best, especially when technologies are appropriate to the LDC due to a specific climate or other distinctive reasons.

Experience to generate technology may not have to be tested at the highest level, but may often be relevant at the regional level [8]. Policy mechanisms for selecting specialization areas are crucial and must avoid research such as, the exploration of basic-research targets, which have potential application possibilities only at some distant point in the future. The ability to generate technology in an efficient manner usually follows on in a specific order mastering the ability to select, transfer, install, adapt and improve other people's technology [8].

2.8. Telecommunications Industry of South Africa

South Africa ranks 23rd in telecommunications development in the world [15]. The country has approximately 5.3 million installed telephones and 4.3 million installed exchange lines. This represents 39% of the total lines installed in Africa [16].

Telecommunications in South Africa, are provided mainly by three companies: Telkom (fixed line operator), Mobile Telephone Network or MTN (cellular service provider), and Vodacom (also a cellular service providers). A third cellular service provider (Cell C) will become active at the end of 2001 together with another yet to be determined fixed line operator [17]. A brief background on the companies' history will be given below. The industry will be discussed using aspects such as:

- Internet and Telecommunications
- Satellite coverage in South Africa
- International Telecommunication

Technology transfers is an international activity between MNCs and LDCs. The aspects mentioned above form an important link to international markets not only for the telecommunications industry but also for the rest of the country's activities and are therefore included in the discussion.

2.8.1. History of South Africa's Telecommunications Industry

Fixed-line Telecommunications in South Africa

2.8.1.1. Telkom

Telkom was granted an exclusivity period of five-year ending in May 2002 during which only Telkom were authorized to supply fixed line telecommunication services in South Africa.

The question of why exclusivity was granted to Telkom are often asked by value-added network operators, almost all in favour of open competition in the telecommunications sector. Andile Ngcaba, director general of the government's Department of Communications, defended the 1995 decision to give Telkom exclusivity in the Act in exchange for assurances that providing telephone services to rural villages would be one of its priorities [18]. To connect a village is a big expense and you need some kind of incentive to make it happen. Exclusivity gave the government a more certain method of getting lines to those villages.

Emmanuel Olekambainei, chairman of the International Telecommunications Union GMPCS-MOU group and a former regulator in Tanzania, said that connecting rural areas in SA is an approach that will bear fruit later. “What SA did, made good market sense. What happens when your urban areas become saturated? The money moves to un-serviced areas. But you need a basic infrastructure there first” [18].

Telkom had significantly enhanced its competitiveness during its exclusivity. Telkom announced on 19 March 2001 that it would not exercise its option to ask for a sixth year of exclusivity [19]. The Company is ahead of its cumulative four-year rollout and service targets. Telkom CEO, Sizwe Nxasana said that Telkom welcomes competition from May 2002, when its five-year period of exclusivity would end. He also added that Telkom is well positioned to remain competitive in all markets, and that they look forward to the introduction of competition in 2002.

MTN has tentative plans to partner with Transtel, Eskom, and an international partner in 2003 to bid to become the country’s second fixed line telecommunications operator [16]. Transnet, one of MTN’s major shareholders, is well positioned to be a major player in this market owing the fact that it has the second largest network in South Africa.

Mobile Telecommunications in South Africa

South Africa's cellular industry is worth approximately R16-billion [20] but the multi-billion MTN-Vodacom duopoly is soon to end. There is very little competition between the existing networks in terms of price and product offerings. Both however argue that this is merely the result of market forces and not a result of agreement between them. Cell C launched its application for an operator's license on June 14 1999 [21] and received the third South African cellular operator license on June 26 2001. Icasa (Independent Communications Authority of South Africa) awarded the licence.

2.8.1.2. Vodacom

In 1994, just before the first democratic elections, Vodacom did not exist. Today, Vodacom is valued between R50 billion and R70 billion [22] and delivers a service to some 3,6 million South Africans which is an integral part of their daily lives.

In September 1993 Vodacom was granted one of two GSM network licenses in South Africa. However, the cellular industry was almost stillborn. The government-in-waiting threatened to withdraw the cellular licenses on assuming power. Frantic negotiations, led by Vodacom’s Managing Director Alan Knott-Craig, set conditions that included minimum levels of black participation, subsidized cellphones in disadvantaged communities and a billion rand Joint Economic Development (JED) program.

The JED plan was based on the principles of boosting foreign investment, job creation, research and development, local exports, developing local value added technology, training and forging international linkages. One of the key elements of the JED plan was to add local value to imported technology. GSM, the technology standard in South Africa's cellular industry, is by its nature high-tech and sophisticated. However, Alcatel and Siemens, Vodacom's main network equipment suppliers, have succeeded in adding hundreds of millions of rands of local value, thereby minimizing the impact on South

Africa’s balance of payments. The creation of a local smart card industry is an example of promoting local manufacturing of high-tech products. Vodacom generated R3,4 million in JED credit by assisting Integrated Card Technology to set up a smart card production facility.

Vodacom's initial growth projections catered for 250 000 subscribers within ten years [22]. They exceeded three million during the year 2000.

An impressive achievement in the JED program was the contribution of Vodacom's community services, a subsidized phone service in disadvantaged communities, which would take the country a step closer to universal telephone access.

Highlights of Vodacom's JED achievements include:

- Research and development activities undertaken by Siemens. This includes the development of Sigi's (Siemens GSM Telephone Interface), the world's first pre-paid GSM community phone, and vehicle tracking, a unit that can be installed in vehicles for multiple purposes besides tracking.

- Transfer of skills from international consultants and development of specialized billing systems by local consultants, creating long-term job creation and increasing the local value of the systems.

- Local Company Atio Corporation was commissioned by Vodacom to develop a call management system for Vodacom's customer care centre. The operator service centres were developed and assembled locally and subsequently also exported by Atio to Celcom, a Malaysian cellular network.

- Alcatel has upgraded their production facility to increase the local value for each unit as a component of its rural communication equipment.

- Vodacom's investments in tertiary education.

- Affirmative action programs implemented by Vodacom and sister company Vodac.

2.8.1.3. MTN

At the start of 1999, MTN’s network covered over 650 000 km2, which accounts for almost 48% [23] of South Africa’s geographic area and providing cellular telecommunication access to more than 80% of the population.

MTN was the first cellular telecommunications company to receive the prestigious ISO 9001 registration for their Network and IS Departments and ISO 9002 for their Customer Services

Global Telecommunications Award panel adjudicated MTN one of the top three cellular operators worldwide. CellExpo also accorded MTN the award for Best Customer Service in South Africa.

The original forecast of a total national subscriber base of 250 000 after 5 years was exceeded beyond all expectations. Currently there are 5.6 million subscribers in South Africa, representing a teledensity of 12.4% [24].

While intelligent planning and management of MTN's current 083 number range has up till now enabled MTN to cope with the rapidly increasing demand for their services, this demand has made it essential for them to open up additional capacity. MTN welcomed ICASA's decision to grant them additional number ranges (the MTN 073 prefixes). The decision will enable MTN to provide the ever increasing advantages of mobile telecommunications to a market expected to exceed 10 million [24] in a few years time."

The famous MTN lightship [23] appears regularly at events, functions and displays in all major cities of the country. More than a striking billboard for MTN, the ship also provides a platform for high quality aerial photography.

2.8.1.4. Cell C

Obtaining a Cellular Operators License

A delay occurred in the license awarding process when a review had been ordered by the high court in 2000 on the grounds that there might have been irregularities during the tender process. Nextcom, a consortium owned 60% by local empowerment groups and 40% controlled by Hong Kong-based Distacom [25] won an interdict preventing Matsepe Casaburri from awarding the license without giving the unsuccessful bidders an opportunity to respond. M&G newspaper said in August 2000 that Cell C (60%-owned by diversified Saudi Arabian group Saudi Oger, and the remaining 40% is owned by black-empowerment group CellSAF [26]) was made winner because of a complex guns-for-oil deal with Saudi Arabia. The Government replied by saying the M&G story is purely fiction [28]. Robert Nkuna, spokesperson for Ivy Matsepe Casaburri, added that there is no proof to suggest the minister had intervened in favour of Cell C [29].

Mr. Talaat Laham, chairman and executive head of Cell C said that the importance of ending the court case had increased tremendously. The delay has already taken 18 months and Cell C has lost close to 500 000 clients of which only a third is probable to return [30]. According to communications minister Ivy Matsepe-Casaburri, almost 1 600 jobs and more than R1,5 billion was lost by Cell C because of the delay. MTN and Vodacom had more than 9 million customers in mid 2001, which is 5 million more than when the third cell bidders started looking at SA in early 1999. But Cell C director Zwelakhe Mankazana believes that the market will plateau at 16,5m [31].

Cell C and Nextcom decided on Friday June 15 on an out-of-court settlement after a drawn-out third cellular license saga [29]**.** Judicial review judge Hekkie Daniels endorsed this settlement, thus ending the costly and bitter legal battles that have dented the country's image among international investors. Mankazana said they elected to settle out of court because there was no way of ascertaining if there would not be further challenges which would have seen the battle drawn out even longer. The settlement was estimated to be worth between R50 and R80 million [29], which would be just about enough for Nextcom to recover its expenses.

The settlement wasn't satisfactory for everyone at Nextcom [29], which has disintegrated somewhat since the SATRA (South African Telecommunications Regulatory Authority) first chose Cell C as its preferred bidder. The decision means the Cell C would be allowed to use both the 900MHz and 1800MHz frequencies as well as the extended 900MHz ranges [32] to provide their service.

License Agreements

Cell C would use the 084 prefix. Enforced upon Cell C by its license agreement, Cell C would have to ensure that its network covers at least 80% of the geographical area of the country and 60% of the population within five years of the launch of commercial services [32], with increased commitments through national roaming with Vodacom. At least 52,000 [32] community service telephones would have to be rolled out within seven years of the launch of commercial services compared to the commitments of 22 000 by Vodacom and 7 000 by MTN [33]. Cell C would have to pay a fixed license fee of R100 million for a renewable 15-year period [32] while an annual variable service license fee of 1% of net operational income for the first five years would also be payable.

Establishing the Cell C Network

Cell C has concluded a roaming agreement with rival operator Vodacom that will give it national coverage from the network launch day. Vodacom was selected ahead of MTN as the firm "offered superior terms that matched our requirements," Cell C CEO and chairman Talaat Laham said. Cell C customers will be able to roam on the Vodacom network for the full license period of 15 years although the major cities of Gauteng, Cape Town, Durban, Bloemfontein and Port Elizabeth would be excluded after three years [32].

Cell C expects to have about 550 base stations [32] up and running by the end of 2001, which would be enough to cover major urban areas with the high capacity GSM 1800MHz network. The 1800MHz spectrum was given to Cell C while MTN and Vodacom's requests for revision of their frequency spectrum licenses were denied. ICASA stated that the 1800MHz spectrum could not at this point in time be granted to existing licensees [34].

Cell C said it had put together a "crack team" to fast-track the network launch to make real its plans to go live before Christmas, covering 40 percent of South Africa's geographical area and 80 percent of the population in the first year [33]. The company also say 2500 direct jobs and 15000 indirect jobs will be created in establishing the network [26].

Cell C consultant Dr. Paul Doany said that Cell C is aiming at 15% - 20% of the South African cellular market by 2006. This will, according to his estimations, be between 2,5 and 3 million users [30]. According to Mr. André Szczesniak, this is a very optimistic view of the future situation and he predict a market share of 10% by 2011 and about 1,4 million users.

Cell C entered into a contract with Siemens and Accenture to the value of R2,05 milliard [30] for the rollout of its infrastructure. Siemens got the contract of R1,77 milliard for the basic infrastructure and has to install it over an 18 months period. The contract also involves maintenance. The contract with Accenture is worth R224 million for information technology solutions.

Cell C chief adviser Paul Doany said half of Cell C's projected peak negative funding of $650 million would be financed through debt. According to Cell C's updated business model, it would be profitable in four to five years.

2.8.2. Internet and Telecommunications

According to the International Telecommunication Union of Africa, for every 10000 citizens there exist 36 Internet users in Africa [1], while there are 183 in Asia, 922 in Europe, and 1167 in America. Me Clare Stone (Britain's minister of international development) said that New York alone has more Internet users than the whole of Africa. She explains that this is because of the high cost associated with the service.

According to the World Bank, the cost of a call from one African country to another is fifty to a hundred times as expensive when compared to the cost of phoning from one State to another in the USA [1]. Internet might be a solution when providing a means of contact with the rest of the world at a more reasonable rate. Telkom however are accused of limiting Internet use through unrealistic price increases. Mr. Myron Zlotnick (M-Web) and Mr. Hein Pretorius (Kalahari.net) are concerned about the high price increases and their impact on Internet use in South Africa [35]. They have requested ICASA to investigate the billing system used by Telkom and have suggested that distinction be made between voice- and data-calls.

Despite this statistics, access to the Internet in Africa has tripled in the last year. Two Internet service providers, Africa Online and UUNet South Africa, have combined forces and formed UUNet Africa. The aim of this alliance will be to provide Internet services to another eight African countries namely: Kenya, Tanzania, Swaziland, Zimbabwe, Zambia, Ghana and Ivory Cost [1].

Battery powered- and wind-up-radios were responsible for providing the initial steps for information transfer into Africa. The use of the Internet would offer the opportunity to strengthen this connection even further.

2.8.2.1. Telkom

TelkomInternet [36] has signed up more than 10 000 customers since it was introduced less than a year ago, and expectations of continued growth in 2001 have prompted Telkom to expand the service to include ISDN access.

2.8.2.2. Vodacom

The next generations of cellphones will all be fully Internet compatible and it is logical for Vodacom to move into the Internet Service Provider business. Vodacom was the first network to offer a commercial cellular fax/data service and the first to offer a cellular pay-as-you-use access to the Internet with Yebo!net [22].

2.8.2.3. MTN

MTN CallQuest and CallAudit [23] were recognized at the international CellExpo Awards as the most innovative services in the telecommunications industry. These Internet-based software packages are comprehensive, on-line bill analysis tools. Suited to both individuals

and corporate personnel, they provide access to valuable information about individual and group cellular usage.

To promote the global competitiveness of South African companies, and to anticipate the fluctuating telecommunications needs of business and industry, MTN has launched Co/Nexsys. A recent joint venture between Co/Nexsys and the Internet Solution exploits the convergence of cellular and Internet technologies and prepares the way for future developments.

2.8.3. Satellite Coverage in South Africa

2.8.3.1. Telkom

Inmarsat currently operates a global satellite system, which is used by Telkom to offer communications services for customers in the air, on the ocean or located in remote areas. Services are then typically offered to users like journalists and broadcasters, healthcare teams and disaster relief workers, land transport fleet operators, airlines, airline passengers and air traffic controllers, government workers, national emergency and civil defence agencies, and heads of state.

Intelsat is the premier commercial satellite communications services provider. Its global satellite system brings video, Internet, and voice/data service to users in more than 200 countries [37]. Very Small Aperture Terminal (VSAT) networks are attractive in meeting remote location communications requirements. Intelsat provides the space segment for VSAT networks.

Transtel uses PanAmSat, which enables Telkom to relay video programming and digital communications for hundreds of customers on a worldwide basis. It also provides communications links for broadcasters, telecommunications service providers and news organizations such as the Associated Press, Bloomberg and Reuters.

Telkom is building new satellite earth stations (“Teleports” located at Crowthorne in Gauteng, Klipheuwel in the Cape and Malvern in Durban [37]) to address the need for high-speed reliable connectivity. This technology is ideal for Internet service providers and broadcast, because it allows a thin stream of data to be transmitted to make the request, and the content is then delivered over a broader spectrum.

2.8.3.2. Vodacom

Vodacom's service provider made an agreement with Globalstar Southern Africa (Pty) Ltd., which, during July 1999, completed the minimum space segment configuration required for a soft launch in South Africa between November 1999 and January 2000. This means that corporate users will be able to try out the Globalstar network during this time. Globalstar will meet the needs of cellular users who roam outside terrestrial-based cellular coverage and South African subscribers will be able to use dual-mode phones capable of switching from conventional cellular telephony to satellite telephony automatically or as required. A $2.6 billion Globalstar [22] system will comprise 52 Low Earth Orbiting (LEO) satellites and a global array of some 60-ground stations. People virtually anywhere will be able to make and receive calls using cellular-sized handheld, vehicle-mounted and fixed-site terminals.

Vodacom also signed a roaming agreement with another satellite system, Iridium. The agreement with Iridium means that Vodacom subscribers in possession of Iridium satellite handsets are able to use their Vodacom SIM (Subscriber Identification Module) cards in the handsets on a R9 billion infrastructure for just R1,60 per minute [22].

During the financial year ending 31 March 2000, Vodacom spent more than R2,3 billion [22] on increasing network capacity and coverage, enhancing the quality of its network, creating adequate capacity for almost three million subscribers.

2.8.3.3. MTN

MTN was the first cellular network in South Africa to provide global coverage for South African subscribers. MTN introduced satellite telecommunications via our roaming agreement with Iridium Africa, which operates a low-earth-orbiting satellite network. Negotiations with ICO, another prominent satellite telecommunications company, were well advanced by June 1999.

2.8.4. International Telecommunication

Better communication with African countries will strengthen South Africa's presence in the market through a connection with institutions in both the public and private sectors. Many LDCs (Less developed countries) need basic standard technologies already viewed as old and unproductive by the developed sectors of South Africa. This situation gives an ideal opportunity for South Africa to appear as the technology source in the technology transfer process.

The telecommunication companies will now be discussed on some international involvements.

2.8.4.1. Telkom

An investment of R10 million [58] was made by Telkom to establish and sponsor a Centre for Information and Communication Technology for Africa with the aim to develop a plan for the continent

2.8.4.2. Vodacom

The company already operates a GSM cellular network in Lesotho in partnership with the Lesotho Telecommunications Corporation. Vodacom partnered Tanzanian company Planetel Communication Ltd and holds 50% [22] of the consortium.

2.8.4.3. MTN

MTN is one of the largest GSM networks in the world, with operations in Africa, which also include Rwanda, Swaziland and Uganda. In addition, MTN has roaming agreements with 153 networks in 76 countries [38].

International networks engage MTN on a consultancy basis in areas such as network planning and optimisation. Some of MTN's advanced analysis tools, developed in-house

for planning, network performance and call data records, are marketed commercially worldwide and are now used by leading Blue Chip telecommunications companies.

MTN's African strategy includes the urge to grow clusters of business by focusing on developing regional hubs, namely Southern Africa, the Great Lakes Region and Central/West Africa. Their aim is to provide significant benefits in these regions through training efficiencies, knowledge transfer, skills sharing, and mutual access to a pool of advanced and innovative technology.

MTN received its first cellular operator's license in Rwanda and in Uganda. An MTN-led consortium was awarded the second national operator license. MTN is also operative in Swaziland, and they continue to conduct negotiations in a number of other African countries.

2.8.4.4. Cell C

In addition to providing services on its own network, Cell C is also licensed to provide international and domestic roaming services to its subscribers [32].

3. LITERATURE STUDY: HOW TO TRANSFER TECHNOLOGY?

A literature study was done to determine existing information on how technology should be transferred from one country to another when at different levels of technology utilization and know-how. The technology transfer process has some precautionary measures that should be taken before their technology transfer model is considered. These include:

- Awareness of critical needed factors for technology transfer. Technology transfer can only be done successful if the LDC is well aware of the critical needed factors (Section 3.1).
- Learn from previously made mistakes. Malfunctions in the technology transfer process are discussed in Section 3.2.
- In LDCs the continuous search for an appropriate technology must be made to suit unique local conditions and interfacing with, often older, existing technologies. The parameters of an appropriate technology for LDCs are discussed in Section 3.3.

One can furthermore only evaluate different technologies when completely certain about one's needs and capabilities and therefore section 3.3.1 are devoted to need- and capability assessment. When aware of the necessary (needed) factors, the development needs and capabilities and mistakes made in the past, a method on how technology should be transferred is needed. This chapter ending with Section 3.4 provides a discussion on possible existing technology transfer methods (models) found in the literature.

3.1. Critical Factors Needed for Successful Technology Transfer

The stakeholders of technology transfer must at all times be aware of the critical factors. These factors (illustrated in Figure 3.1 [7]) should be in order before technology transfer will benefit the transferor as well as the receiver. Some factors can be related to the country and the situation within its industry whilst other factors are related to the acquisition process (Left and right in Figure 3.1 and separated by the back thick line).

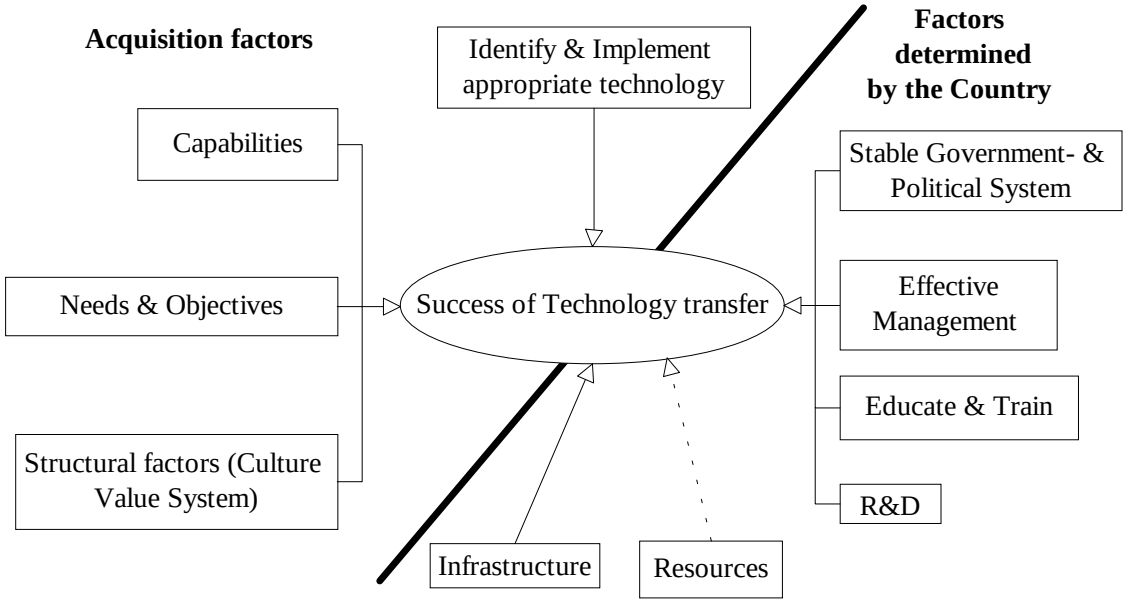


Figure 3.1 Critical factors for successful technology transfer

The link between resources and the success of the technology transfer process is indicated by the dotted line in Figure 3.1. The reason is that the availability of resources can be counterproductive if not managed effectively. Availability may help to trigger the development by using these initial advantages to explore, expand, and diversify the economy but the long-term development will never be assured. A more detailed discussion on this aspect is given below.

3.1.1. Stable Government and Political System

When governments restrict the exportation of certain technologies, as they normally do with defence technology, they protect their allies against potential enemies. Policies may also be enacted to protect a country's competitive edge. They then protect local manufacturers from foreign competitors and give them a competitive advantage.

The success or failure of transferred technology may depend to a large extend on the policies adopted by the receiver of technology. Investors are frequently very sensitive to political statements or actions due to the unusually high risks that may be involved in transferring technology to unstable economies.

Although it may often be necessary to enact laws to protect the receiver of the technology, attention should be paid to how such legislation may hinder technology progress. With fewer administrative controls and greater emphasis placed on innovativeness and entrepreneurship, local enterprises are more able to negotiate foreign collaboration agreements. The misdirected focus of some of the governments of the LDCs on technology as part of the foreign policy arena continues to limit and also hinder technology transfers. Analysis of the government's regulation, political history, and economic stability are usually done before MNCs engage in joint ventures with LDCs.

Emphasis should be on the long-term goal, potential and prospect of the LDC and also on what the MNCs (competitors) are doing in such environments. Beyond supplying technology to the LDCs, the MNCs have greater roles to play within the LDCs. If MNCs can effectively transfer appropriate technology to LDCs, the social and economic environment of the LDCs will be improved and a more conductive business environment suitable to the MNC's operation will be developed. Essentially, technology transfer to LDCs should be evaluated on its long-term merits by both the transferor and the transferee.

3.1.2. Management Process

Managers must be innovation orientated [7]. Managers should therefore be both sensitive to their environment and committed to the new technology. They must develop the ability to plan, diagnose and solve problems. They should also be familiar with organizational behaviour and the dynamics of the organization and able to manage change in an orderly fashion.

In order for technology to succeed and thrive in a LDC, an effective management of processes is required. Processes refer to organizational as well as production processes or more broadly speaking any process that has the capacity to transform input (raw material) into desired outputs. Thus, management of processes should also involve the management of human resources.

Effective management will lead to efficient utilization of the LDC's limited resources [7], making it possible for the LDC to plan the use of its resources. Appropriate educational programs need to be in place in order for a pool of effective managers to be developed. Management is a complex process, especially in the presence of new technologies. Technological and social changes should be anticipated scenarios. Managers should further understand the interactions and interdependence between their environments and the global environment, and how these influence the decision-making process. The management should thus be confidant about local conditions. Foreign managers rarely own the necessary skills to effectively utilize new technologies because of their lack in understanding local conditions and the current situation.

3.1.3. Education and Training

With effective training and educational systems, the LDCs are better able to improve and modify technology to suit their unique local needs [7]. In the absence of appropriate educational systems, LDCs will continue to be largely dependant on the transferor to supply the right labour force, to carry on technological innovations, and to engage in research and development [7]. The educational and training programs must address the needs and the problems of a LDC, and how they may be solved through technology. Without the proper educational system and training program, the receiver will not be able to fully utilize the transferred technology, let alone try to modify and improve on it.

Programs like on-the-job training, in-house training, seminars, and tuition reimbursements plans are often carried out to keep the workers abreast of technological changes. Creativity and the ability to modify technology exist only if those concerned have knowledge of the technology [7].

Cultural differences are seldom integrated in training programs developed for people in the LDCs. Cultural differences reflect the different environments of the receivers and the transferors of technology. A training program that works effectively in a certain country might be inadequate to a LDC [7]. Perhaps something may be learned from how the technology operates in other environments, but each country must be viewed differently.

The transfer of technology can also have a positive effect on this critically needed factor. With technology from MNCs, education that will strengthen the LDCs' capabilities could follow. A brief discussion on this topic will now be done.

Training of Local Employees in MNC Affiliates

The transfer of technology from MNC parents to affiliates is not only embodied in machinery, equipment, patent rights, and expatriate managers and technicians, but also realized through the training of the affiliates' local employees [14]. These include people from simple manufacturing operators, supervisors, technical advanced professionals and top-level managers. Types of training range from on-the-job training, seminars, formal schooling and overseas education (perhaps at the patent company depending on the skills needed) [14].

The various skills gained while working for an affiliate may spill over as the employees move to other firms, or set up their own businesses. The public

educational system in LDCs is relatively weaker and spillovers from training are much more important for the LDC [14]. The mobility of employees in the MNCs contributes to spillovers, both within the industry and elsewhere.

Managers move from MNCs to other firms and contribute to the diffusion of know-how [14]. This mobility of managers in MNCs seem to be lower than for managers in local firms, because MNCs pay more for their labour than local firms do, even when skill levels are taken into account. Another reason is because of the fear that MNCs have of a "brain-drain" to local firms.

MNC's training expenditures are significantly (several times) higher than those of local firms [14]. Chen studied technology transfer in Hong Kong (1983) and concludes "the major contribution of foreign firms in Hong Kong manufacturing is not so much the production of new techniques and products, but the training of workers at various levels" [14].

By recognizing the impact of the LDC's structure on technology, appropriate education systems and training would enable the members of the LDC to devise means of working with and taking advantage of their limitations [7]. In addition, innovative measures may be developed to satisfy the LDC's needs in the light of these limitations.

3.1.4. R&D Inter-firm Agreements in Developing Countries

MNCs undertake R&D in their host countries, although it is strongly concentrated to the home country's R&D. The affiliates' research effort should be compared with R&D [14] efforts of local firms, rather than with the parents' total R&D. The affiliate firm has access to the know-how of the parent and related affiliates, and sometimes also to the parent's R&D facilities. The affiliates' R&D may therefore be more efficient than that of local firms.

Foreign investments and inter-firm contractual agreements are the main channels for the diffusion of technologies towards LDCs [39]. Knowledge is an important determinant for the decision of starting production abroad. R&D are often carried out by networks of firms located in different countries, and even in LDCs. R&D cooperation seems to be the only way for most firms to participate in the extremely expensive R&D phase of the product-life-cycle. This occurs, even under rather unexpected conditions, i.e. when firms compete in the product market and when endowments of knowledge across partners are asymmetric [39]. Partners in the joint venture are and remain independent units with partly common but partly conflicting objectives.

Dispersion R&D seems to be increasingly related to the need to exploit specific and localized technological knowledge or networks of innovation. This occurs in two ways namely: Vertical and Horizontal Investments:

- ***Horizontal Investments:***
  Horizontal investments imply the reproduction abroad of production processes already carried out at home [39]. They may concern the whole production process or only a few stages. Overseas R&D by subsidiaries of MNCs is mostly carried out to adapt to local market, i.e. in relation to horizontal investments.

- ***Vertical Investments***
  Vertical Investments refers to the setting up abroad of production processes or stages of production, which are not carried out at home yet [39]. Vertical Investments are fostered by trade liberalization, increasing labour cost in the industrialized world and raising global competition.

3.1.5. Resource Availability

Most of the LDCs relay largely on foreign aid to sustain their growing population. Some OPEC (Organization of Petroleum Exporting Countries) nations expected oil prices to continue to skyrocket to their own advantage, and they ruled out the possibility that alternatives to oil can be devised or the fact that consumer patterns may change as a response to high prices. Basically these resource-laden nations developed a one-base economy [7]. Thus, the availability of resources can be counterproductive if not manage effectively.

The long-term economic prosperity of a nation may not be totally dependant on the availability of its natural resources. Availability may help to trigger the development by using these initial advantages to explore, expand, and diversify the economy. Complete dependence on these mineral resources, which are depletable and normally not replenishable, will eventually lead to economic problems. Nations should acknowledge their limitations and devise innovative ways to make good out of these weaknesses. The availability of natural resources is not a necessity for the development of a country as will be shown below [7].

1. Switzerland is a land locked nation with a high cost of labour, strict environmental laws and few natural resources (least of all cacao). Yet, it is the world leader in chocolate, not to mention pharmaceuticals, banking and specialized machinery.

2. Japan, which is severely limited in terms of natural resources and the availability of usable land, has emerged as a leader in most industrial and consumer goods. Much of the success achieved by Japan can be attributed to the country's economic disadvantages. For example, strategies such as just-in-time manufacturing and shorter production lines exploit the fact that there are limited spaces, which can be used for inventory or manufacturing.

3. Taiwan is one of the most densely populated regions of the world with 546 persons/km^2. Only one quarter of the land is arable, two thirds is forest (highly limited because of poor accessibility), and it is poor in minerals and fossil fuels In spite of all these difficulties, Taiwan emerged as one of the newly industrialized countries (NICs).

Once LDCs understand that foreign aid implies economic dependence and that it represents only a temporary solution to their greater problems, more proactive remedies are likely to be developed [7]. LDCs should look at the history of other nations with similar characteristics and structures, which have benefited greatly from technology transfer, and learn from them. Natural resources are absolutely not a necessity for sustainable national development.

3.1.6. Infrastructure

Structural changes take place as a result of technology transfers [7]. These changes influence both the social and economic conditions of the LDC. Although we may be able to predict the direction of the changes, we may never know the magnitude. The concept of infrastructure consists of four principal dimensions [40] as presented in Figure 3.2.

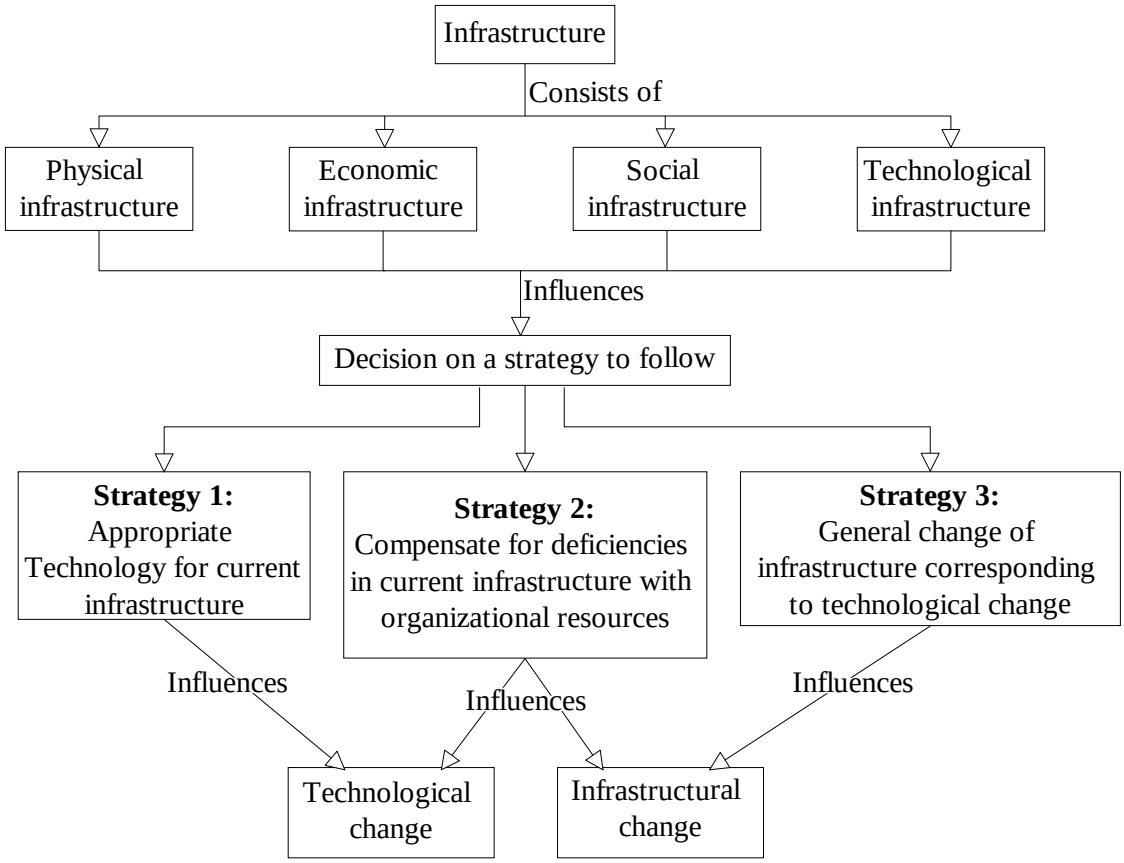


Figure 3.2. Division of Infrastructure in Technology Transfer [40]

The four principal dimensions are:

- ***Physical Infrastructure***
  The physical infrastructure includes systems of transport, energy, telecommunication, and to some extend different types of public works. This part of the infrastructure makes possible the movement of goods, labour, and other inputs to the production.

- ***Economic Infrastructure***
  Economic infrastructure consists of the channels through which the actors of technology obtain access to financial resources to realize their transactions with other production units and actors (the capital market, credit institutions, regulations of investments, and subsidies).

- ***Social Infrastructure***
  Social infrastructure consists of systems for health and education particularly seen as a matter for the qualification of the labour force. It also covers the structure and the functioning of the labour market.

- ***Technological Infrastructure***
  Technological infrastructure covers various types of institutions dealing with the generation and diffusion of technology and the education of scientific personnel.

Until today mainly the physical dimension of infrastructure has been developed internationally, but efforts are being made to extend the international scope of infrastructure to the social, economic, and technology dimensions of infrastructure as well [40]. This must be seen in relation to the requirements of the new technology.

The optimal function of a given technology requires infrastructural equipment of a certain quality and quantity. The level of the infrastructural dimensions therefore decisively influences the behaviour of the carriers of technology. Confronted with infrastructural constraints the carriers choose between three different strategies [40] as presented in Figure 3.2. These are:

- ***Appropriate Technology for current infrastructure:*** Adjust the project fully to the given infrastructure conditions, by limiting its scope, reducing its quality and finding new ways to use the given resources. No important technological changes can take place without corresponding infrastructural development.

- ***Compensate for deficiencies in current infrastructure with organizational resources:*** Dedicate some of the organization's resources to compensate for the deficiencies of the given infrastructure, typically through in-house training and education, private road telecommunication construction, and other private systems of transportation etc. This strategy implies a spread of resources away from the main activity and calls forward the necessity of a broader technological capability. This strategy thus, diminishes the possibility of specialization.

- ***General change of infrastructure corresponding to technological change:*** A course of general change of the infrastructure corresponding to the technological change can be considered. However, this possibility is seldom within the reach of individual actors at micro-level. Mostly such changes can be carried out only by the state or large groups of micro-carriers.

The first strategy has been called *appropriate technology*, but it is doomed to be a blind alley as stagnation will be an inherent characteristic [40]. The second strategy will be relevant in relation to projects of technology transfer from developed countries to LDCs. It implies a move of technology from well developed to less-developed infrastructural surroundings. The third is the only one with more far-reaching and dynamic implications. A more or less simultaneous change of technology and infrastructure is optimal to technology and socio-economic change, and should always be considered as crucial in any policy of technological change [40].

3.1.7. Cultural Value System

Technology has an impact on the cultural value system of the receiving nation. The cultural value system needs to be integrated into the planning process for the technology transfer. Culture is a sensitive aspect to most LDCs. Analysis of the culture will identify things that are of value to the people of a particular LDC together with those factors, which motivate them to work [7]**.** It is in an attempt to protect their culture that the members of the LDC often reject technology. Knowledge of the integration of the LDC's cultural value system into technology transfer decision-making will enhance the successful transfer of appropriate technology.

Need Capability assessment together with the identification and implementation of the technology will be discussed in the Technology transfer model formulation section.

3.2. Malfunctions in the Technology Transfer Process

The failures of technology transfer to a LDC can be mapped in three different dimensions [7] namely structural, technological end behavioural functions, which can also be used to characterize a particular country.

3.2.1. Structural Failures

Structure refers to the different local governments, ethnic groups, government agencies, or the private sector. These groups may exercise different levels of control and influence on the decision to transfer of technology. Structural failures may be due to failures of *logic, adaptability and regulations* [7].

1. The ***logic*** levels often provide the knowledgebase and the methods of reasoning to solve the problem. Technology transfer involves the transfer of logic levels (also see "Knowledge" component of the Technology Triangle of Appendix A).

2. ***Adaptability*** requires that adjustments be made to accommodate a changing environment by either seeking to control the environment, or by adjusting internally in accordance with external changes [7]. The long-term economic growth of LDCs will depend on their ability to maintain, adapt, and improve the transferred technology in their own unique ways. What is often at fault is not the people's culture but the inability to understand how to adopt technology to these different cultures [7].

   Once installed, it is often necessary to adapt imported equipment or procedures to local conditions. These might include physical, climatic, and temperature conditions [8]. Adaptation may also be necessary because the inputs, which are utilized and locally sourced, are not the same as those for which the equipment was designed.

   The problem of adaptation does not apply only to the operation of physical equipment. Even managerial procedures may require some adjustment. Educational policies need to be tailored to meet requirements of technology acquisition, adaptation, and development. With the absence of sufficient maintenance staff, an

adjustment to the equipment that is purchased might be required. The problem of adaptation is often neither simple nor of trivial importance. In some cases it may require relatively sophisticated inputs of skill of information, drawing on the experience of other local firms. It may also not be possible to undertake adaptation without assistance either from government, from the tertiary educational sector or form specialized consultants. In Africa [8], various empirical studies have shown that the primary source of technological change within firms arose not from formal R&D activities, but from efforts to adapt equipment and procedures to the local conditions.

Structural malfunctions occur when the organization is unable to adopt. The introduction of the technology has to be gradual [7] in order for it to be successfully incorporate and absorbed into the environment of the LDC.

3. When there is no agreement between the mindscapes of the designers and those of the users, problems may arise. It is then necessary to solve this through ***regulations*** on consensus seeking methods. One, who possesses technology, may not necessarily posses the authority to implement the logic levels. Consequently, technology transfer fails when logic and authority levels are not unified [7].

3.2.2. Technological Failures

A country's competitiveness and productivity is to a large extent dependant on technology [7]. Technology involves hardware and software. Hardware is the design of equipment, machinery and instruments, while software is data, information and management systems.

Technology malfunction occurs when an inappropriate technology is transferred which is unable to satisfy the needs and aspirations of the LDC [7]. The solution that the transferor and the receiver develop is linked to their backgrounds, which influences the ways that information is analysed. Misconceptions can be avoided if they recognize and respect each other's perceptions of the problem. Differences such as cultural value systems, environments, work ethics, motivations, and capabilities have to be considered in order to successfully transfer technology to LDCs.

Other circumstances that are significantly different in LDCs than in the industrialized countries are [13]: religious situation, demographic features, relatively low GNP and salaries, high unemployment rates, financial depths to international institutions, ineffective land policies and lack of valid (up-to-date) information.

3.2.3. Behavioural Failures

The purpose of an organization may be religious, economic, charitable or social and the existence of such goal structure gives rise to what are typically called institutions [7]. The formation of an institution's goal structure requires human input. As the LDCs embark on a mission to transfer and develop technology, the humanistic and behavioural aspects of such decisions need to be evaluated.

Decisions have to be made on the introduction, maintenance and enhancement of technology. These decisions may be objective or subjective. Assumptions often made in solving purely technological problems, are not applicable when socio-technological issues

are involved. Decisions are subjective in a sense that they are influenced by a combination of factors including models, worldviews, environment, cognitive dissonance and human judgment [7].

The increasing role of ethnical and cultural issues in the successful transfer of technology suggests that simple models cannot be relied on in order to transfer technology successfully [7]. An appropriate model should be able to integrate most of the socio-technological variables with an understanding that satisfactory rather than an optimal solution will be achieved.

Policy planners should develop adequate means of dealing with controllable factors and also be able to anticipate and plan for some of the uncontrollable factors [7].

Transferred technology may also fail if it is insensitive to the values and believes system of the LDC. Sensitivity towards culture will ensure acceptance of the technology and enhance the implementation thereof [7]. This issue thus brings the topic of a cultural value system into the discussion.

3.2.4. Failure to Enrich the Culture Value System

Acceptance of technology for socio-economic development may depend on how well technology is integrated into the culture value system of the LDC [7]. In transferring technology to different environments, a bond between technology and culture should always be identified.

It is further to the advantage of the transferor to understand how technology may be used to enrich some cultural goals. Society develops through “enriched” strategies. Rather than seeking to substitute or displace an existing social system with another by overemphasizing the role of technology in a different environment, the transferor should seek to offer the LDC technological enrichment [7]. One way culture can be enriched is through the gradual transfer and implementation of appropriate technology which can satisfy the needs and aspirations of the LDC, make use of their limited resources, and provide increased opportunities for the people.

3.3. Need- and Capability Assessment

In a literature study the author found four approaches to the transfer of technology. These will be discussed later. They all had one objective in common and that is to obtain the country’s needs and capabilities. This issue of defining a country's needs and capabilities will thus firstly be discussed.

Effective technology transfer and technology development requires a thorough analysis of the LDC’s needs and capabilities. This enables the LDC to clearly identify its strengths and weaknesses and match them to the different technologies.

Environmental analysis should be conducted to anticipate and perhaps develop strategies to manage impacts of uncontrollable factors. Controllable factors on the other hand should be planned for and managed. Resources determine the ability of the LDCs to afford or develop technology, supply the skilled labour force, develop the required raw materials, develop management and technical skills, afford adequate maintenance of machinery, or to

carry out effective research and development programs [7]. Natural resources and labour force can be a competitive advantage to the LDC but increasing emphasis on high technology has significantly diminished the labour advantage.

Value analysis deals the assessment of socio-economic growth, efficiency, technology utilization, and cultural values. Appropriate technology must satisfy these goals [7] at reasonable social and economic costs, be sensitive to short- and long-term goals, enable LDCs to solve domestic problems such as unequal distribution of income, restricted social mobility, and poor education and training, which limit socio-economic growth. The needs of a LDC refer to the aims to satisfy the purpose or mission such as socio-economic development, competitiveness, technological progression, and the ability to satisfy local demands.

3.3.1. Finding the Appropriate Technology

3.3.1.1. Need-Capability Assessment Matrix

The Need-Capability Assessment Matrix is a 3 × 3 matrix, which positions the LDC in terms of its needs and capabilities for a specific technology. A specific technology that is being evaluated will fall in one of the cells in the Need-Capability Assessment Matrix. The Need-Capability Assessment Matrix was also suggested as a method for obtaining one's needs and objectives in the model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa (section 4.3, Chapter 4). The columns represent the LDC's needs while the rows represent capabilities that are necessary to support this technology as shown in Figure 3.3 [7].

Needs

Capabilities	Low (1)	Medium (2)	High (3)
Low (1)	1	2	3
Medium (2)	2	4	6
High (3)	3	6	9

Scale	**Statement of Importance**
1	Undesirable
2	Least desirable
3	Desirable with risk
4	Desirable with little risk
6	Very desirable
9	Highly desirable

Figure 3.3. Need-Capability Assessment Matrix

The value within each cell of the matrix is determined through multiplication of the values associated with the capability of that specific row and the need of that column. The cells with a value of 1 are undesirable and no further time should be spent analysing any technology that may fall there. The cells with a value of 2 are least desirable but might represent opportunities that need to be developed and become of strategic importance if more attractive cells cannot be presently obtained. Further evaluation might be required in order to determine whether capabilities can effectively be developed or whether demand can be generated. The cells scoring a value of 3 or 4 in the matrix, offer good support for future considerations of the technology. Questions that have been addressed here are [7]: Can sufficient capabilities be developed to satisfy the high need? Can new demands be created to support technological services? The cells containing a value of 6 must definitely be considered as a potential technology to transfer. The established needs and capabilities indicate that technologies in these cells may play a vital role in achieving the missions of the LDC. Finally, the most desirable cell with a value of 9 gives no doubt that a technology that assumes this position must be transferred.

The Need-Capability Assessment Matrix serves as a screening process assisting in narrowing down the list of technologies to be considered for transfer [7]. Technologies with a value of 1 or 2 should be dropped, while those with scores of 3 should be evaluated further. The result of the evaluation should determine whether or not they should be included in the list of potential technologies to transfer. Those with scores 4, 6 and 9 are considered desirable and are passed on to the next stage of decision-making.

3.3.1.2. Applying Need-Capability Assessment Matrix

Firstly a LDC should specify their mission. A group of stakeholders should then be commissioned to undertake the task of identifying needs of the LDC and technologies, which might fulfil those needs considering their capabilities [7]. The identification process can be achieved through a brainstorming technique. Each of the stakeholders independently generates a list of needs and capabilities, which are then combined and redundancies eliminated. The combined list is then analysed and values (between 0 and 10) denote the importance of the technology in relation with the needs and the capability of the LDC to support the technology.

Let W_{ijk} represent a weight assigned by stakeholder i, when comparing need, j, to technology, k, and i = 1, 2, 3, ...N; j = 1, 2, 3, ...M; and $0 \leq W_{ijk} \leq 10$. Thus, for any given technology k, the combined score assigned by N stakeholders based on M needs of the LDC can be obtained as:

$$\sum_{i=1}^{N}\sum_{j=1}^{M} W_{ijk} \tag{3.1}$$

An example of a weight assignment for need assessment is shown in Figure 3.4 [7].

	Socio-economic growth	Revenue generation	Employment opportunities	Enhanced competitiveness	Total
Stakeholder 1	5	4	5	3	**17**
Stakeholder 2	7	4	5	6	**22**
Stakeholder 3	4	3	8	7	**22**
Total	**16**	**11**	**18**	**16**	61

Figure 3.4. Weight assignment in the need assessment process

Similarly the combined score for any given technology given the capabilities of the LDC can be obtained. A Weighted factor for technology k can be calculated as:

$$\frac{\sum_{i=1}^{N}\sum_{j=1}^{M} W_{ijk}}{10\times N\times M} \qquad \textbf{(3.2)}$$

Thus, the weighted factor for technology k of Figure 3.4 is 61/(10×3×4) = 0.51. However, to implement this score into the Need-Capability Assessment Matrix, we must further multiply this weighted factor by 3 which is the maximum scale used in the axes of that matrix. Thus, we obtain a need desirability factor for technology k on the basis of needs through:

$$\left[\frac{0.3\times\sum_{i=1}^{N}\sum_{j=1}^{M} W_{ijk}}{N\times M}\right]^{+} \qquad \textbf{(3.3)}$$

where $[]^{+}$ refers to the closest integer.

Thus, the need desirability factor for technology k of Figure 3.4 is $[(0.3\times61)/(3\times4)]^{+} = [1.53]^{+} = 2$ (thus column 2). Similarly, the capability desirability factor for technology k on the basis of capabilities can be assessed. An example of a weight assignment for capability assessment is shown in Figure 3.5.

	Effective waste management	Labour requirement	Supporting services	Financial requirements	Organizational management	Resource development	Supporting industries	Total
Stakeholder 1	5	4	5	3	4	5	3	**29**
Stakeholder 2	2	3	5	2	3	5	2	**22**
Stakeholder 3	4	5	6	7	5	6	7	**40**
Total	**11**	**12**	**16**	**12**	**12**	**16**	**12**	91

Figure 3.5. Weight assignment in the capability assessment process

The capability desirability factor for technology k of Figure 3.5 [7] is therefore $[(0.3\times91)/(3\times7)]^{+} = [1.3]^{+} = 1$ (thus row 1). The position on the Need-Capability Assessment Matrix is then fixed for a specific technology and the value within the cell calculated by multiplying the need desirability factor with the capability desirability factor, which is $1 \times 2 = 2$ for the technology in Figure 3.4 and 3.5 (Least desirable and should be dropped).

Need-capability assessment is not the only factor that determines appropriate technology. Figure 3.6 [7] identifies the major determinants of appropriate technology transfer.

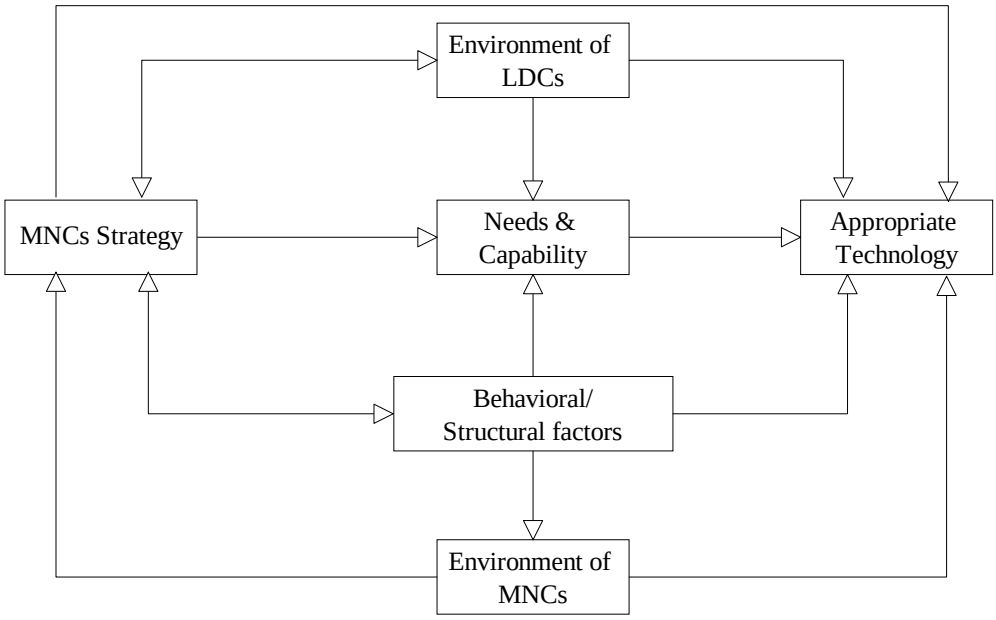


Figure 3.6. Determinants of appropriate technology transfer

This relationship makes it clear that the nature of needs- and capability assessment is one of interdependency. The other determinants' impacts need to be understood by the stakeholders. Each determinant will now be discussed briefly.

The Environment of the LDC

The environment of a LDC influences its needs and capabilities. Some needs are related to the social environment where social conditions imply obsolete land ownership systems, unequal income distribution, inequalities of ethnic integration, segmentation of production and marketing systems, inequalities in varies socio-economic groups in education and training and restricted social mobility.

The political structure of a country also influences demand and development of resources. Entrepreneurship has to be encouraged in the LDCs and their governments should expand their role by funding R&D programs. LDCs account for less that 3% of the total world expenditure on R&D while U.S.A. accounts for 33%, Western Europe and Japan for 33% and the Soviet Union and Eastern Europe for about 31% [7]. These data may explain comparative technological disadvantage on the part of the developing countries. To develop efficient capabilities requires effective R&D.

The Environment of The Transferor or MNC

The transfer of "sensitive" technologies is limited and existing patent law and government policies all influence the ability of the LDC to legally acquire technology. The constraints imposed in terms of leverage allowed to the LDCs may hinder the utility of such technologies for achieving national goals. In conducting the need-capability assessment, these limitations and their ramifications are evaluated. When the LDC is unable to unbind from these restriction, the capability to effectively transfer the technology is severely limited and other potential transferors with more conductive environments should be considered. The environment of the transferor will also dictate the quality and the demands of the technology.

The world today is concerned with issues such as environmental and atmospheric pollution, labour displacement, the erosion of cultural value systems, and social inequalities that result from technological developments. Quality of technology should be evaluated not solely on the basis of finished products and services but also on the environmental impact [7] and its ability to satisfy the mission of the LDCs.

Behavioural and Structural Factors

Technology must interface with the human labour force. This means that various components of human factors are involved, which can be divided into three groups [7]:

Safety Factors: Unfortunately when technologies are transferred to LDCs, less stringent controls are applied, following the argument that the costs of implementing these safety programs are too high.

Social Environment Sensitivity: Laws are used to guide industries in the disposal of pollutants, especially the chemical, oil and nuclear industries. It is not incidental that some

of the major corporations in these industries operate abroad, especially in the LDCs where less stringent environmental laws exist to protect the quality of the environment [7]. This short-term approach to profit is gradually threatening the security of the whole world as the concerns over the effect of global worming illustrates.

Decision Process: Technology relates to processes of production, while the human's ability to make decisions helps in the effective running of the technological processes. Effective decision-making requires manpower development and training. The reasoning and thinking processes or the worldviews of these decision-makers are influenced by their cultural and ethnical value system.

The environment of the LDC can influence the strategy adopted by the transferor, while at the same time the transferor's strategy can influence the LDC's environment. However, the effective development of a strategy must be based on a need-capability assessment and social impact analysis. Performance measures are then used as control mechanisms in evaluating the ability of the technology to continuously satisfy society's needs.

A decision can be made whether to modify the technology or retain it as is. This decision, however, is based on feedback received from the set performance measure. Policy makers in LDCs should paradoxically be both forward looking and introspective [7]. They must realize that successful transfer of technology is influenced by factors that are both internal and external to their environments.

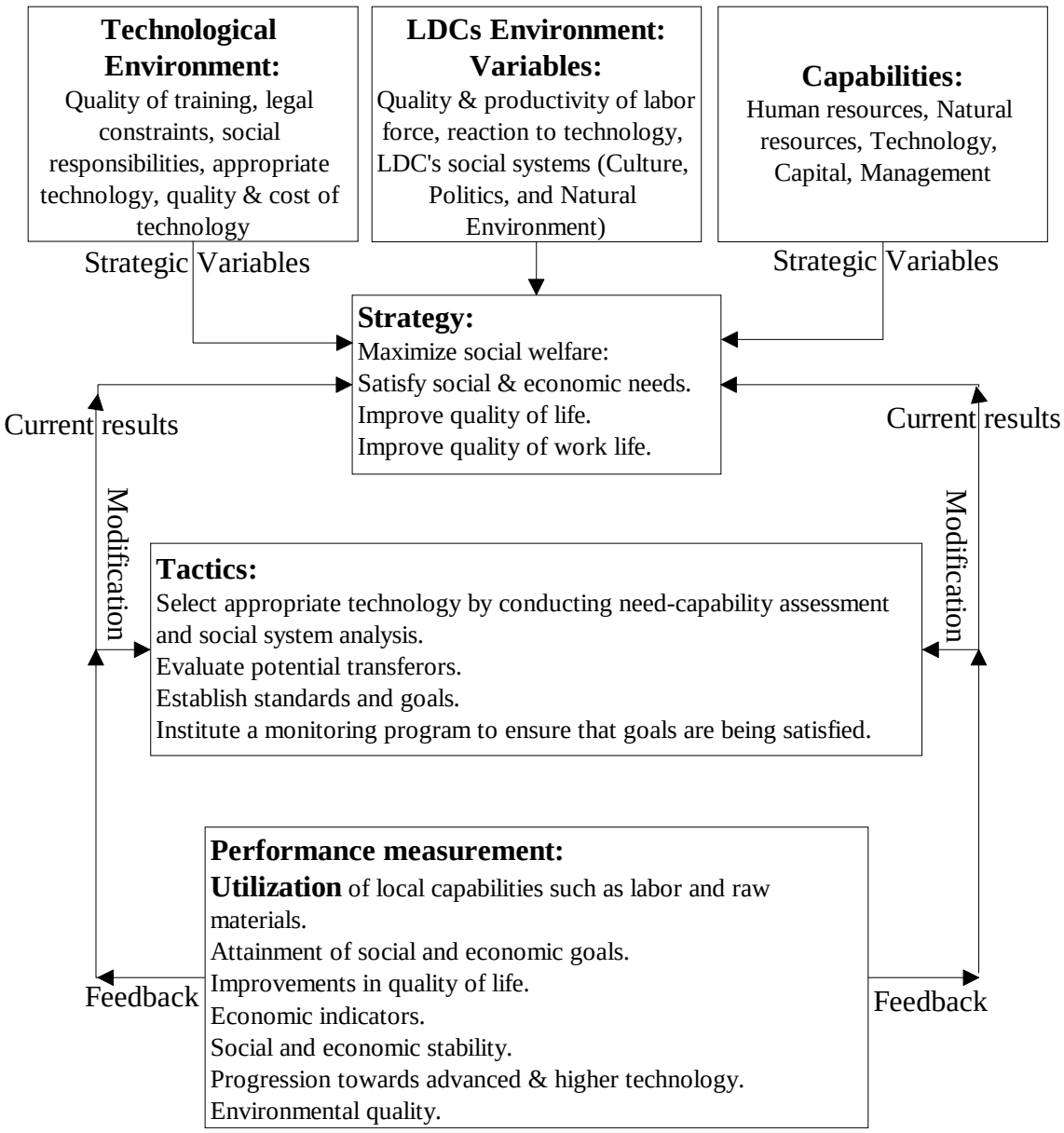


Figure 3.7. Continuous Strategic Planning/Feedback Loop [7]

3.4. Generating a Technology Transfer Model

The technology transfer problem viewed in an economic context neglect the interconnectedness between technology, the economy, and the other important subsystems of LDCs. Subsystems account for aspects such as socio-economic, environmental, cultural values, and political systems which must be integrated into the planning framework for technology transfer. Questions that need to be answered in transferring technology include the following [7]:

- What technology to transfer?
- How many national resources to devote to each technology type?
- From where to transfer the particular technology?

- What is the future of the technology once it is successfully transferred?
- What are the transferor's and receiver's strengths and weaknesses, and how can these be effectively used to transfer technology to the receiver?
- Why do we need technology?

The five different but complementary technology transfer approaches found in the literature are briefly discussed below. They are:

1. A Prescriptive Framework for Technology Transfers.
2. Strategic Planning in Technology Transfer.
3. Strategic Planning Dialectical Approach.
4. A Systems Approach to the Transfer of Mutually Dependant Technologies.
5. The Technology Acquisition Hierarchy (TAH)

3.4.1. A Prescriptive Framework for Technology Transfers

Figure 3.8 presents Madu's [7] step-by-step approach towards technology transfer.

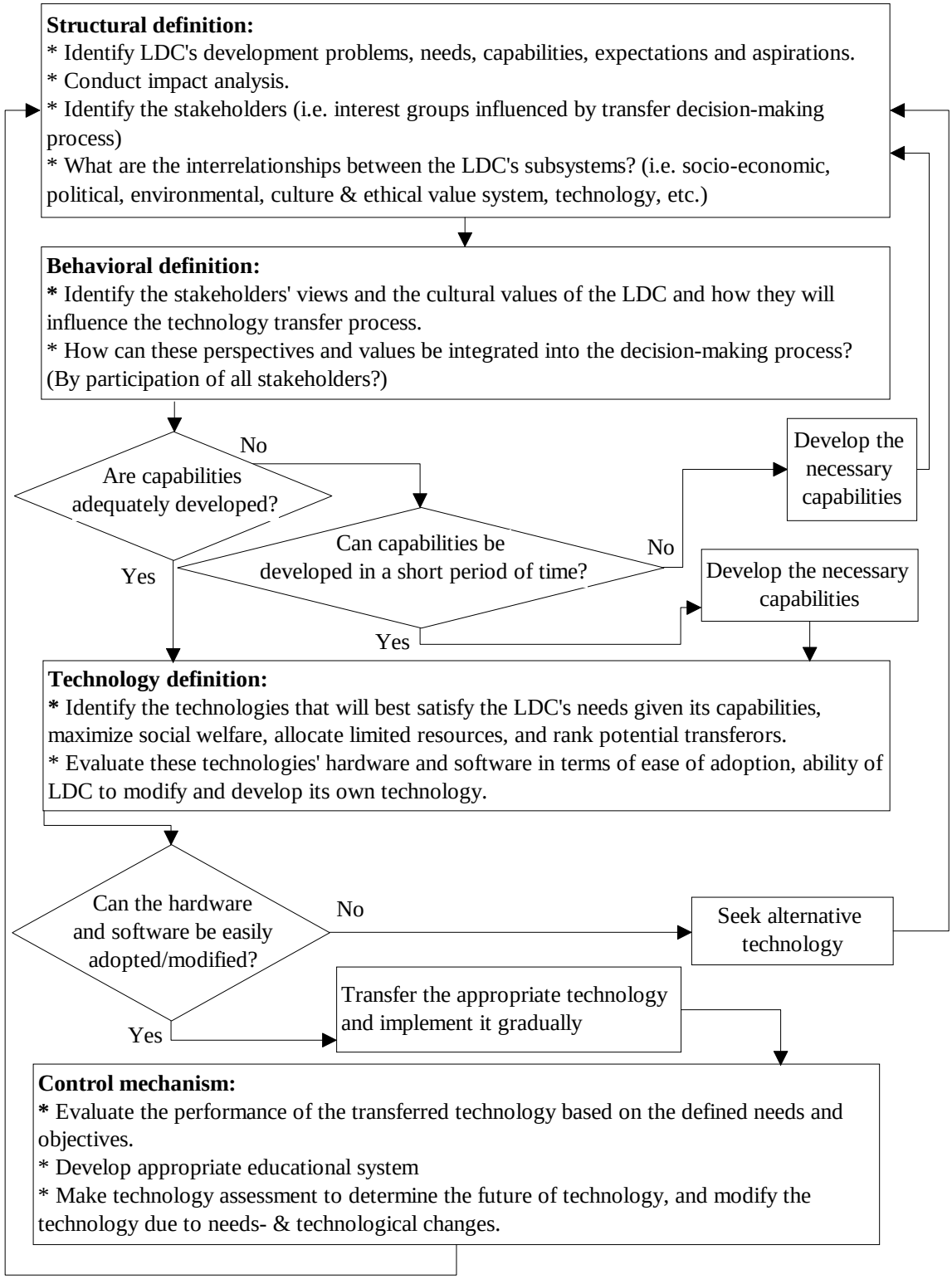


Figure 3.8. A Prescriptive Framework for Technology Transfers

This framework breaks down the technology transfer problem by specifically considering the three major dimensions of failure in the technology transfer process (see Section 3.2).

By doing so the policymaker is made aware of the role of each of the system dimensions in achieving the LDC's technological goals.

An appropriate technology refers to a technology that will provide to the needs of the LDC at a minimum social- as well as economical costs and maximize utilization of capabilities to become independent from the transferor [7]. The needs and capabilities are determined in the Structural phase through a Needs-Capability Matrix.

3.4.2. Strategic Planning in Technology Transfer

The definition of planning consists of three phases. They are presented in Figure 3.9.

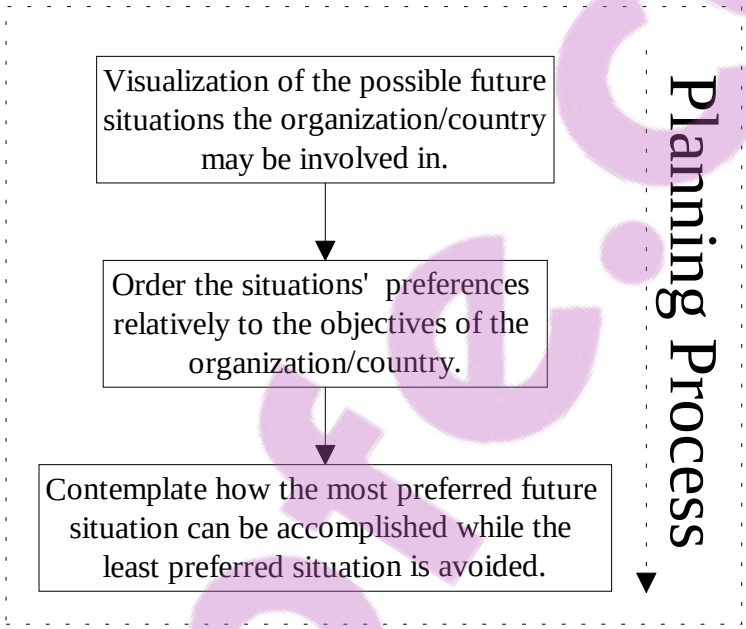


Figure 3.9. Diagrammatic Definition of Planning

An implication of the partnership between the MNCs and LDCs is that two parties often have different goals and objectives. Specifically, the MNCs are profit-orientated while public institutions often adopt goals more socially responsive. Recent controversies have centred on the marketing of expired drugs, unproved products, which are still in the test phase, baby formulas, and increasing attempts to dump nuclear wastes in these impoverished nations. The tolerance of both parties concerning conflicting objectives and the need to achieve compromise may reinforce and enhance technological decisions.

MNCs must start now to plan ahead and do the right things before they become engulfed in the emerging social changes within the LDCs. Technological changes, on the other hand, are taking place at a much faster pace. This increased uncertainty in the environment of the MNCs also means higher risks and dangers of extinction for those companies whom are not innovative and those slow to adapt.

Strategic planning evaluates the mission of the organization, its objectives, and possible actions given the environment. Strategic planning is not restricted to long-range plans but also consider short-term tactics. Furthermore, the aim is not to reduce and eliminate the

risks associated with technology transfer, but to rather recognize risk and aim at taking advantage of the rewards the risk might offer. Figure 3.10 is a simplified systems paradigm for technology transfer. It is not a strategic flow, and responsiveness to the environment is accommodated through the presence of feedback loops.

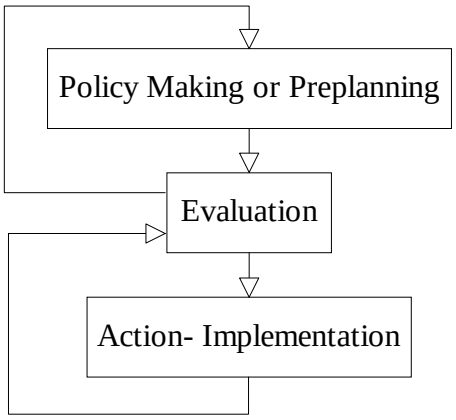


Figure 3.10. A Simplified Paradigm for Technology Transfer [7]

3.4.2.1. Policymaking or Preplanning

The policy maker initiates the technology transfer process by first identifying the development problems that need to be solved. He also identifies the stakeholders who are capable of solving problems initiated by the ministry or department of planning and development in the respective LDC. Free enterprises are not the rule in LDCs [7]. The public sector has a greater role to play in supporting and encouraging entrepreneurs until the private sector is able to initiate such processes independently.

The “active” participants identified by the policy maker planners are referred to as stakeholders [7]. They are groups or individuals whose actions and activities are likely to influence the technology transfer decisions. The policy makers also have hierarchies for the different social and economic problems afflicting their country. It must be decided which of these are presently and primary concern and should be readily addressed.

The needs derived should also pay attention to the LDC’s culture and value system, the availability of resources, socio-economic factors, and the ability to afford [7]. The stakeholders therefore identify the strengths (Such as raw materials, the availability of a labour force, responsiveness to the environment, or low cost of production) and weaknesses (Such as lack of support services like fire protection, ineffective communication system, poor transport networks, underdeveloped related industries, poor supplier chain, and lack of skilled labour force in management and engineers) of the country given their needs.

The stakeholders also have to identify the different technologies available to satisfy the LDC’s needs given their capabilities and limitations [7]. There should also be a screening procedure in place to narrow down this long list of alternatives.

3.4.2.2. Evaluation

Due to "bounds of rationality" on human judgment, it is difficult to comprehend, analyse compare, and contrast several alternatives at a time and still be consistent in our judgments. One approach might be to use statistical analysis in determining which of the technology types are more significant in achieving the LDC's goals and objectives. The narrowed list can be offered for further analysis. Then one of the following decision making models [7] can be used to take a decision.

- Nominal Group Technique
  Groups work in a structured environment with strict control over discussion. Decisions on which technology to transfer will be based on ratings by group members.

- Stakeholder Analysis/Cooperation
  The decision-maker resorts to an innovative approach to manage change by including stakeholders in the decision-making process. Recommendations made by the interested groups will be used to derive a final decision.

- Scenarios
  Various environmental conditions that may influence the decision are specified. The most probable future condition are stated and used as the basis for making the final decision.

- Delphi
  Judgment of external experts on probable events and responses are used. Their innovation can be used as a basis for selecting the appropriate technology.

- Social Judgment Analysis (SJA)
  Those affected by technology transfer use different judgment processes `to arrive at a conclusion. Group members study the logic behind these judgments and a consensus for resulting decisions is arrived at.

- Morphology
  Technology transfer in composed of a number of factors, which need to be integrated into the overall decision-making process. The decision-maker acts on these to derive at a conclusion.

- Analytic Hierarchical Process (AHP)
  This requires the development of priorities for the different technologies based on the decision-makers judgment. The appropriate technology is selected, based on a quantitative solution to these rankings.

- Optimisation
  Though difficult to achieve the technology transfer-type environment, it can be applied at a micro level for the allocation of limited resources.

- Simulation
  Experimental analysis uses a prototype model to test the effect of the technology and how it can enhance the LDC's development objectives.

3.4.2.3. Action-Implementation

The action-implementation process includes setting goals and verifiable standards to measure the success or failure of the technology transfer process. The standards are necessary to ensure that the desired goals and objectives of the LDC are continually being satisfied. A Modified Relevance Tree Diagram (MRTD) [7] is used to present the LDC's mission, objectives, constraints and standards. An example of such a MRTD is shown in Figure 3.11.

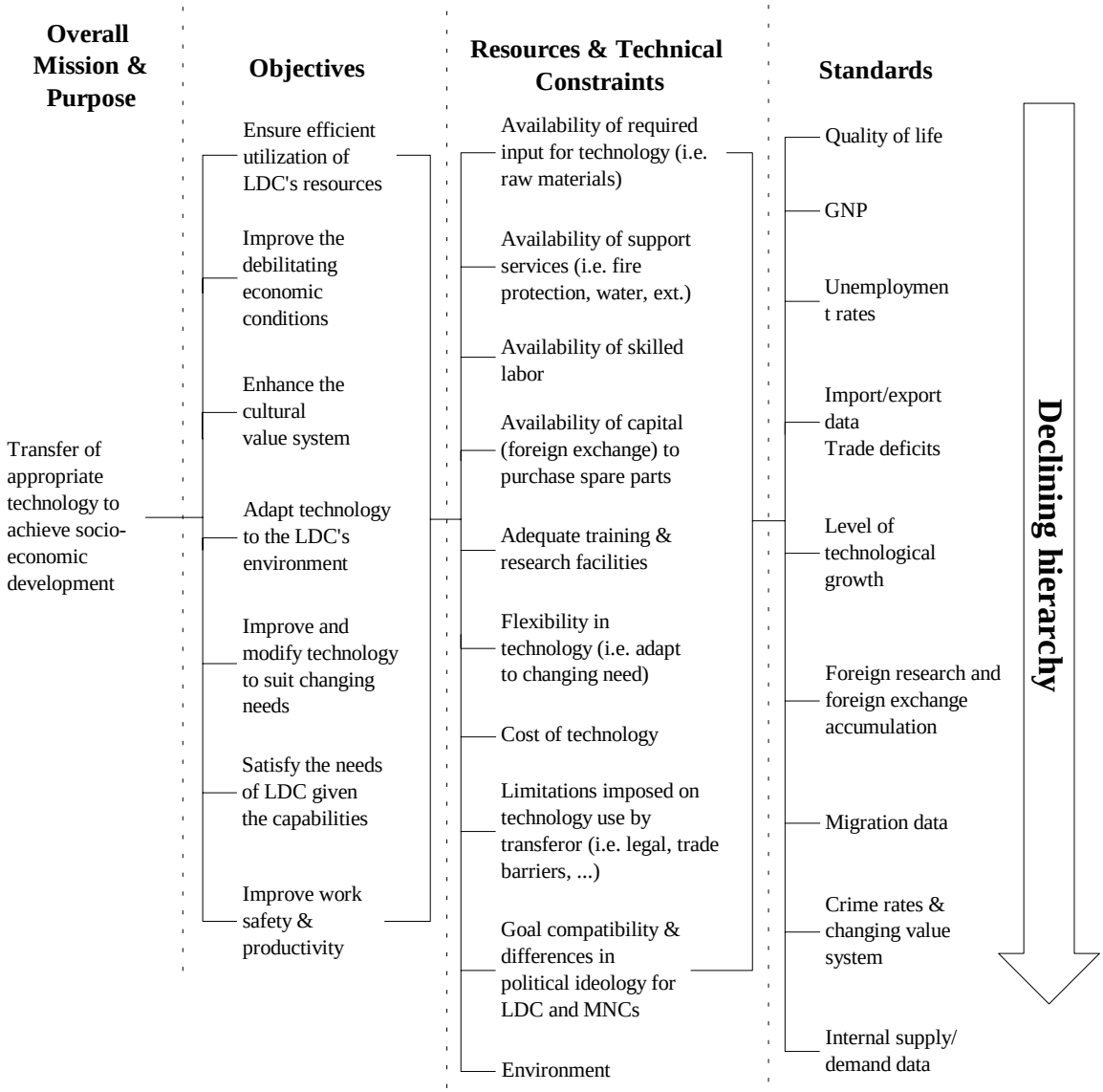


Figure 3.11. A Relevance Tree Diagram for Transfer of Appropriate Technology

Although it is seldom possible to control the external environment factors, proactive strategies may be developed to anticipate them and contingencies developed for dealing with them in the event they might occur. This is why the environment is included in Figure 3.6 as a limitation.

Standards as presented in the MRTD cover measures for both social and economic growth. It is imperative that appropriate support systems be in place before technology is

transferred. This implies the extension of the planning horizon of the technology transfer process in order to develop these supports. Awareness programs should be developed to acquaint the LDC's citizens about the role of the technology in improving their quality of life. This is vital to ensure their support in the successful implementation of technology [7].

Governmental restrictions may impose constraints on a new technology, even when the technology may be appropriate. It is still necessary to appraise the technology on such scores as reliability, dependability, maintainability, efficiency, aesthetics, and safety [7]. Although it may seem more rational to seek the best quality, it may not always be the desired choice for the LDC given its economic limitations. It is therefore, the ability to afford that will determine the level of technology transfer. Technological growth and advancement should follow a gradual process. The focus should be first to satisfy the local market and then to gradually penetrate the international market [7].

Quality of Life

In evaluating the nations performance, GNP does not take into account social costs due to industrial waste, crime, congestion, and different perceptions of the inhabitants about their changing environment [7]. A more integrative index is needed to consider both the economic as well as the social performance of a society. The cost-benefit approach will expand the LDC's worldview and potentially reduce the probability of transferring inappropriate technology.

In most LDCs productivity is low and the transfer of technology may not easily improve it. Automation and high technology may not be the answer to the declining productivity in the case of LDCs. The living standard in LDCs is low, malnutrition persists, and diseases like malaria and AIDS incapacitate the working force leading to the decline in productivity [7]. Successful technology transfer requires the existence of critical inputs such as skilled labour force and effective management [7]. However, to improve productivity, the quality of life in the LDCs needs to be improved.

Many may assess the success or failure of the technology transfer process by evaluating only the LDC's economic indicators like GNP. Much of the country's population continue to reside in the rural areas where statistical data are often very difficult to obtain. Many of the economic transactions such as trade by barter and exchange of goods (i.e. food) for services are often intractable and almost never show up in the government records [7]. Thus, economic indicators are inadvertently misleading.

There is therefore a need to consider the importance of human and political factors in development problems, the uncertainties in the decision-making environment, the shortages of data and skilled manpower, and the large communication gaps between different groups in any approach to solve development problems. The appropriate development models should have the following [7]:

- Build in flexibility.

- The capacity within organizations to collect the data and carry out studies themselves.

- Encouragement for grass roots participation in problem definition, data collection, and implementation.

These attributes are percent in the quality of life index as a measure of socio-economic and technological progress. Mankind is increasingly becoming aware of his natural environment and actively protesting to prevent its blatant destruction. These attempts are aimed at improving his quality of life as he realizes that there is a serious trade-off between economic and social development. Both economic gains and social costs associated with technology are analysed better through the use of more integrative methods such as the quality of life index [7].

A systems detailed paradigm for technology transfer is shown in Figure 3.12 and makes evident the fact that technology transfer is an ongoing process which is continually dependent on information flow on the performance of existing technology

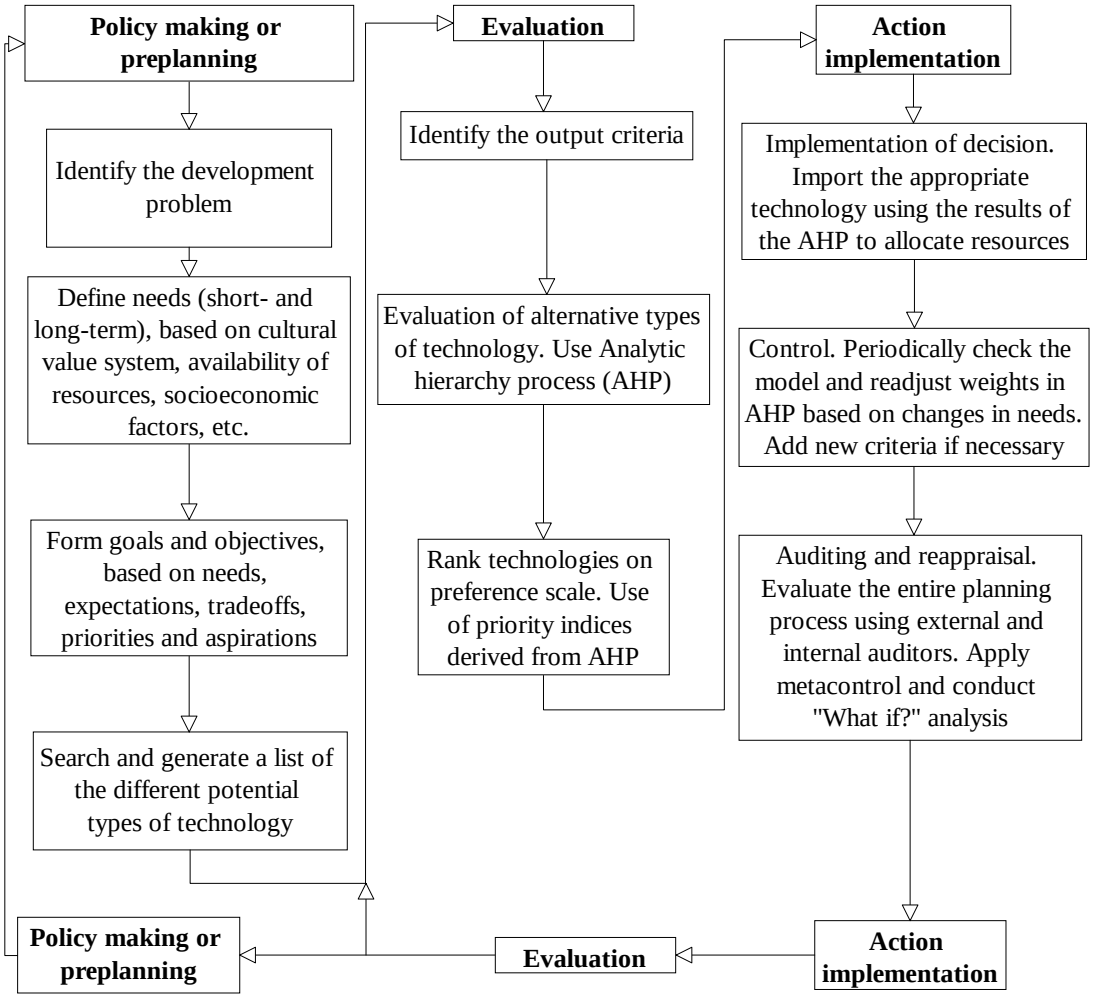


Figure 3.12. Systems paradigm for Technology Transfer [7]

3.4.3. Strategic Planning Dialectical Approach

The increased importance of the political aspects in decision-making has brought to light the role of cognitive factors in strategy formulation. Overemphasis is placed on the economic implications of technology transfers [7]. While economic issues are important, they are effectively addressed only when a wide range such as cultural, behavioural, structural, and political aspects are integrated into the decision-making process. To successfully benefit from these collective efforts, we must understand the cognitive differences between the transferor and the transferee of technology [7]. In group-decision-making participant's psychological attributes differ and influences their decisions. The chosen plan is based on the decision makers' perspective of reality, which differs since the transferor and receiver have different experiences, cultures, value systems, needs, and capabilities.

Through the formation of coalitions, stakeholders who may share different worldviews are brought together in order to analyse and solve the technology transfer problem. The uncertainties in the decision are reduces if the stakeholders understand each other's perspectives.

Achieving reasonable compatible goals between multinational corporations (MNC) and less developed countries (LDCs) will lead to synergistic effects and further progress in the transfer of technology. Dialectical inquiry system (DIS) can be applied to demonstrate decision-making problems [7]. It recognizes the different worldviews of decision makers making it pertinent for use in complex decisions such as technology management. DIS involves examination of the assumptions underlying an expert's proposals, the negation of these assumptions, and the development of the counterproposal based on the negated assumptions. Through theses and antheses, syntheses may be achieved which will benefit the participants in technology transfer. Some technology transfers have failed due to poor management and implementation. By using DIS, the decision makers can consider several alternatives and plan for the transfer.

Figure 3.13 represent in a diagrammatic format the needed path to follow to reach goal compatibility between the LDC and the MNC. Each step in the Goal Compatibility concept diagram will be briefly discussed.

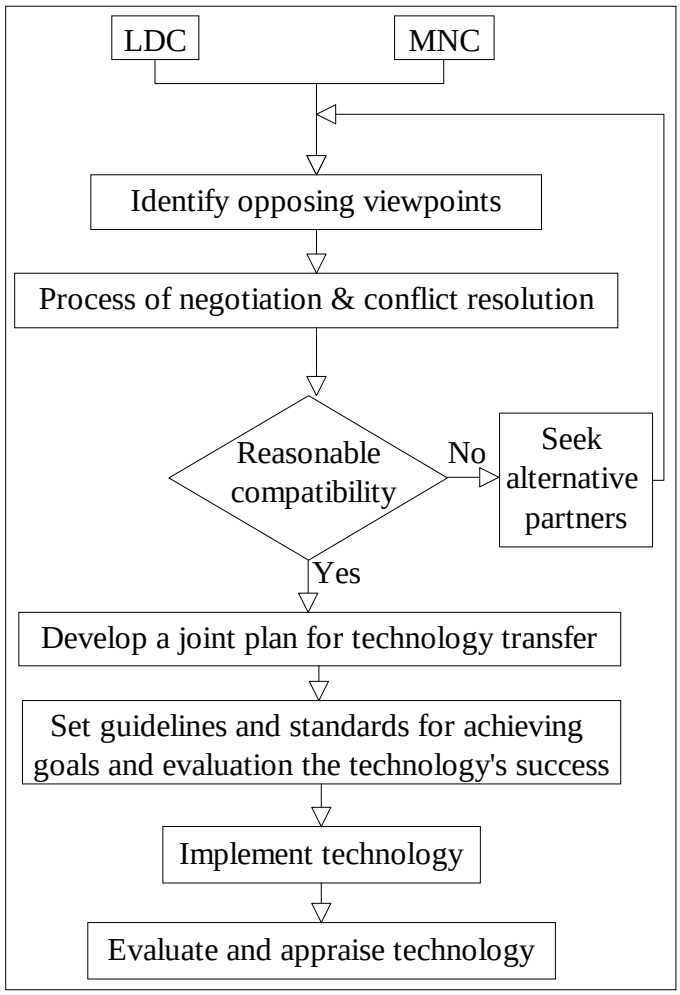


Figure 3.13. Goal Compatibility Concept using Dialectical Approach

3.4.3.1. Identify Opposing Viewpoints

Successful transfer of technology requires that both the transferor and the receiver have some compatible goals and objectives. MNCs are profit-making institutions while LDCs' governments are non-profit and concerned with social gains. This alone is enough to produce incompatible goals.

The need for technology is overwhelming and technology continues to be transferred even in the absence of compatible goals and objectives [7]. Planners in developing countries should have multiple perspectives in order to understand alternative paradigms that may be a function of culture and different worldviews.

LDCs need not to resolve all conflicts in technology transfer. Some conflicts may never be resolved, and might actually be beneficial by serving as a challenge to the system, fostering creativity and innovation [7]. The system should operate within these limits. Negotiations

of technology transfer should take into account the different worldviews and the cultural value system that may make it difficult to achieve compatibility. Negotiation processes should therefore accept some conflicts as given, and work within this framework.

The conflict resolution process will not only lead to innovation and change but can also make change more acceptable. The source and intensity of the conflict must however be understood and managed effectively [7].

Figure 3.14 shows the productivity vs. conflict curve that indicate the use and positive side of conflict. With low or no conflict, people become stagnant and the group will deliver limited challenges. More conflict will also be degenerative. People become suspicious and do not trust each other. This then lead to an unpleasant working environment with low productivity. The optimal region of conflict (shaded aria indicated on Figure 3.2) will stimulate innovation, encourage more effective work-performance, motivate a search for effective problem solving, and give a better change adoption. This region is found just to the left of the maximum productivity point. The reason therefore is that once a firm has had too much conflict, management will have difficulty getting back to the, more desirable left side of the figure [41].

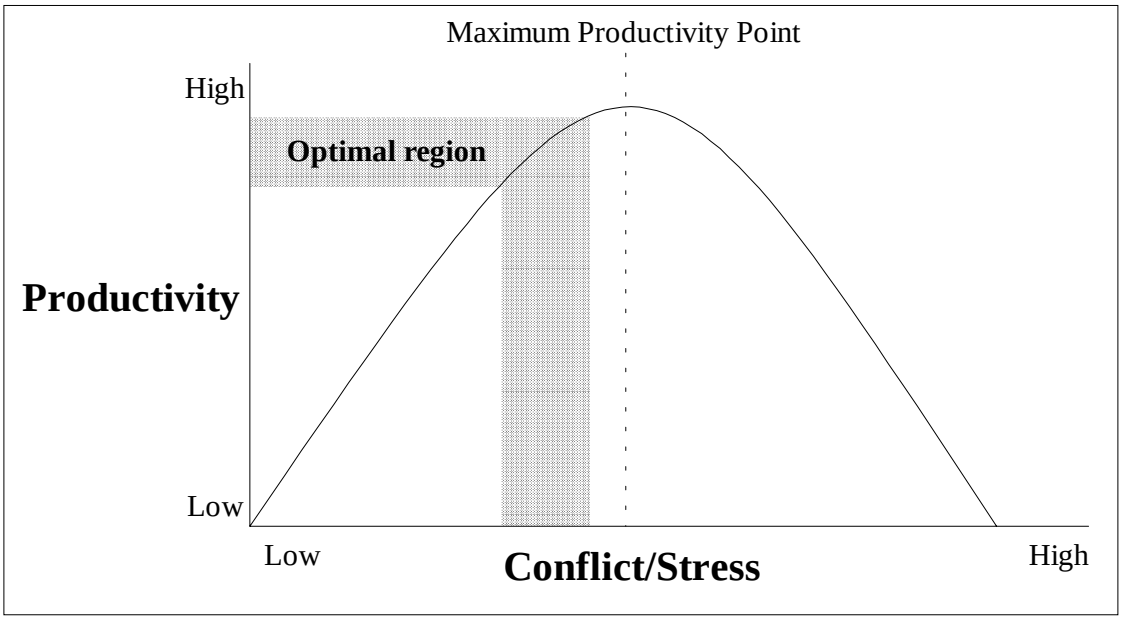


Figure 3.14. The relationship between productivity and conflict/stress [41]

3.4.3.2. Negotiation and Conflict Resolution Process

The MNCs may require some stability assurance in terms of political stability, public policies (such as taxes, foreign exchange, regulations, or import/export restrictions), and so forth. On the other hand, the LDCs will want to know about legal constraints limiting the extend of technology utilization, pollution that may be associated by the technology, training of the LDC's nationals, the availability of limited patents for producing technology, the limitations on exports, the cost of purchasing technology, the conditions for purchasing spare parts and of getting equipment maintenance, and the possibility for developing appropriate research.

The process of negotiation aids in establishing a communication pattern between the LDC and the MNC. Through effective communication, the goals, objectives and aspirations of both parties become clear. Thus, effective communication is invaluable for the effective transfer of technology [7].

There are a number of different ways [41] to deal with conflict and these could also be combined to form an approach. The different ways are:

- *Avoiding* - Ignore the conflict. It will resolve itself.
- *Resolving* - Integrate differences and hit upon a compromise.
- *Higher goal approach* - Identify higher goals that both parties have in common.
- *Restricting\Limiting* - Well structured interaction and communication, with a time limit and informal discussion about conflict. Involve a third party if necessary.
- *Confrontation* - Integrated problem solving. Plan interaction and search to find compatible goals. A consultant or third party may be used with complicated situations involving large groups. There shouldn't be too much emphasis on a time limit with an instant solution. A mutual minimum amount of trust must exist.

Figure 3.15 [41] gives a graphical presentation of possible strategies that could be followed with regard to ones orientation towards self-reward and cooperation.

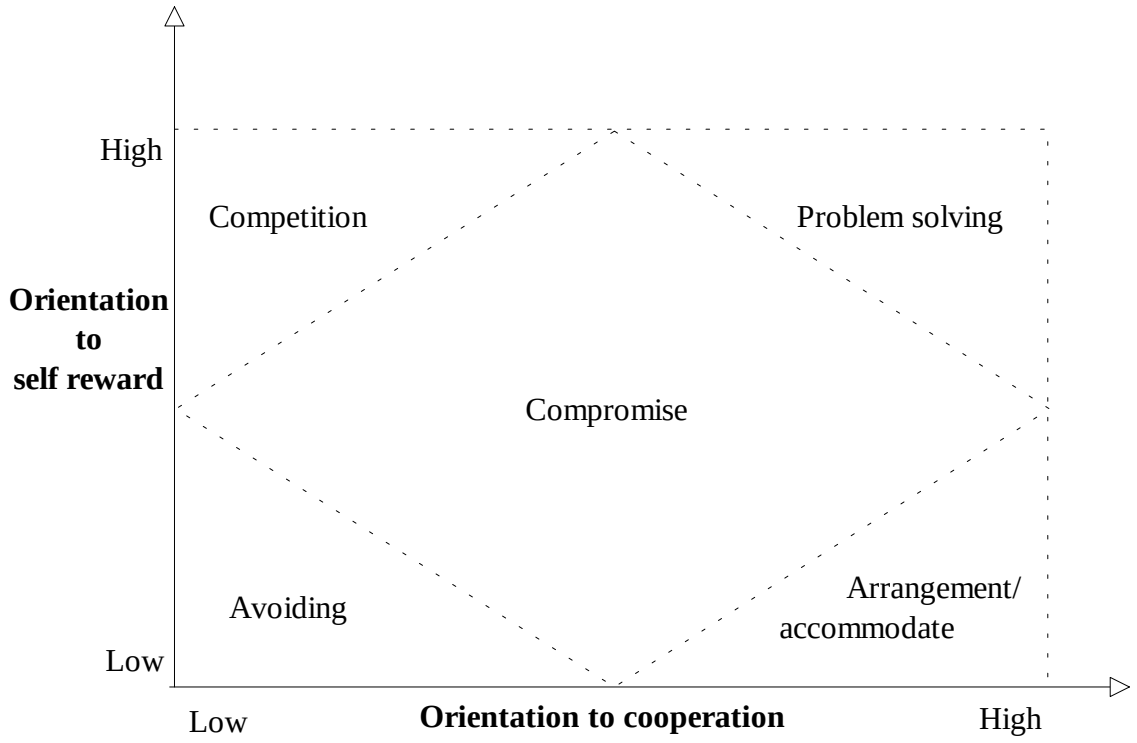


Figure 3.15. Possible strategy to resolve conflict [41]

3.4.3.3. Development of a Joint Plan for Technology Transfer

A plan is developed with a set of guidelines and standards on how to transfer technology. This plan should include timetables for transfer and the sequence of transfer, education and training of the local workforce, development of the local management process, implementation phases and resource requirements, a program for R&D, and plant location sites [7]. The guidelines and standards are control measures for assessing the success or failure of the transfer.

Technology transfer to the LDCs nowadays often take place with ever more complicated arrangements with the technology seller. For example the Algerians have increasingly sought to transfer technology through, what they call, clef en main, produit en main, and marché en main [42]. These arrangements mean:

- ***Key in hand (Clef en main)***
  Here the technology supplier's involvement continues past the point of completing the production facility to the training of staff.

- ***Product in hand (Produit en main)***
  Produit en main transactions are not complete until the facility is fully operational and has delivered products for an extended time.

- ***Market in hand (Marché en main)***
  In the marché en main arrangement, the technology seller provides both the produit en main service and a guaranteed market segment.

3.4.3.4. Implementation Of The Technology

Implementation can be "incremental" of "whole". With the "incremental" approach the technology may not be introduced all at once. This often occurs while the critical capabilities such as labour, natural resources, or capital, are inadequate or lacking [7]. The "whole" technology concept requires that the company is sufficiently capable to provide the needed critical inputs. A country can progress from an "incremental" to a "whole" concept if their capabilities are improved.

The implementation of technology also implies the existence of some support systems, such as a trained workforce, an infrastructure (transport, communication, energy), and the support of the LDC as well as the MNC, in order to achieve success. The implementation approach itself should be one of gradual nature and not drastically forced onto society. This will assist in acceptance, which is needed for success and avoid rejection.

3.4.3.5. Evaluation and Appraisal of Technology

After achievement of short-term goals, the technology can be upgraded to a more advanced technology. However, the upgrading of technology requires that the recipient is capable of sufficient innovation and R&D [7]. The MNC has a role to play here by integrating its technical staffs, which are nationals of the LDCs in the R&D decision-making process. These people have working knowledge of the culture, socio-economic, and political systems of the country and will help the MNCs in developing appropriate technologies.

MNCs should therefore adapt an environmental/institutional strategy to adapt to the changing needs of LDCs.

Enthalpy and Entropy Cycle

The dominant economic, social, cultural, psychological, and political forces of a LDC also influence the direction of technological change. Enthalpy is achieved when growth occurs or there is progress, while entropy is the result of societal decay or decline [7]. In whatever state the country might find itself, it must work towards progression. Enthalpy and entropy are achieved at different levels and could also be defined for a company. The difference between enthalpy and entropy can be given as:

- ***Enthalpy***
  Enthalpy is achieved when appropriate technology is transferred, pollution is controlled, social responsibility is maintained, planning and implementation is achieved, and the recipients are able to achieve technological independence and sustainable development.

- ***Entropy***
  Entropy can come as a result of the transfer of inappropriate technology, incompatible goals of LDC and MNC, or poor planning and implementation.

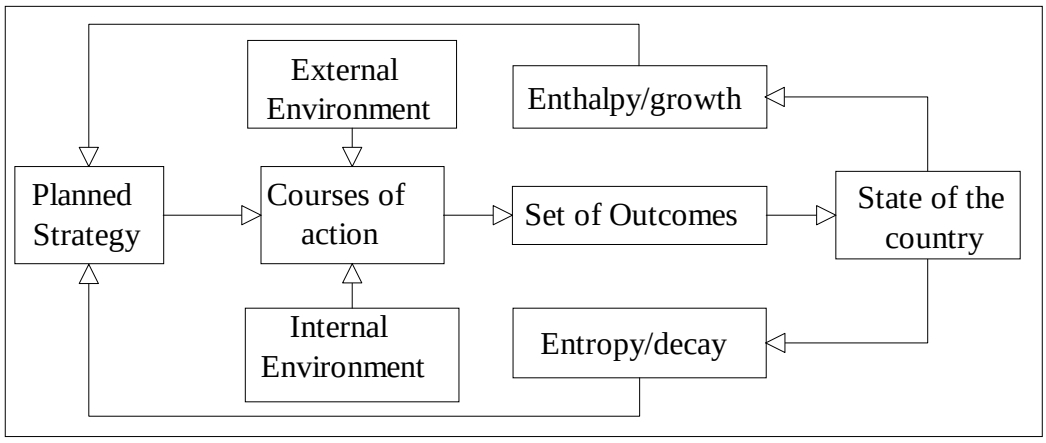


Figure 3.16. Strategic Planning in Technology Transfer [7]

Each arrow in Figure 3.16 indicates, that the object at the beginning of the arrow has an influence on the object at the end.

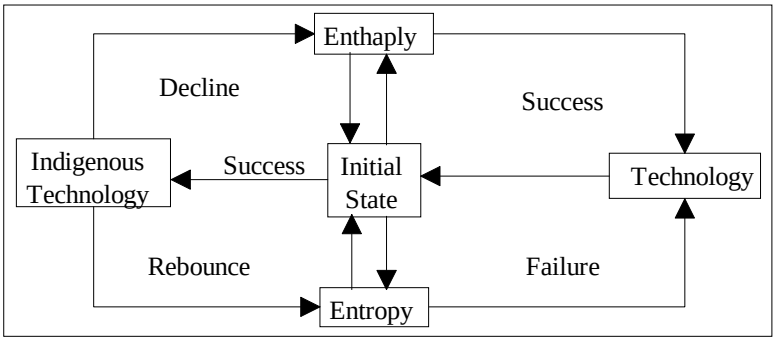


Figure 3.17. The Enthalpy and Entropy Cycle in Technology Transfer [7]

The Enthalpy and Entropy Cycle in Technology Transfer is a dynamic system. Success of technology transfer may also lead to development of indigenous technology that can lead to further growth, but might also cause decay. A country finds itself thus in an initial state and through either the indigenous- or the foreign technology can it drift towards enthalpy or entropy. The cycles are presented in graphical format in Figure 3.17 [7]. In Figure 3.17 one can see 4 different cycles that could be caused by technology. Two cycles are indigenous technology, and the other two foreign.

3.4.3.6. The Six Principles of the Dialectical Materialism Inquiry System (DMIS)

DMIS deal with the field of policy and strategic planning from a holistic systems and dialectical point of view. Six principles of DMIS, which can enhance the technology transfer decision-making process, are: the principle of change, contradiction (Unity and Conflict of Opposites), transformation of quantity into quality, totality and interconnection, negation, and praxis. The six principles of DMIS lay much emphasis on change as an important phenomenon, which must be anticipated and planned for if technology transfer is to succeed. This will facilitate making quality decisions. The six DMIS principles are discussed briefly [7].

1. ***The Principle of Change:*** The LDCs seek technology to improve their economic well-being and enhance their development programs. Change may be the only solution to the numerous economic problems facing them. With technology, different needs and opportunities are likely to emerge and people's perceptions and values are often changed. The cumulative effect will be a change in the social and economic structure of the country. What is needed is knowledge about how to manage change. Change can be managed through appropriate education, training, and awareness development programs.

2. ***The Principle of Contradiction (Unity and Conflict of Opposites):*** The socio-economic system might reveal political instability, high unemployment, a poor standard of living or quality of life, or other problems. The culture value system may also show strong attachment to families, a commitment to the preservation of nature, rejection of new and foreign technology, inadequate motivation, and other qualities. The socio-economic needs may thus operate in contradiction to the culture value system, where different cultures exist. LDC's governments might be willing to operate at an economic loss as long as its social goals are satisfied. MNC,

on the other hand, are profit orientated. This creates contradictions and has to be resolved.

3. ***The Principle of Transformation of Quantity into Quality:*** Entropy will lead to social decline, possibly as a consequence of a misinterpretation of knowledge, poor planning and implementation of technology, or as a result of inappropriate technology. As growth continues, the receiver develops some of the capabilities (human resources or capital) that might have been lacking initially. When a threshold level is reached, a diminishing marginal return effect may occur. Increments of more resources might not necessarily yield the quality and quantity desired. Per capita productivity might decline and there might be a need to automate and upgrade existing technology.

4. ***The Principle of Totality and Interconnection:*** The systems approach will allow the planner to view his/her system as a subsystem of a larger system. With this mode the interaction with other systems can be studied. Systems approach further allows the decision maker to consider all possible that might influence the technology transfer decision-making process. Technology transfer decision-making should consider all the components of the society (social, political, cultural, and economic system), and also the capabilities and possible capabilities of the country (human- and natural resources, and capital) before contemplating a possible joint venture with neighbouring countries of MNCs.

5. ***The Principle of Negation:*** The satisfaction of lower needs can generate new and possibly higher needs. Technological changes will lead to new assumptions, new needs, and new propositions that might negate the previously held believes and assumptions.

6. ***The Principle of Praxis (Habits):*** Through Praxis we justify technology if it achieves social utility and can be applied in solving social and economic problems. Thus, the interaction between technology, economy, improvement, and social utility can be explained using this principle. The social gains and losses due to technology ought therefore to be considered in determining whether social utility is achieved.

3.4.4. A Systems Approach to the Transfer of Mutually Dependant Technologies

Each LDC must address the following issues: identification of technology to transfer, assignment of priorities to the identified technologies, and technology forecasting [7]. The systems approach to transfer mutually dependant technology address these first two issues. Unlike economic models, which consider primarily quantitative factors, the systems approach integrates behavioural, structural and technological issues in making decisions. When technology is transferred without consideration of all these subsystems, a planning gap is created that may eventually lead to political, economic, and cultural decline.

Mutually dependence means, that some technologies may yield more benefits if there are other technologies in existence to support their activities [7]. LDCs may seek to transfer such interlinked technologies to maximize their social welfare. Although the benefits of such technologies may be apparent, its resources available may limit a particular country.

The systems approach to transfer mutually dependant technology will assist policy makers in LDCs in considering their vital subsystems while making decisions. These decisions include which technology to transfer, the allocation of the country's limited resources to the different technology types/industrial sector [7] in order to maximize social welfare, and the source for the transfer of appropriate technology.

The Systems Approach Framework

The Systems Approach Framework is presented in Figure 3.18 [7]. This approach certainly may not address al the pertinent problems that may be involved and it will not guarantee the optimum solution. However, it does offer an integrative approach to this important problem. If policy makers are conscious of the interdependence between technologies and how such relationships can help in maximizing the efficiencies of their industries, they are more likely to develop long-term policies that will support development of dependant technologies.

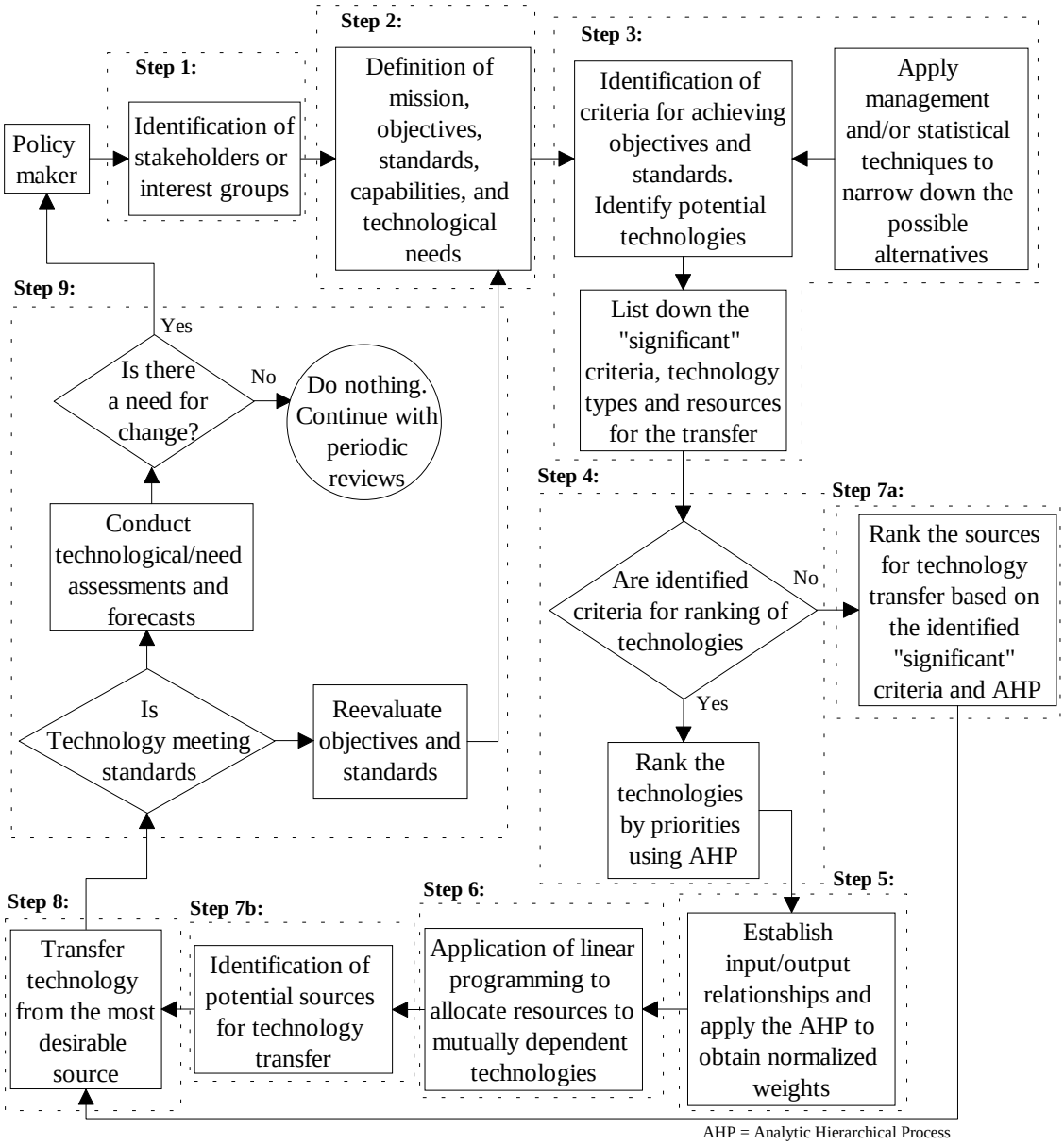


Figure 3.18 A Systems Approach to the Transfer of Mutually Dependant Technologies.

A brief description of the 9 steps in Figure 3.18 follows.

3.4.4.1. Step 1: Identification of Stakeholders or Interest Groups

The policy maker identifies the stakeholders or interest groups whose actions may influence the technology transfer process. A team is then formed to evaluate and recommend the appropriate transfer technology to the policy maker. If the stakeholders participate actively in the technology transfer decisions, the implementation of technological decisions reached by the team will be enhanced.

3.4.4.2. Step 2: Definition of Objectives, Standards, Needs, and Capabilities

The modified relevance tree diagram (MRTD) gives a typical example of the LDC's mission, objectives, constraints and standards [7]. Once the objectives are well defined and all limitations and capabilities well understood set criteria could be established to achieve these objectives.

3.4.4.3. Step 3: Identification of Criteria and Dependent Relationships

A set of criteria for achieving the transfer of appropriate technologies is socio-economic growth, culture value, R&D, resource utilization, cost of technology, and the impact on the environment [7]. The influence of these criteria on technological decisions becomes apparent once the stakeholders express their opinion on how these criteria may influence their social system. There may be different types of technologies which are able to satisfy these criteria and they should be evaluated and decisions then made based on how well a particular technology is able to satisfy these criteria.

3.4.4.4. Step 4: Ranking Technology Types

The essence of considering the different technologies is to ensure that the most appropriate technology is transferred. The analytic hierarchical process (AHP) provides a systematic way to develop priorities for different alternatives based on the stakeholders' judgments [7]. AHP is a multi-criteria decision model that uses hierarchic or network structure to represent a decision problem and then develops priorities for the alternatives based on the stakeholders' judgment.

AHP is used because of a number of reasons briefly described below [7]:

- It's based on pare-wise comparison between competing alternatives which reduces the number of alternatives.

- AHP allows for the consideration of both objective (i.e., cost of technology) and subjective (i.e., culture values) factors.

- Consistency measures are easily derived and used to evaluate the quality of the stakeholders' judgment. Although consistency does not infer quality decisions, however, all quality decisions are consistent. Thus consistency will improve the probability of reaching a quality decision.

- AHP enables people to analyse group decision-making, and arrive at a unique decision that will reflect the opinions of all the participants.

- AHP is an effective tool in arias of management, policy-making, and conflict resolution.

AHP is put into action through a series of pair-wise comparisons between alternative actions or decisions based on a nine-point scale. These definitions are:

Point	Definition
1	Equal importance
3	Moderate importance of one over the other
5	Strong importance of one over the other
7	Very strong importance of one over the other
9	Extreme importance of one over the other

Through the AHP, a factor called consistency ratio (CR) is computed to measure consistency in the stakeholders' judgment. A CR value greater than 0.1 shows that the decision makers were inconsistent. Thus CR<0.1 for consistency.

Example [7]***:***

Geometric mean of weights assigned by the stakeholders						
Technologies	**Mining**	**Agriculture**	**Textile**	**Oil Exploration**	**Information Processing**	**Eigenvectors**
Mining	1.00	0.33	1.00	1.00	1.00	0.153
Agriculture	***3.00***	1.00	2.00	0.50	3.00	0.259
Textile	1.00	0.50	1.00	0.20	2.00	0.120
Oil Exploration	1.00	2.00	5.00	1.00	5.00	0.384
Information Processing	1.00	0.33	0.50	0.20	1.00	0.085

CR = 0.093 < 0.1 Thus consistent.

Table 3.1. Judgment with respect to cost as a goal [7]

Table 3.1 shows the geometric mean of the weights assigned by the stakeholders in comparing the five different technology types on the basis of cost of the technology. Table 3.1 shows for example that agriculture technology has a preference score of 3 over mining technology in terms of cost (indicated in bold in Table 3.1). The scores indicate the importance of the horizontally listed technologies over the vertically listed ones.

It is also important to measure the consistency of the stakeholders. For example, it could be expected that when a stakeholder prefer agriculture technology to oil exploration by a

score of 2 and oil exploration to textile by a score of 3, he should prefer agriculture to textile by a score of 6 (2 × 3). The CR (consistency ratio) of 0.093 (smaller that 0.1) indicates that the stakeholders where consistent in their judgment.

The analysis on Table 3.1 was conducted using an Expert Choice program (decisions support system developed to facilitate AHP). The consistency ratio as well as the eigenvector values was calculated within this analysis. The eigenvector values indicate that, in this example, oil exploration is the most desirable technology to transfer when considering cost, followed by agriculture, mining, textile, and information processing as the least desirable technology.

Table 3.1 could be set up for a number of criteria (such as impact on the environment, resource utilization, R&D, impact on culture, and socio-economic influence). A separate table could also be set up which indicates the importance of the different criteria as presented in Table 3.2. For this example, socio-economic is the most important criterion, followed by culture, R&D, resource utilization, environment and cost as the least important criterion (indicated by the eigenvector values).

Goals:	**Socio-economic**	**Culture**	**R&D**	**Resources**	**Environment**	**Cost**	**Eigenvectors**
Socio-economic	1.00	1.00	3.00	5.00	7.00	7.00	0.359
Culture	1.00	1.00	2.00	3.00	5.00	5.00	0.271
R&D	0.33	0.50	1.00	3.00	5.00	2.00	0.168
Resources	0.20	0.33	0.33	1.00	3.00	5.00	0.107
Environment	0.14	0.20	0.20	0.33	1.00	3.00	0.054
Cost	0.14	0.20	0.50	0.20	0.33	1.00	0.041

CR = 0.083

Table 3.2. Judgment with respect to goal comparison [7]

The overall eigenvector priorities are obtained using the eigenvectors in the tables for all the criteria (such as impact on the environment, resource utilization, R&D, impact on culture, and socio-economic influence). This forms a vector matrix α, which is also calculated using the computer software. The α matrix, shown in Table 3.3, implies that oil exploration should have the highest priority, having the highest eigenvector value, for this specific LDC. It further indicates consistency with a CR of 0.06.

Technology	Overall Eigenvector
Mining	0.117
Agriculture	0.181
Textile	0.274
Oil Exploration	0.169
Information Processing	0.259

CR = 0.06

Table 3.3. The α Vector Matrix to indicate overall importance of a technology [7]

3.4.4.5. Step 5: Establish Input-Output Relationships

It is necessary to establish the input-output relationships between different technologies since resources cannot be allocated in terms of priority when there may exist some interdependence between these industrial sectors. Table 3.4 presents the established hypothetical input-output relationships between the five technology types. For example, there is a flow from mining to textile industry while the reverse movement shows partial dependence of the mining sector on the textile industry.

Technologies	Mining	Agriculture	Textile	Oil Exploration	Information Processing
Mining	1.06	0.11	**1.98**	0.00	0.00
Agriculture	0.22	1.11	0.50	0.00	0.00
Textile	**1.11**	0.76	1.59	0.15	0.00
Oil Exploration	0.26	0.34	0.18	0.15	0.15
Information Processing	0.76	0.89	1.16	1.09	1.09

Table 3.4. Input-Output Matrix [7]

The coefficients in the (i,j) position of the input-output matrix of Table 3.4, is weighted by α_i and α_j and summed over each row to obtain the dependence vector matrix β (Table 3.5).

Mining	0.08017
Agriculture	0.06565
Textile	0.19928
Oil Exploration	0.03431
Information Processing	0.2668

Table 3.5. The β Vector Matrix indicates overall dependence on technologies [7]

The β vector matrix indicates the overall importance of all the technologies in a network where the technologies are interdependent. For this example, Textile technology is the most preferred technology to be transferred and it seems to be the most appropriate technology in this situation.

3.4.4.6. Step 6: Formulate the Linear Programming (LP) Problem

Linear programming is applied to the problem of technology transfer in allocating the LDC's limited resources to mutually dependant technologies. These resources have to be allocated in such a way as to consider all the criteria identified and their respective priorities in maximizing social welfare of the country. The allocation process makes thus use of both the input-output matrix and the priority indices obtained for the technology types. The linear programming problem is then solved using a LP package called Lindo, and given by [7]:

$$\mathbf{Max\ z = 0.08017w_1 + 0.0656w_2 + 0.19928w_3 + 0.03431w_4 + 0.2668w_5} \quad (3.4)$$

Where the variables w_i represent the ratio of resources allocated to the five industrial sectors, and are upper-bounded by their requirements of the specific resource.

3.4.4.7. Step 7: Deciding the Source of Technology Transfer

The appropriate transferor must share some common goals with the transferee. Different technologies may be transferred from different sources or transferors as each technology poses different constraints. Different technologies may also have different criteria (as indicated in Figure 3.19), which the stakeholders will have to identify and analyse.

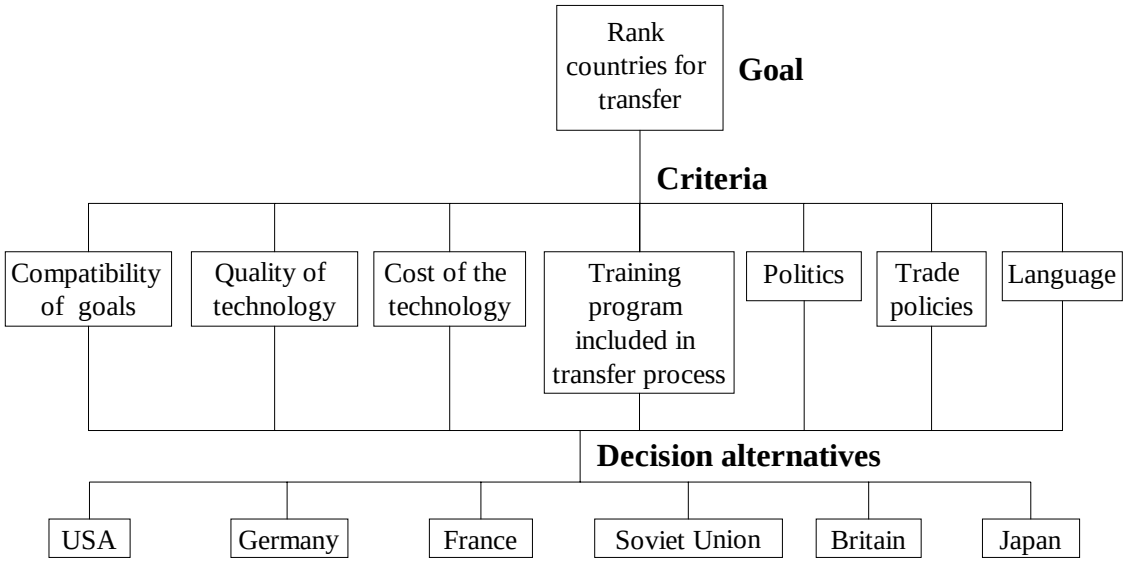


Figure 3.19. A Network Structure for Selecting the Appropriate Transferor for a Chosen Technology [7]

The analytic hierarchical process (AHP) is once again used to decide on an appropriate technology. For each criterion noted in Figure 3.19 there should be an analysis done (similar to the one described in Table 3.1) and their overall eigenvectors once again

calculated (as in the β vector matrix in Table 3.5. This analysis will yield a priority matrix indicating the appropriate transferor with the others in declining priority. This might be useful if the most appropriate transferor becomes unavailable due to a specific reason.

3.4.4.8. Step 8: Implementation of Technology Transfer Decision

If the policy maker adopts the group's plan at least to a large extent, the chance of successful implementation is enhanced. The policy maker can effectively argue that all the significant groups participated and adopted the plan. Thus, no particular group can argue that it is not part of this decision process. Since these decisions are based on the stakeholders' consensus, it is possible, but not guaranteed, that these decisions may get the support of the significant interest groups represented by the stakeholders. The approach followed here integrates all the factors, important and influencing the choice of technology.

An incremental approach may be followed in which the basic supporting industries are gradually developed first. The industry least dependent on the others should be developed first [7].

Even when it is possible to create economic motivations to introduce technology, it may be quite difficult to make a switch from the existing practice in an organization. A new technology may be launched quite successfully through dissemination of information about it and through pricing it appropriately, but its success will often depend on its trouble-free performance and reliability. Technology must pass through a learning phase over which the user must become familiar with, and understand the managerial requirements associated with its use [8].

As a new technology is adopted, a backlog of unsolved problems associated with its functioning begins to build up. These problems can be solved only when an adequate number of professionally competent people are available [8], otherwise the pile-up backlog of problems discourages further adoption.

3.4.4.9. Step 9: Control and Technology Assessments

The monitoring process is a form of control to ensure that the country's missions are being fulfilled. Both the stated objectives as well as the standards should be continually re-evaluated. There may be a need to modernize or update the existing technology in anticipation of changing needs. The original standards may also not be appropriate and there will be a need to change [7]. When such needs emerge, the LDC's mission may be redefined, and new objectives and standards established. When the process is operational according to expectations, and there are no new social and economic needs to fulfill, the do-nothing strategy is adopted.

If it is detected that there is a need for change, the policy maker may elect to identify new stakeholders to analyse the problem. These stakeholders also follow the same stepwise approach introduced in Figure 3.18.

3.4.5. The Technology Acquisition Hierarchy (TAH)

The technology acquisition hierarchy model sets three different levels in the technological know-how of the transferor and receiver as shown in Figure 3.20.

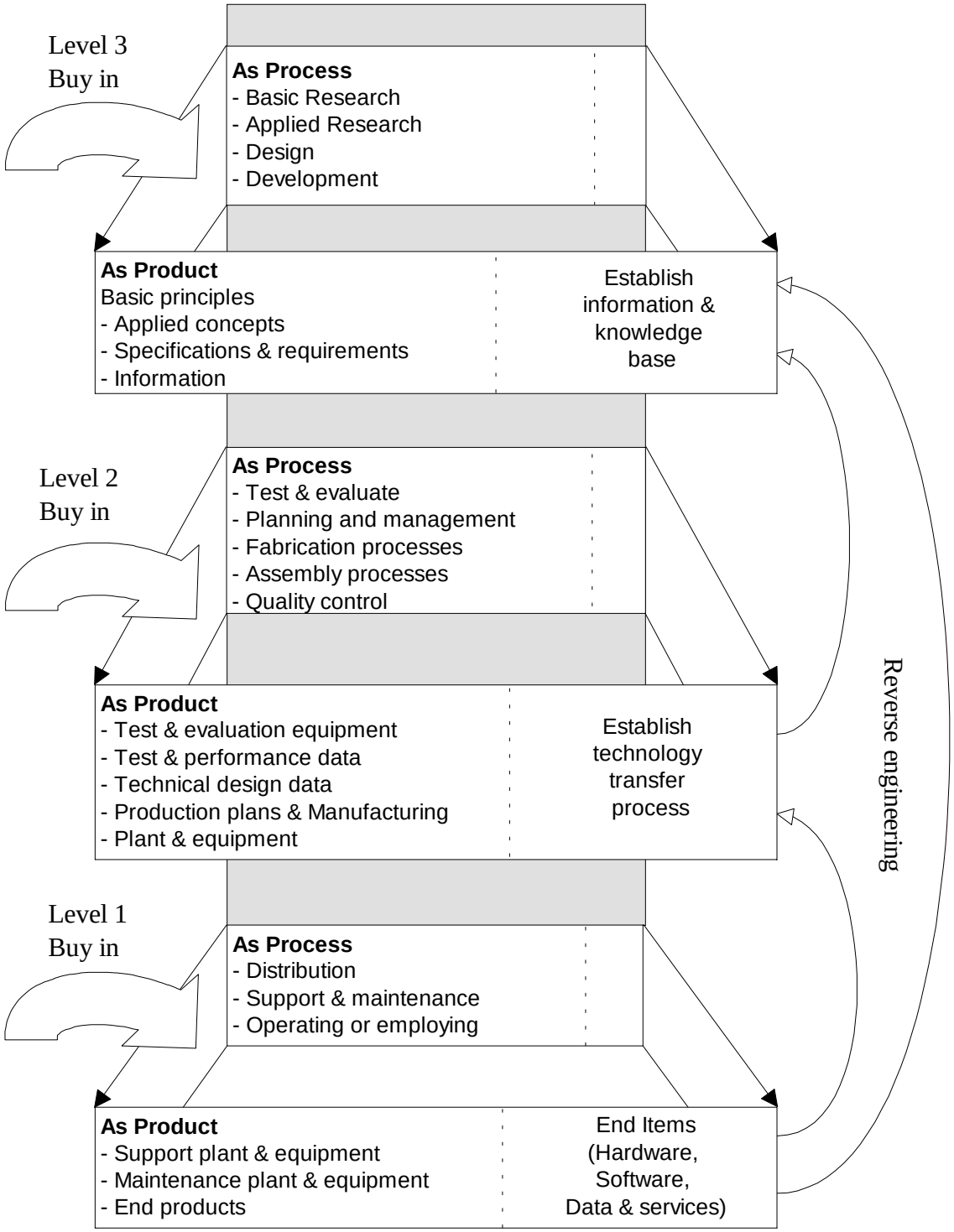


Figure 3.20. Technology Acquisition Hierarchy (TAH)

The basic idea of the TAH is that technology can only be transferred from one party to another at the same level of technological knowledge. The source can supply technology in the form of completely developed product designs to be manufactured by the receiver

(level1), transfer of product designs which the receiving country develop themselves (level2), or as research where technology usually flows bi-directional and the receiving country do design and development of products themselves. South Africa is mainly at level one of the telecommunication technology hierarchy when using designs and developed plans from MNCs for production.

In South Africa, more than 80% of the value in industrial business activity is done under (foreign) license [9], and more than 50% of this activity is subject to market constraints. The development strategy followed by South Africa was to educate and develop skills of the human resource appropriately and to create a business environment that made it attractive for MNCs to base a significant part of their manufacturing capability in the country [9]. The later strategy was focused on independence, and were planned to add value at earlier stages of the product life cycle. Industrial growth in the 60's, 70's, and 80's were evolved around the mining and/or agriculture industries. These two sectors dominated the country's development in the transport-, telecommunication-, and energy infrastructure. South Africa should be prepared to cope with the loss in value of natural resources, (such as gold, diamonds, and all the other minerals) which were the traditional providers of economic welfare. The focus should be on "reversed engineering" (also see section 2.5.2. in Chapter 2) and backwards integration along the product life cycle, thereby adding value at earlier stages of the life cycle and gaining ownership of intellectual property. Moving up in the technology hierarchy (indicated on the right hand side of Figure 3.20) provides the freedom to export [9]. South Africa should transfer more technology in the form of design and development, applied research and eventually basic research.

The technology acquisition hierarchy model advises countries not to transfer technology across different technological hierarchy levels. Countries at lower levels do not have sufficient capabilities vested within to productively receive technologies from higher-level countries. The focus is on earlier value addition, self-development, and "reverse engineering" to improve the technological situation.

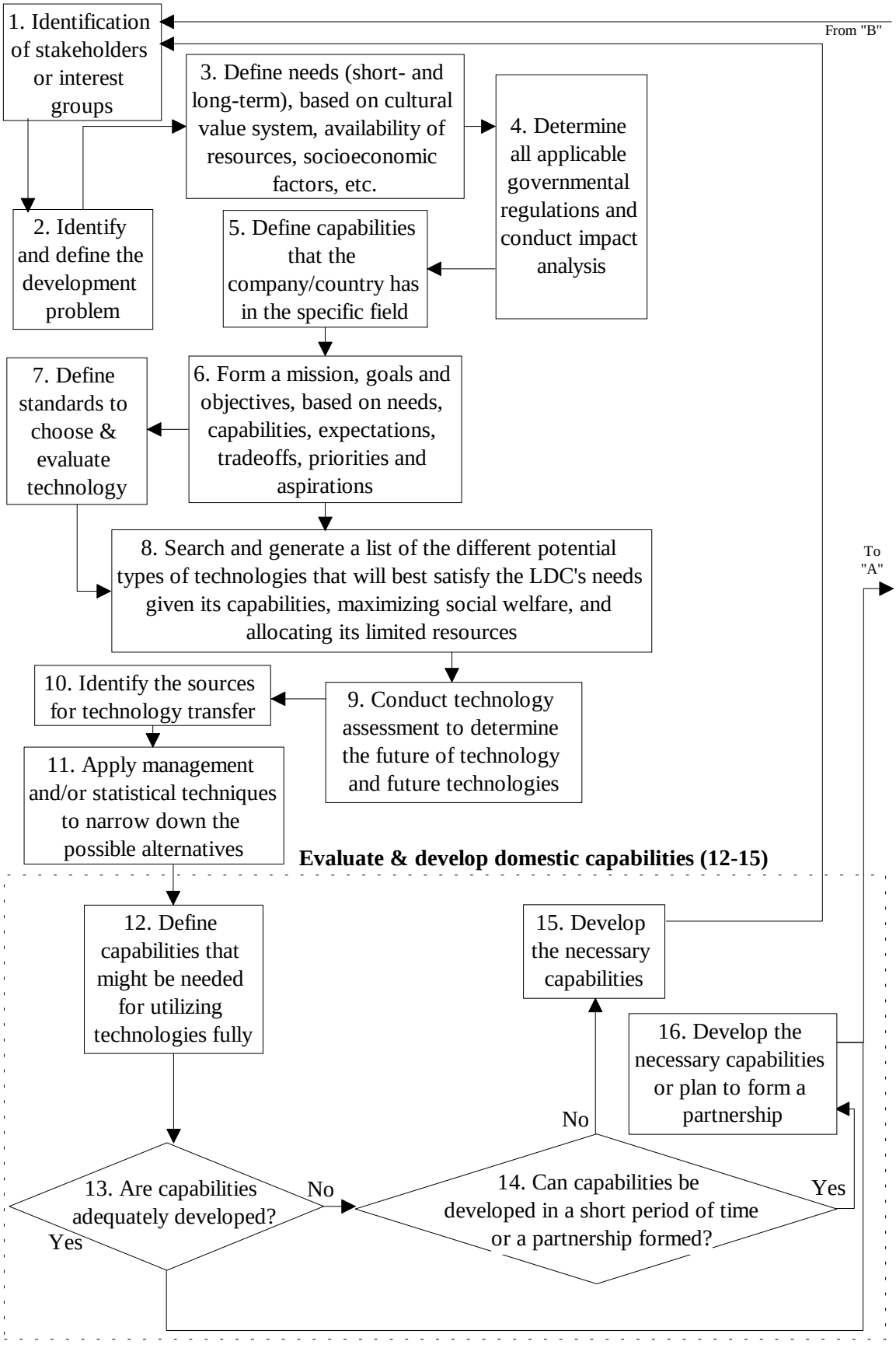
4. A Model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa

Technology transfer is a complex process that, if not managed wisely, can become a burden on national development. When transferring technology from one country/company to another, at different levels of technological know-how, the process holds many problems that need to be overcome.

The telecommunication industry is a high-tech fast moving field with ongoing technology transfers taking place. Problems do exist and a solution is needed to plan proactively for future technology transfers. If not planned systematically the transfer process can lead to unsuccessful allocation of resources.

The Model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa forms the core of this dissertation. This chapter provides the telecommunications industry with systematic guidelines (model) for technology transfers, which includes both parties (source and receiver). The situation in South Africa will also be discussed on the basis of the transfer model in Chapter 5.

The model is divided into two parts shown in Figure 4.1 and Figure 4.2. The interaction between Figure 4.1 and Figure 4.2 is shown through the lines: *To "A"*, *From "A"*, *To "B"*, and *From "B"*. The sub-elements of both figures will be described below. The reason for the division is purely because of paper size and no official technical meaning was attached to the separation.



AHP = Analytic Hierarchical Process

Figure 4.1. Model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa (Part I)

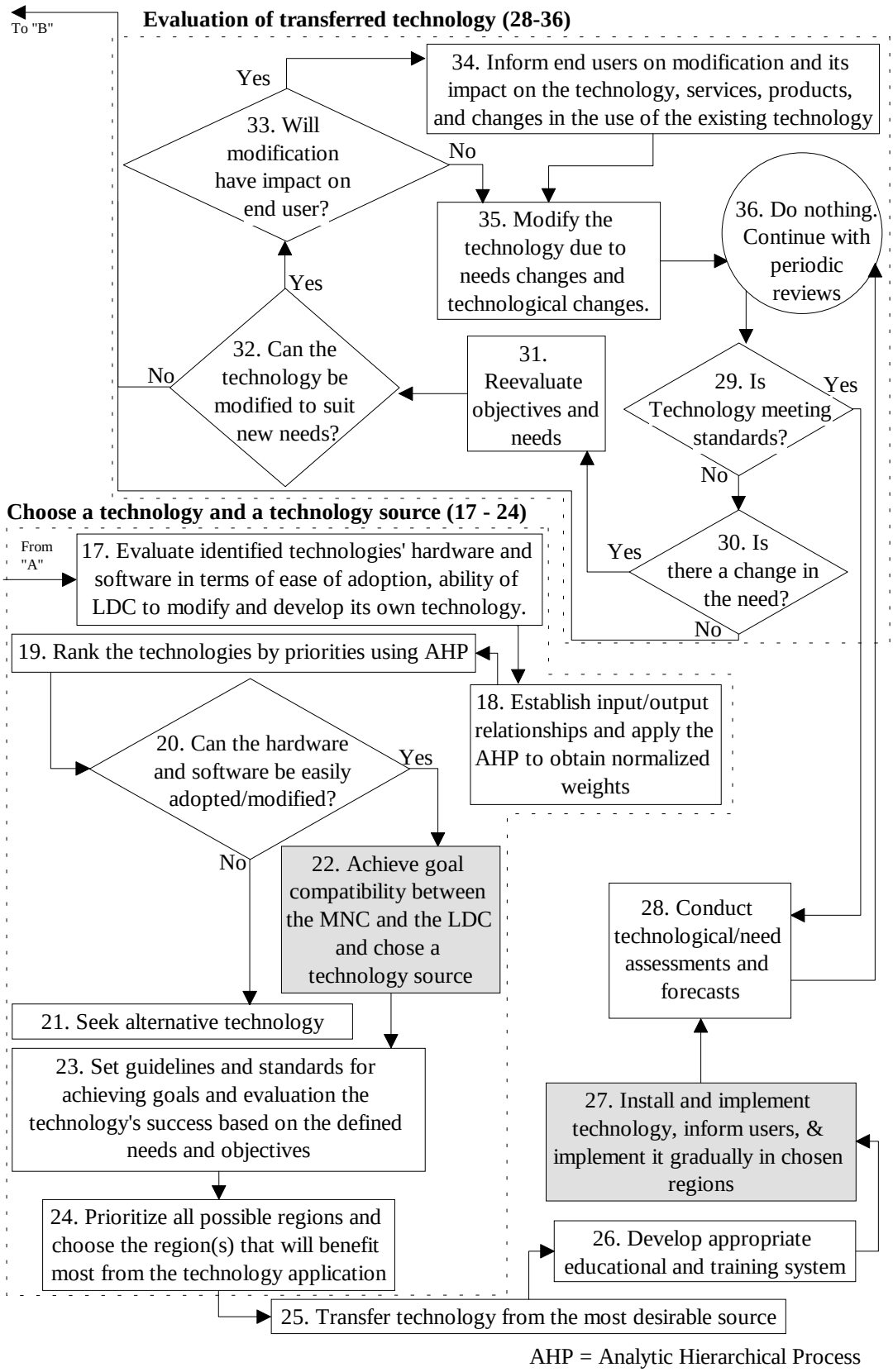


Figure 4.2. Model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa (Part II)

4.1. Identification of Stakeholders or Interest Groups (1)

The policy maker identifies the stakeholders or interest groups whose actions may influence, or who are influenced by, the technology transfer process. A team is then formed evaluating and recommending the policy maker the appropriate technology to transfer. The team of stakeholders consists of people such as:

- People directly involved in the technology implementation,
- People involved in adaptation and modification,
- Corporate personnel of the receiving telecommunication firm,
- Corporate personnel from the technology supporting and supplying,
- The end users, and
- The Governmental regulator.

The *active* participants identified by the policy maker forms the stakeholders. If their participation is actively integrated into the decision-making process, the implementation of technological decisions reached by the team will be enhanced.

It is also important to identify the stakeholders' views and their cultural values. One needs to determine these values and viewpoints because they will definitely have an impact on the transfer process. The difficult part however is to integrate these aspects into the decision-making process.

It is extremely important to view the end users as stakeholders and to incorporate their ideas and needs into the transfer of technology. One of the biggest mistakes made is to only conduct a market research and then to believe that all useful inputs are accounted for. It is however still of importance to know as much as possible about the end user's preferences and to draw up a profile. To know your customer is a cardinal key to client satisfaction in the service industry.

4.2. Identify and Define the Development Problem (2)

Each country/company is unique in a sense and therefore the development problem, while many similarities might exist, will also be unique in many ways. The development problem definition is a clear outlay of all the factors/problems that limit the overall growth or development of the involved country/company. To be able to identify the right development problem the stakeholders need to have vision and must be comfortable with the local conditions. One must be extremely careful when using outsiders during this process. They are often unrealistically expensive and not always in tact with the country/company's situation.

The use of foreign consultants are only advised when the country/company's personnel does not have sufficient capabilities, and then it must be done in collaboration with local stakeholders which will still allow them to give their inputs.

4.3. Define Needs (Short- and Long-term), Based on Cultural Value System, Availability of Resources, Socio-Economic Factors, etc. (3)

In this phase of the technology transfer model the LDC needs to set up most of the modified relevance tree diagram (MRTD) (discussed earlier). The standards included in the MRTD are defined later in the transfer model. Setting up a MRTD forces the stakeholders to define an overall company goal, mission, and the purpose or reason for existence. When the LDC's objectives, strengths, and weaknesses (constraints or limitations) are clearly defined the stakeholders can make decisions, recommendations, and analysis based on the right foundation. These objectives are then used to establish standards for achieving the desired outcome**.** The needs of a country can be determined using the Need-Capability Matrix as discussed in Chapter 3.

A sufficient quantity of information is available in the literature on the subject of determining needs using the Needs- Capability Matrix. The method was not repeatedly described here because the author feels the topic was thoroughly covered during the literature study (3.3.1.1, Chapter 3). The reader is therefore referred to Chapter 3 for more in-depth information concerning this topic.

4.4. Determine All Applicable Governmental Regulations and Conduct an Impact Analysis (4)

The telecommunication industry plays a very important role in the provision of the infrastructure needed for national development. The government therefore have a certain regulatory function to fulfil. Through regulations Icasa delimits the borders of the telecommunications playfield. The task of the regulator is however to steer the industry in the right direction and not to set unrealistic goals and expectations. Section 2 of the 1996 Telecommunications Act is a tool with the primary object to provide regulation and control of telecommunication matters in the public interest. If not wisely managed, the regulations can be a burden on the industry and limit the technology utilisation. The regulator should therefore have the latest news available and should do periodic evaluations on the impact of the regulations on the industry. Only then can Icasa have a positive influence on the industry.

This influence from the regulator on the industry can be noticed when observing the fixed line telecommunication industry of South Africa. The situation will now briefly be discussed:

4.5. Define Capabilities That the Company/Country has in the Specific Field (5)

The ability to receive a transferred technology depends on certain capabilities that need to be vested within the country/company. Focussing on ones capabilities and strengths is a recipe for success. A country must use its competitive advantage while still not neglecting its weaknesses and limitations. The Need-Capability Assessment Matrix is a useful tool for making technology decisions based on defined capabilities

4.6. Form a Mission, Goals and Objectives, Based on Needs, Capabilities, Expectations, Tradeoffs, Priorities and Aspirations (6)

Once a country knows its needs, capabilities, strengths, weaknesses, and limitations, it can form goals and objectives to solve the defined development problem. Only the local stakeholders can truly assess the expectations and aspirations of the people. There will always be tradeoffs between different alternatives and goals, which should also be defined clearly. Once the objectives are well defined and all limitations and capabilities well understood set criteria could be established to achieve these objectives.

4.7. Define Standards to Choose & Evaluate Technology (7)

Once the technology is in place and operational its success must be evaluated continuously. The standards on which one chooses a specific technology are derived from the needs and capabilities determined earlier in the transfer model. These standards are also included in the modified relevance tree diagram (MRTD).

4.8. Search And Generate A List Of The Different Potential Types Of Technologies That Will Best Satisfy The LDC's Needs Given Its Capabilities, Maximizing Social Welfare, And Allocating Its Limited Resources (8)

Because of the fast moving technological nature of the telecommunications industry many alternatives will often be possible, which could fulfil the need of LDCs and help them in reaching their goals. As each technology poses different constraints, the focus of this block in the transfer model should be on identifying as many alternatives possible. The more alternatives one have, the better decision can be made on choosing the most appropriate technology for the specific country’s situation. When generating the list of alternatives a country should only identify technologies and try not to evaluate them in the same exercise. The decision on which technology to transfer will be dealt with at a later stage in the technology transfer model when most of the deterministic factors are known.

4.9. Conduct Technology Assessment To Determine The Future Of Technology And Future Technologies (9)

Conducting technology assessment to determine the future of technology and future technologies is a difficult task, which requires experience. Many LDCs with limited experience make use of foreign consultants to fulfil this function. Several authors [44] have presented useful techniques, such as technological progress functions (S-curves), trend extrapolation, the Delphi method, and scenario development.

One way of forecasting technology is to determine the technology being applied in military applications. In this method of forecasting, the user determines the average lag time for technology to be diffused from a military application into commercial markets. One assumes then this calculated average lag-time and uses it to predict the future technologies. In Figure 4.3 the acceptance and urge to apply the technology is shown on the vertical axis. Time is given on the horizontal axis with contours of the two application positions (military and commercial markets) shown. The lag time is then the average time a technology takes to be accepted into the commercial market from the point in time the same acceptance was experienced in the military. This is however a very rough estimation but technology forecast is a topic on its own that needs much more attention, which was

not intended with this dissertation. The reader is referred to Wheelwright and Makridakis [44] for further information on the topic.

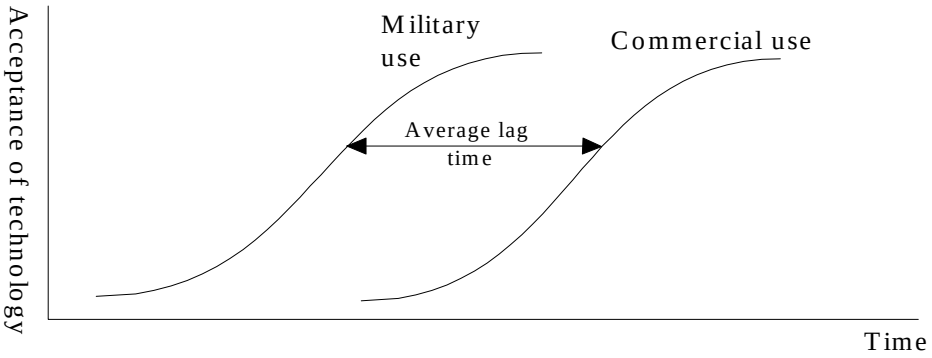


Figure 4.3. Technology diffusion from military application into commercial market

4.10. Identification Of The Sources For Technology Transfer (10)

This block of the technology transfer model guides the receiver to again consider all alternative technology sources. One should be careful to build up a business relationship with only one technology provider and not to consider other alternative sources for technology. The decision on the specific technology source will be done later in the process.

4.11. Apply Management and/or Statistical Techniques To Narrow Down the Possible Alternatives (11)

Once the lists of alternative technologies and technology sources are generated the possibilities are often very resource intensive when evaluating all individually. Systematic approaches can then be applied and statistical techniques used to narrow down the list.

4.12. Evaluate and Develop Domestic Capabilities Needed for Technology Utilization (12-16)

Any technology needs support. Whether in the form of energy provision, information management, maintenance, expansion, adoption, or supplying needed inputs, it plays a very important role in determining to what extend the technology can be utilized. The LDC should evaluate its ability to fulfil these supportive tasks and plan accordingly.

Cross-hierarchical communication between corporate and executive management must occur. Technology space maps, also known as S-L-H-Maps (Space, Lifecycle, and Hierarchical map), is a tool used to communicate complex technical concepts in a simple manner to corporate (financial) managers. This tool is also very useful for a country/company to determine their capabilities, needs, and weaknesses. A brief description of the Technology space map and its application in the technological need determination will be given below.

A technology space map is a collection of two-dimensional matrixes, one for each component of the “Technology Triangle” (people, tools, and knowledge). This collection of two-dimensional matrixes form a three dimensional cube. For clear and simpler

representation two-dimensional S-L-H-Maps are used. An example of a S-L-H-Map is given in Figure 4.4.

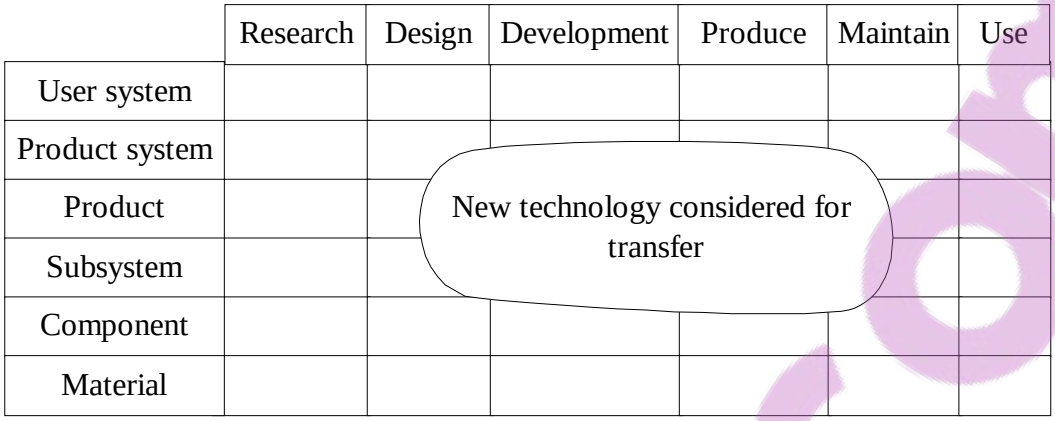


Figure 4.4. Transferred technology's planned utilization area on a S-L-H-Map (Space Map)

On the horizontal axes the system life cycle is subdivided into subdivisions. The Vertical axes indicate the system hierarchy. Through evaluation of the technology in each hierarchical level and in each phase of its life cycle, the LDC should plan and identify the utilization capabilities and plot them on the S-L-H-Map. In order to determine the needed supports that must be vested within a country to enable them to fully utilize the new technology, they should first position their planned utilization area on the space-map.

The LDC must be able to support the transferred technology on two sides namely the positions exactly to the left and to the bottom of the technology. These areas can be identified as a class 1 and a class 2 support for the new technology respectively as indicated in Figure 4.5. The Class 1 support is a support that the technology needs earlier in the life cycle phases in the same hierarchical level as the one in which the company is planning on utilizing it. This support can be in any component of the "technology triangle" (described in Appendix A of the technology transfer model). A class 2 support is a supplier on lower hierarchical levels at the same phase in the life cycle.

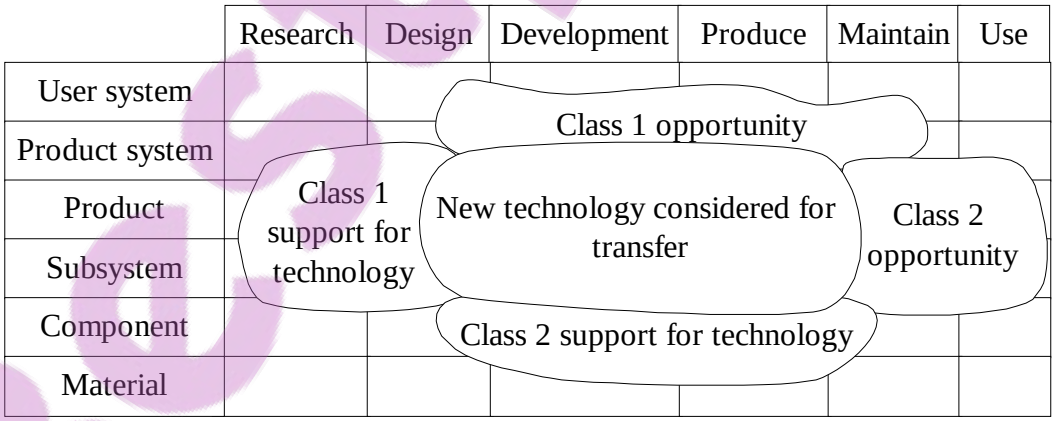


Figure 4.5. Transferred Technology's needs and opportunities on a S-L-H-Map (Space Map)

The LDC should identify limitations on aspects that the country have insufficient capabilities and develop them if possible in a reasonable time span. If not possible a capability development plan should be generated and followed before the country/company is ready to participate in technology transfers, or the LDC will only become increasingly dependant on MNCs. If most of the needs, but not all, can be fulfilled by the LDC it should seek for a partner to supply the support infrastructure.

The new technology can in its turn enable the company to operate as a support to other technologies/firms in two ways. The customer can be a class 1 client where the transferred technology will be appearing in the position of a class 2 supporting unit, or the client can be of class 2 in which case action will be conducted as a class 1 supporting unit. The class 1 and class 2 clients are opportunities for the receiving company (LDC) in the technology transfer process when exploiting the transferred technology. Caution must however be taken to prevent these opportunities to make the LDC too enthusiastic and optimistic. Neglecting the shortcomings in fulfilling the needed support functions for the new technology is a vital mistake, which is often made.

4.13. Choose a Technology And a Technology Source (17 - 24)

4.13.1. Evaluate Identified Technologies' Hardware And Software in Terms of Ease of Adoption, Ability of LDC to Modify and Develop Its Own Technology (17)

As the LDCs embark on a mission to transfer and develop technology, the humanistic and behavioural aspects of such decisions need to be evaluated. There may be different types of technologies able to satisfy aspects such as ease of adoption and ability of LDC to modify and develop its own technology. They should be evaluated and decisions made based on how well a particular technology is able to satisfy these criteria. In the case of technology transfer to LDCs they should evaluate the possible technologies carefully to find an appropriate technology. The focus should be on a search for technology that will best satisfy needs, maximise social welfare, allocate limited resources wisely, and do all of this whilst minimising the LDC’s dependency on the MNC. Essentially, technology transfer to LDCs should be evaluated on its long-term merits by both the transferor and the transferee.

Quality of technology should also be evaluated not solely on the basis of finished products and services but also on the environmental impact [7] and its ability to satisfy the mission of the LDCs.

4.13.2. Establish Input/Output Relationships and Apply the AHP to Obtain Normalized Weights (18)

Technologies are always dependant on other supportive technologies and have an interfacing relationship with other technologies on the same level of the technological hierarchy. It is necessary to establish the input-output relationships between different technologies since resources cannot be allocated in terms of priority when interdependence exists. This can be done through the use of an input-output-matrix as discussed in the section: “How to transfer technology”.

4.13.3. Rank Technologies by Priorities Using AHP (19-21)

A transferred technology should offer opportunities to the LDC to create a sustainable growth culture and should not make the LDC dependant on the MNC. The new technology will always have different properties compared to earlier existing ones. Skills must be developed within the LDC to adapt technology to local conditions and modify/adopt the hardware and software. If this aspect is not easily achievable the LDC should seek for an alternative technology. The local technicians can also play a role in the adaptation process through the setting of all technical specifications to MNC. This can also enable all interfaces with older technologies to function properly.

4.13.4. Achieve Goal Compatibility Between MNC and LDC and Choose a Technology Source (22)

In order to transfer technology successfully between two parties that differ on aspects such as technological capability, need, aspiration, and expectation (as is the case with technology transfer between a MNC and a LDC), both parties need to acknowledge and understand the differences between them and plan accordingly. In order to clearly identify all differences one firstly needs to have another look at the basic definition of technology and evaluate the two situations on the basis thereof (see Appendix A).

The characteristics between the LDC and the MNC of all three components of the technology triangle differ for a specific technology (see Figure 4.6). In order for a technology to be transferred effectively the provider (source) and receiver must be well aware of these differences. The countries will definitely differ for each component when a technology is transferred from a developed country (MNC) to a less developed country (LDC). The focus of this block in the technology transfer model is on all three aspects of the technology triangle. This is indicated in Figure 4.6.

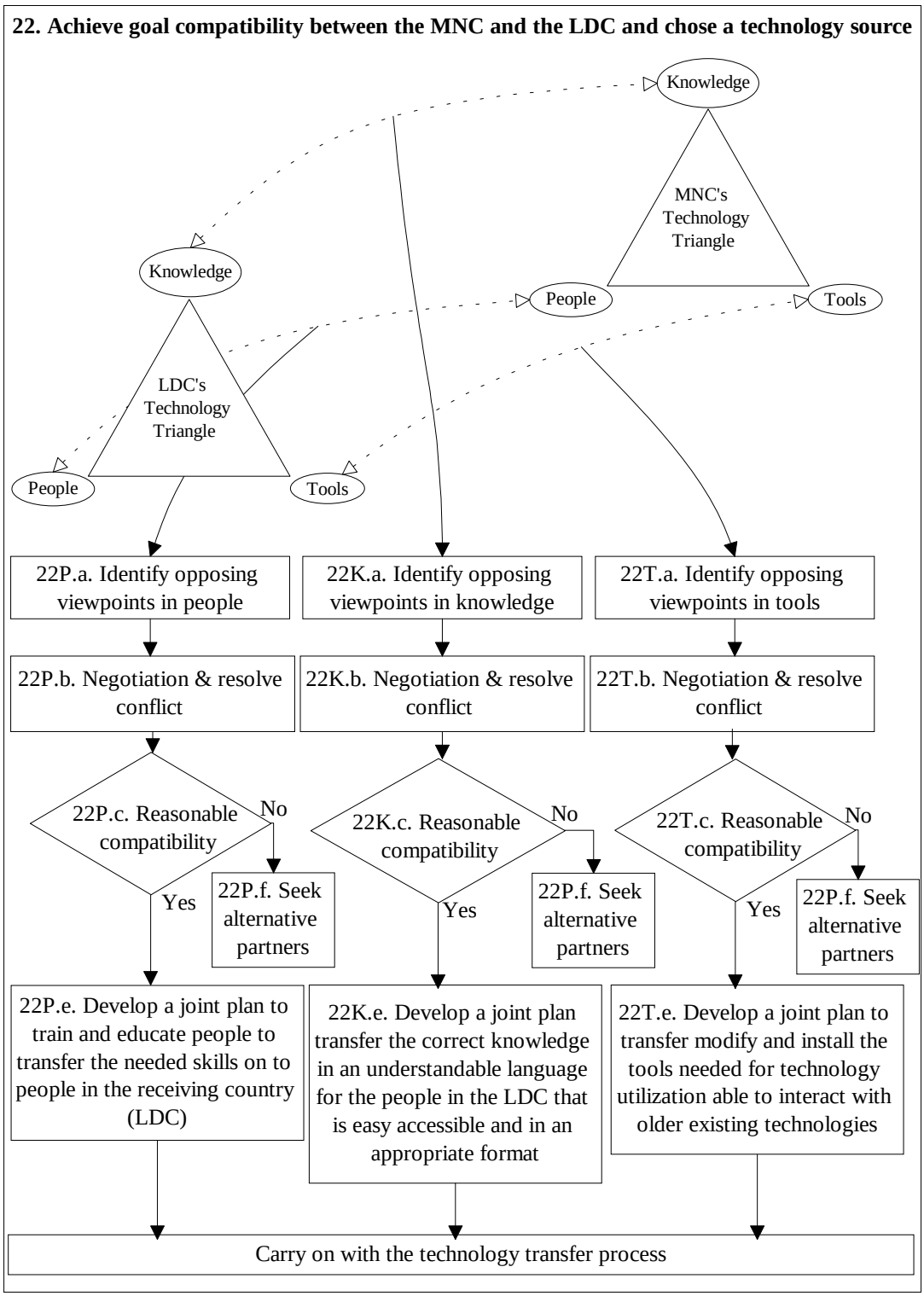


Figure 4.6. Achieve goal compatibility between the MNC and the LDC and choose a technology source

Opposing viewpoints between the objectives of the supplier and the receiver on all three technology components must be identified. The conflicting aspects should be negotiated until there is reasonable compatibility. Without this stage being reached the technology should not be transferred from the specific provider (source) and if this stage cannot be

reached an alternative supplier must be considered. A joint plan should then be developed for each component in the technology triangle in order to make the transfer of appropriate technology possible and viable for both parties.

The Joint Plan

The joint plan should include three aspects. These are:

- A training and educational program for the LDC's people. The MNC have a responsibility towards the LDC to transfer the needed skills that will enable the LDC to utilise the technology fully.

- The transfer of the correct knowledge in an understandable language, easy accessible, and in an appropriate format for the people in the LDC.

- Modification and installation plans for the needed tools in the technology utilization. It is extremely important to be able to integrate this new technology with older existing ones.

4.13.5. Set Guidelines & Standards for Achieving Goals and Evaluating the Technology's Success Based on Defined Needs and Objectives (23)

Setting standards should be done carefully and in conjunction with the goals, mission, and objectives defined. These standards are necessary to ensure that the desired goals and objectives of the LDC are continually being satisfied. If the standards are wrongly defined the stakeholders will have difficulty evaluating them on the basis of reaching their goals or advancing in the right direction.

Both the stated objectives as well as the standards should be continually re-evaluated. The original standards may not be appropriate if there comes a change in the needs/objectives. The focus should be on setting standards verifiable to measure the success or failure of the technology transfer process. Guidelines and standards are a control measure for assessing the success of the technology.

4.13.6. Prioritise All Possible Regions and Choose the Region(s) Which Will Benefit Most From the Technology Application (24, 25)

The borders of the telecommunications playfield are delimited through Icasa regulations. The Telecommunications Act's objectives are to provide telecommunication in the public interest. With new transferred technologies, the success and overall advantage to the public might depend to a large extend on the parameters of the rural community in which the technology will be utilised. The policy maker should therefore acquire updated information on the user's profile through research and market surveys. One mistake that is often made is to outsource this task and not to be involved in it at all. The market survey can be outsourced effectively only if the policy maker plays an active role and are involved continuously. This exercise should be done on a periodic basis and evaluations made on the impact of new technologies on the community.

The author found, as explained in the research postulate, that this is another phase in which the South African telecommunication companies seems to be failing.

Once the regions are identified and prioritised the technology can be transferred from the most desirable source. Considerable attention should be given to joint plans developed in block 22 of the technology transfer model, and the focus steered on transferring all three technology-definition-aspects accordingly.

4.14. Develop Appropriate Educational and Training Systems (26)

Education plays a vital role in the utilisation success of telecommunication technologies. Educational policies need to be tailored to meet requirements of technology acquisition, adaptation, and development. With effective training and educational systems, the LDCs are better able to improve and modify technology to suit their needs [7]. In the absence of appropriate educational systems, LDCs will continue to be largely dependant on the transferor to supply the right labour force, to carry on technological innovations, and to engage in research and development [7].

Poor education and training limit socio-economic growth. The educational and training programs must however be focused on addressing needs and problems of a LDC, and how these may be solved through technology. Programs like on-the-job training, in-house training, seminars, and tuition reimbursements plans are often carried out to keep the workers abreast of technological changes.

A joint plan between transferor and transferee should include education and training of the local work force. Change can only be managed through appropriate education, training, and awareness development programs. The appropriate educational programs are furthermore needed to create an effective pool of managers.

4.15. Install and Implement Technology, Inform users, & Implement It Gradually (27)

Another problem that cannot be neglected is the one expected in the research postulate where the rural communities are not always adequately informed about the use of and advantages that the technology holds. Considerable time and resources should be allocated towards solving this problem.

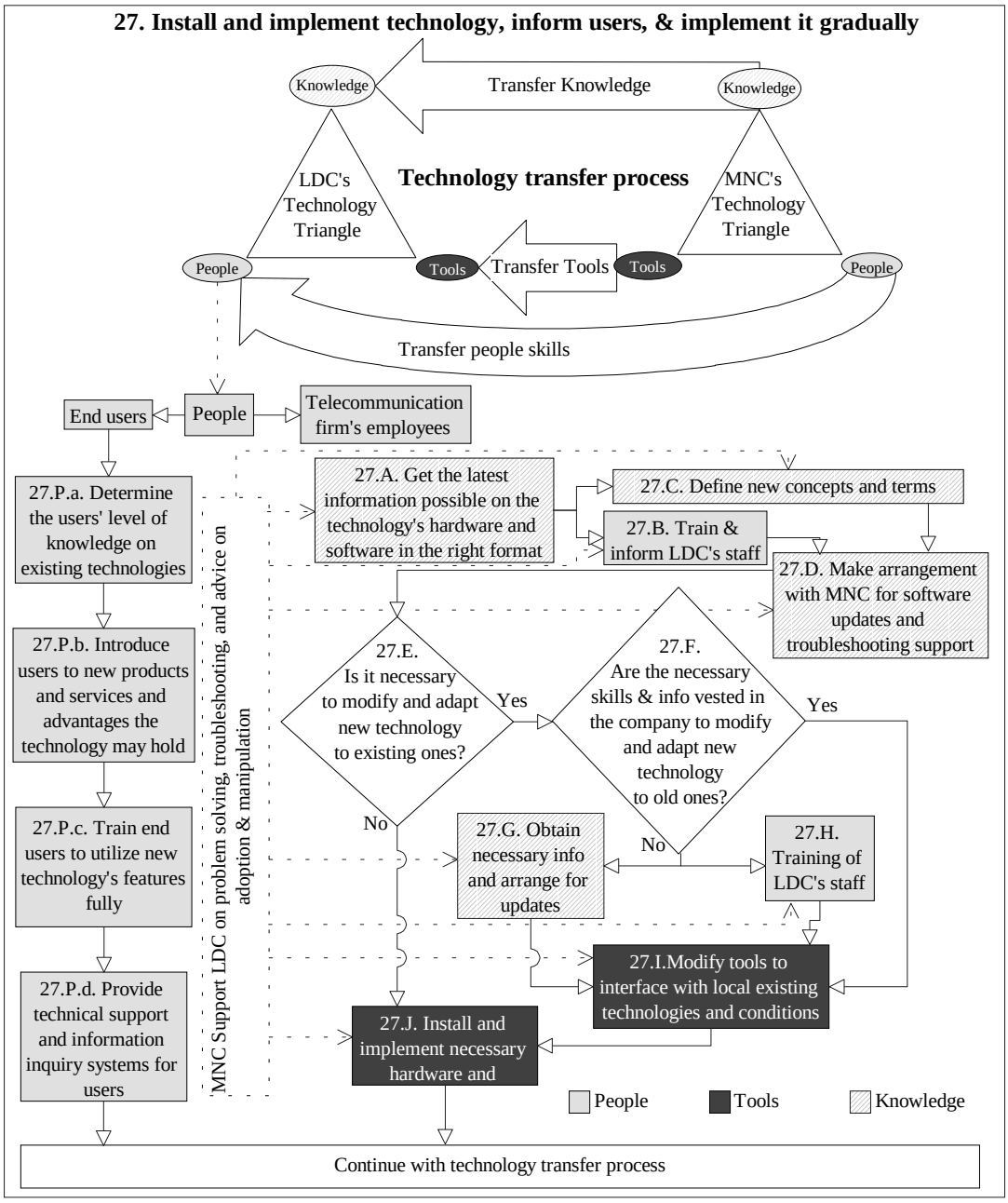


Figure 4.7. Install and implement technology, inform users, & implement it gradually

Informing rural communities can be done through a systematic four step approach (see Figure 4.7 left column) involving:

- Determine the users' level of knowledge on existing technologies (27.P.a.)
- Introduce users to new products, services and advantages the technology may hold (27.P.b.)
- Train end users to utilize new technology's features fully (27.P.c.)
- Provide technical support and information inquiry systems for users (27.P.d.)

Installing and implementing the technology is another crucial block in the technology transfer model, which include sub-procedures of informing end-users and implementing the technology gradually. This sub-process is once again related to the three elements of the "technology triangle" and the filling effects used in the blocks shows the distinction as indicated at the right lower corner of Figure 4.7.

One should obtain the latest information possible on the technology's hardware and software. This should be in an appropriate language and in the right format (17.A.). The MNC should be involved in the training and informing process of the LDC's staff (27.B.). The better the level of the LDC's personnel's knowledge on the new technology, the better the chances are that the LDC would be able to modify the technology to interface with local conditions and existing technologies and even to develop or improve technologies in the future. This is a very important aspect in determining the ability of the LDC to become independent of MNCs. The local staff should be familiar with new concepts and terms (27.C.) before they would be able to communicate effectively with the MNC.

The LDC should further arrange with the MNC (27.D.) on obtaining software updates and troubleshooting support. This will enable maximum utilisation and facilitate future adaptation of new technologies to interface with the current transferred technology. The question that needs answering is whether the new technology needs to be modified and adapted to existing ones and to what extend this should be done (27.E.). The next step should be to obtain necessary skills, and then to adapt/modify the information of this new technology (27.F, 27.G, 27.H.). This brings the process to a point where tools are modified to interface with local existing technologies and conditions (27.I.) actually being installed and implemented (27.J.)

4.16. Conduct Technological/Need Assessments and Forecasts (28)

An important element in the technology transfer process is the capability to perform systematic technological forecasting. Maintaining a logbook for the purpose of technology forecasting is often an effective way of doing data collection.
Several authors have presented useful techniques, such as technological progress functions (S-curves), trend extrapolation, the Delphi method, and scenario development. The reader is referred to Wheelwright and Makridakis [44] for further information on this topic specific.

4.17. Evaluate Transferred Technology (29-36)

The technology evaluation process is one where the stakeholders continuously determine whether the transferred technology is still meeting the set standards to achieve the wanted

outcome. A situation might rise where the transferred technology is not fulfilling needs any more. This might be caused by one of two reasons (29, 30).

Firstly, the technology might become unsuited for solving current development problems. In the case where the technology is no longer suitable for solving unchanged objectives of the LDC, a new technology must be either developed (if possible) or considered for transfer, which will restart the whole technology transfer process again.

Secondly, the objectives can change over time as the needs are connected to the dynamic human factor. This calls for a re-evaluation of the objectives and the needs of the LDC (31). Once new needs, goals, objectives, expectations, aspirations, strengths, and weaknesses are all defined the transferred technology needs evaluation. The stakeholders need to determine whether the transferred technology can be modified to suit the new needs (32). If this is not viable the LDC should develop a new technology or transfer a technology to suit these newly defined needs in which case they restart the technology transfer process.

If however it is possible to adjust/modify the transferred technology to meet new standards an impact analysis (33) should be performed on aspects concerning the end-user. Depending on the outcome of the impact analysis the company should inform end-users on modification and its impact on the existing technologies, services, and products. The users must be informed on all changes in the use of existing technology (34). The technology modification should now be implemented gradually (35). Block 36 suggests the periodic review of the technology to ensure that the involved technology is the appropriate one to achieve the LDC's/company's development goals.

During this "idle period" the LDC has time and should focus on human resource development and research if possible. This is the only way LDCs will ever be able to generate and develop their own technologies and better their independency status.

5. Research Design

During the research design a number of functions are fulfilled. The research design is a planning phase that determines to a large extent the possible impact of results at the end of the day. The research for this dissertation can be divided into two separate but interdependent research attempts.

1. Research was conducted with corporate personnel at telecommunication firms of South Africa (Telkom, Vodacom, and MTN). This part of the research was done through questionnaires and interviews. The questionnaires are included for completeness as Appendix E (MTN Questionnaire), Appendix F (Vodacom Questionnaire), and Appendix G (Telkom Questionnaire). The collected data was integrated into the analysis of Chapter 6. An information gathering exercise was done on background information for all three companies and was described in Chapter 2. The formal research design process was not followed for the first part of the research because the research targets (telecommunication companies: Telkom, Vodacom, and MTN) were already defined with one representative from each, selected to represent the whole company in each interview. The author apologizes for information on MTN being limited in some instances. The reason therefore was that MTN provided incomplete cooperation.

2. Research was conducted in a rural area to determine the current telecommunication technology utilization situation in South Africa's underdeveloped areas. The rural region research furthermore served as an evaluation of the needs and a gathering on information about the rural citizen's expectations and aspirations. For this part a systematic research design process was followed which includes:

   - Postulate
   - Sample survey design:
   - Taking precautions to assure reliability of the collected data

5.1. Postulate

A research postulate was set on the hand of the technology transfer model described in chapter 4. A number of postulates were defined beforehand to do an analysis on telecommunication technology transfer and find problems that exist in the processes the industry use. Four postulates were formed. These are:

5.1.1. Level of education

Hypothesis: "Rural communities in South Africa are poorly educated and the situation is hindering technology utilisation." Without proper education the rural regions will always stay dependant on developed areas and sustainable development will stay a distant fairytale never to be realized. This is an area to which, not only the government should grant more attention and allocate more resources, but also one where the telecommunication industry should get more actively involved. The use of high-tech equipment can never clearly be explained to uneducated people. Telecommunication offers a number of advantages apart from a medium to keep in contact socially with friends and relatives. Without adequate

education, people will never be able to grasp the opportunities and advantages made available through telecommunication.

5.1.2. Level of knowledge on telecommunication services

Hypothesis: “Service providers are not informing users enough on services, products and advantages.” If people don’t know how to utilize or don’t understand advantages of a certain technology, the technology will never be effectively put to work to solve society’s problems at a reasonable social and economic cost. Only when a rural citizen is aware of the possibilities vested within a technology can needs and aspirations be clearly expressed and defined.

5.1.3. Prioritisation of underserved rural areas

Hypothesis: “A means for prioritisation is needed to assist the telecommunication industry when doing network expansion.” Any kind of rural network expansion is extremely expensive because of the remoteness and geographical profile of such areas. If guidelines can be set to prioritise regions according to differences in telephone use on the basis of specific economic and social characteristics of villagers before doing expansion, the investment can be done more effectively and to a higher level of need satisfaction for both the industry as well as the rural community.

5.1.4. Spending patterns of rural citizens

Hypothesis: “Rural communities spent money insufficiently, and the illiterate’s priorities are incorrectly formed, this aspect limits their ability to make use of telecommunication technology’s advantages.” The rural communities have always had a different perspective about money and the way one should manage funds. People in underdeveloped regions have, for a long time, had no access to telecommunication services and a lifestyle was created where money in household budgets were spent unbalanced in the favour of regular entertainment (including liquor and gambling).

5.2. Sample Survey design

Since observations cost money, a design that provides a precise estimator of the parameter of interest for a fixed sample size yields a savings in cost to the experimenter. The objective of a sample survey is to make an inference about the population of interest based on the information contained in a sample [45]. The purpose of sample survey design is thus to maximize the amount of information for a given cost. The Sample survey design is concerned with the following aspects:

- Division of South Africa into regions
- Selecting the region for the field research
- Information gathering on the selected region
- Selecting a sampling technique
- Determining the sample size using the selected sampling technique.

5.2.1. Division of South Africa into regions

All the information on population density, expenditure, and educational level can be obtained at a magisterial district level. A magisterial district was, at the time of Census ’96, the basic administrative area, as determined by the Department of Justice. Census ‘96 [46] was a process of counting the number of people, living in South Africa during 1996, collecting information about their demographic, social and economic characteristics. The information collected was then processed, analysed and disseminated. South Africa (consisting of nine provinces) was divided into 365 magisterial districts. Existing information is available on a magisterial district level (as indicated in Figure 5.1) and this division was thus also used for dividing South Africa into researchable regions.

Figure 5.1. Map of South Africa divided into magisterial districts

5.2.2. Selecting the region for the field research

For the selection of a region to perform the field research, the rural areas have been prioritised on the bases of a survey done in Costa Rica [12] This criterion have been applied to the underdeveloped areas (regions with no/limited cellphone coverage) in South Africa when considering the coverage maps of MTN and Vodacom (mobile telecommunication service providers). Telkom is able to offer fixed-line telecommunication services anywhere in South Africa and was thus not used as a criterion. A short description of the survey done in Costa Rica [12] follows:

5.2.2.1. Rural Village Public Call Office Benefit Regression Analysis

In a survey done in Costa Rica in 1976 [12], a cross section of sixty-four villages in rural areas was taken and data gathered on public telephone use. The data came from an official government census, rural telephone traffic (collected by the national telecommunications entity), and survey data about individual telephone users compiled by telephone concessionaires.

Several models were specified and statistical regression estimated in which telephone traffic or telephone use variables were used as the dependent variable. It was hypothesized that if differences in telephone use could be explained on the basis of the different economic and social characteristics of the villages, then it would be possible to predict which village, then without service, would benefit most from gaining service. Those villages with a high potential to benefit would then be placed high on a priority list for new telephone investments.

The results of the regressions suggested that Public Call Offices benefits tended to be greater in rural Costa Rica villages possessing one or more of the following characteristics:

1. Per capita village income that is higher than the average of all other villages.

2. Villages with a relatively large population.

3. Villages located far from the major economic, social, and government centre of San Jose.

4. Villages with an educational level above average.

5. Villages were the population tended to cluster more around the site at which the telephone would be located.

These findings were applied to the magisterial districts of South Africa to select a region for field-research. The findings of the Costa Rica survey [12] were used to select an area for the field research. The Costa Rica findings were used as follow:

1. ***Per capita village income***

   Mainly, the following question arouses. Which information to evaluate? Income or expenditure? The Alderman's study (*Combining census and survey data to construct a poverty map of South Africa, Chapter 2* [47]) found that expenditure proved to be a more reliable measure than income in estimating economic well-being. Thus expenditure rather than income per household was used for evaluation.

2. ***Population density***

   For the evaluation of regions on the basis of population density, information from the Statistical department of South Africa (Stats SA) was used.

3. ***Villages located far from the major economic, social, and government centre***

   This criterion could be difficult and very time-consuming on a national level. Thus, the criteria can only be applied when a region is selected on the basis of the other criteria.

4. ***Level of education***

   For the evaluation of regions on the basis of educational level, information from Stats SA was again used.

5. ***Population tending to cluster more around the site at which the telephone would be located***

   This issue only becomes active after the installation of the public telephone and will therefore not be included as an evaluation factor.

5.2.2.2. Cellphone coverage in South Africa

Cellphone coverage is an abstract and also extremely important issue and is dependant on atmospheric conditions, building structures, one's cellphone, topographical, and other factors. Whilst outdoor coverage using a hand held cellphone is generally assured in covered areas, indoor coverage is dependant on the type of building structure. The national cellular coverage maps for Vodacom and MTN are shown in Appendix H (MTN Coverage map) or [48] & Appendix I (Vodacom Coverage map) or [49], [50], and [51].

Hand held phones are usually 2 watt whereas boosters and car phones are usually 5 watt or 8 watt. Whilst 5 watt and 8 watt cellphones should operate in all coverage areas shown, hand held cellphones would operate in more than 90% of the coverage areas indicated [5].

5.2.2.3. Vodacom's Coverage

Vodacom's computer generated coverage map is shown in Appendix I (Vodacom Coverage map) or [49], [50], and [51] as on January 2001. In the blue inland areas (within South Africa) it should be possible to make and receive calls on the Vodacom network. Vodacom also guarantees 45 000 km² offshore coverage.

5.2.2.4. MTN's Coverage

In January 2001, MTN's network covered in excess of 804 905 km2, equating to 66% of South Africa's geographic area, and providing cellular telecommunication access to more than 89% of the population [52]. In addition, some 90% of the coastline is provided with coverage, resulting in 75 000 km2 of service area at sea. The network also allows one to make calls along over 19200km of the national roads. The coverage for MTN is shown as yellow areas in Appendix H (MTN Coverage map) or [48].

5.2.2.5. Actual decision on the area for field research

When one uses the criterion as described above, the Magisterial Districts with the highest scores are Sekhukhuneland and Mokerong in the Northern Province of South Africa. These scores for each magisterial district is indicated in Appendix C. Sekhukhuneland was selected as the district for evaluation because of the geographical size of the district being smaller and thus easier to research. The magisterial district Sekhukhuneland is indicated in Figure 5.2. The relative position of Sekhukhuneland is indicated on the small South African map in the right bottom corner of the figure.

Figure 5.2. Sekhukhuneland in the Northern Province of South Africa

5.2.3. Information gathering on the Magisterial District Sekhukhuneland

Sekhukhuneland is a magisterial district located in the Northern province of South Africa as indicated in Figure 5.2. In Sekhukhuneland, the average household expenditure is R1 399.00. The population of 414790 people consists mainly of 99.09% African or Black people. The other 0.91% of the population in compounded as indicated in Figure 5.3.

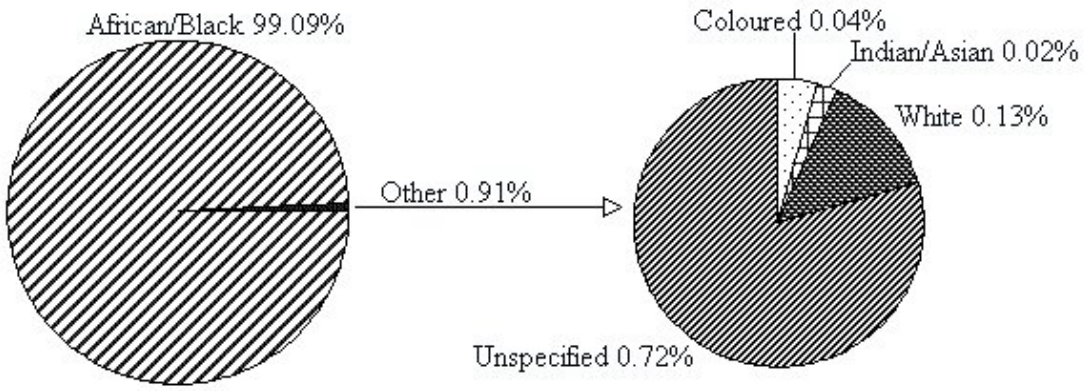


Figure 5.3. The Composition of Sekhukhuneland's 0.81% Non-African or Non-Black Population

During the period of the 6 to 11 February 2000, a serious disaster hit Sekhukhuneland when floods came down on the districts and many where left homeless [53].

Education in Sekhukhuneland

Various educational programs are available in Sekhukhuneland like the Jim Joel Foundation that commissioned JET to evaluate its Sekhukhuneland Educare Project [55]. This evaluation examines the impact of the training of teachers on the teachers' practice and knowledge, their centres, the children and communities.

The people living in Sekhukhuneland have the ability to contribute to the country's economy as two boys showed at the turn of the millennium. Ranti Mothapo beat everybody in South Africa at mathematics [56] when he achieved 100 percent (higher-grade) maths in the 2000 matric examination. Mothapo also scored 99 percent in accounting and 96 percent in physical science, achieved an A for biology and Sepedi and a B for English [56]. Another Sekhukhuneland achiever Mokgome Mogoba's marks showed that he had obtained 100 percent in science, 99 percent in accounting, 98 percent in maths and an A for English. He had Bs for biology and Sepedi.

Writing their matric in rural Sekhukhuneland's St Marks College, these two young men studied by candlelight for at least 10 nights during the examination because of a power failure.

5.2.4. Selecting a sampling technique

5.2.4.1. Sampling Techniques

The probability theory can reduce the chances of getting a non-representative sample and permit precise estimation in the likelihood that a sample differs from the population by a given amount. Probability samples furthermore enables one to calculate sampling error. Sampling error is the extent to which the values of the sample differ from the population from which it was drawn.

Many types of probability samples exist like simple random sampling, systematic sampling, area sampling, and stratified sampling [45]. For the purpose of the project: A

Model for Telecommunication Technology Transfer to the Rural Sector of South Africa, simple random sampling is an adequate sampling technique.

5.2.4.2. Sample size

Selecting a sample size should be done in such a manner that it represents the population from which it was drawn. A larger sample is more representative than a smaller one but deciding on an appropriate sampling size is unfortunately more complicated than this. There are five factors that influence the selection of the sample size. These factors are shown in Figure 5.4 and briefly discussed below.

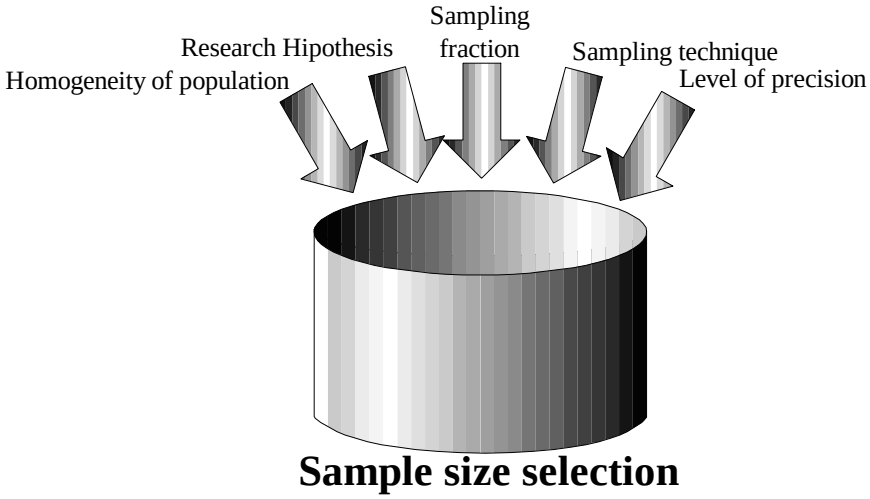


Figure 5.4. Influential factors when considering sample size selection

5.2.4.3. Research Hypotheses

A sufficient number of cases need examining for a specific research hypothesis. For example: A situation where 3 variables with 3 values each exist will have 27 possibilities in a cross tabulation form. Each possibility needs a minimum of cases (e.g. 100 cases generally considered as the bare minimum in the literature) for proper testing [45].

5.2.4.4. Level of Precision

The level of precision (the level of sampling error) one is willing to accept in a research is an important factor, which influences the sample size. In reality, the sample statistic is known but the population statistic is unknown. The question then is how the difference between the sample and the population value can be assessed. To answer this question, the assessment can be done in terms of the likelihood that a sample value differs from the population value. This is done by establishing a confidence interval, i.e. range in which it is fairly certain that the population value lies between [45].

Precision is directly related to the sample size so that larger samples are more precise. The probability theory enables one to calculate the sample size that would be required to achieve a given level of precision [45]. The level of precision thus enables one to say that for a specific research, chances are X percent that if all elements in the population have

been surveyed using the same questionnaire, the finding would differ from these poll research findings no more than Y percentage points in either direction [57].

5.2.4.5. Population Homogeneity

The variability of the population to be samples is also a factor, which impacts on sample size. Unfortunately, most of the time researchers know little about the homogeneity of the target population. The probability theory accounts for this problem by assuming maximum variability in the population (i.e. 50% variability) [45]. Such estimates are of course conservative and will result in sample sizes larger than strictly needed for a given level of precision.

5.2.4.6. Sampling Fraction

Sampling fraction is the number of elements in the sample relative to the number of elements in the population (n/N). This can however be ignored with large populations [45] such as the one used for the project: *A Model for Telecommunication Technology Transfer to the Rural Sector of South Africa* as the sample fraction will constitute, by definition, only a small fraction of the population. For large samples, the research hypothesis, sampling error, and population homogeneity are the mostly sufficient to determine sample size.

5.2.4.7. Sampling Technique

Some sampling techniques like simple random sampling, area sampling, or stratified sampling can be used to conduct the sample size determination. Simple random sampling or stratified sampling are mostly used and will briefly be defined:

> ***Simple random sampling*** [45]***:*** If a sample of size n is drawn from a population of size N in such a way that every possible sample of size n has the same chance of being selected, the sampling procedure is called simple random sampling. The sampling thus contained is called a simple random sample.
>
> ***Stratified sampling*** [45]***:*** A stratified random sample is one obtained by separating the population elements into non-overlapping groups, called strata, and then selecting a simple random sample from each stratum.

Simple random sampling, the basic sampling design, often provides good estimates of population quantities at low cost. For the purpose of the survey in Sekhukhuneland for a *Telecommunication Technology Transfer Model*, there is very little data available on the different groups (e.g. urban and rural) existing within the district. When stratified sampling wants to be used, it is almost impossible to assure that a non-overlapping groups are defined because of the freedom all elements in the population have to move around.

It is however almost impossible (and economically totally non-viable) to conduct a perfect Simple random sample with a population of 414790 people when considering that very little information is available about permanent addresses of many. Thus, *An approximate* s*imple random sampling* technique will be used. This implies a convenience sample that is taken with the aim to cover the whole spectrum of people when considering their level of

education. The evaluation of the sample size was done using the *Simple random Sample* technique.

5.2.5. Determining the sample size using Simple random sampling

At some point in the design of the survey, a decision about the size of the sample to be selected from the population must be made. Simple random sampling was used to determine the sample size here. The implications of such a decision are obvious. Observations cost money. Hence if the sample size is too large, time and talent are wasted. Conversely, if the number observations included in the sample is too small, we have brought inadequate information for the time and effort expended and have again been wasteful.

The number of observations needed to estimate a population mean μ with a bound on the error of estimation of magnitude B is found by setting two standard deviations of the estimator $\bar{y}$, equal to B and solving this expression for n. Thus, we must solve:

$$2\sqrt{V(\bar{y})} = B \tag{5.1}$$

With

$$V(\bar{y}) = \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right) \tag{5.2}$$

Hence, the sample size required to estimate μ with a bound on the error of estimation B is:

$$n = \frac{N\sigma^2}{(N-1)D + \sigma^2} \tag{5.3}$$

where

$$D = \frac{B^2}{4} \tag{5.4}$$

If N is large (N>1000), as is the case for this survey, the (N-1) can be replaced by N in the denominator of equation 5.3. This approximation will then yield:

$$n = \frac{4N\sigma^2}{NB^2 + 4\sigma^2} \tag{5.5}$$

Solving for n in a practical situation presents a problem because the population variance σ^2 is unknown. A method for guessing a value of variance σ^2 when very little prior information is available is needed. Based on the normal approximation theory, an acceptable procedure to follow is to estimate the standard deviation by taking one sixth of the range, that is the difference between the largest and the smallest values [57].

$$\hat{\sigma} = \frac{Maximumvalue - Minimumvalue}{6} \tag{5.6}$$

For this survey, the level of education plays the most important role in determining the area that will benefit most from a new telecommunication system. Another important aspects namely income (expenditure) is correlated to level of education when one assumes that racial discrimination does not play an active role. Education was thus used as the main

criterion for evaluation here. The problem that needs to be evaluated here can be seen as follows:

It is necessary to establish the average level of education μ for the population of the magisterial district Sekhukhuneland in the Northern Province of South Africa. To estimate the level of education variance σ^2, it is known that the population's level of education can be measured in years of educational experience. A certain amount of years are then associated with each qualification as indicated in Table 5. 1**.**

Highest qualification	Associated years of education
Grade 0	1 year
Grade 1	2 years
Grade 2	3 years
Grade 3	4 years
Grade 4	5 years
Grade 5	6 years
Grade 6	7 years
Grade 7	8 years
Grade 8	9 years
Grade 9	10 years
Grade 10	11 years
Grade 11	12 years

Highest qualification	Associated years of education
Less than matric & certificate/dip	13 years
Grade 12 or Matric only	13 years
Matric & certificate	14 years
Matric & diploma	15 years
Matric & Bachelors degree	16 years
Matric & Bachelors & diploma (dip)	17 years
Matric & Bachelors & honours	18 years
Matric & Masters degree	20 years
Matric & Doctors degree	24 years
Matric & Other qualification	14 years
Unspecified	no education

Table 5. 1. Years of education associated with qualifications

When the population's level of education lie within a range from 0 to 24 years, an estimate of σ^2, the population's level of education variance can be made through the use of equation 5.6 repeated here for convenience:

$$\hat{\sigma} = \frac{Maximumvalue - Minimumvalue}{6}$$

Thus:

$$\hat{\sigma} = \frac{24 - 0}{6}$$

$$\hat{\sigma} = 4$$

There are N = 414790 elements (people) in the population of Sekhukhuneland. The sample size can now be calculated to estimate μ with a bound on the error of estimation B = 6months or ½ a year (2.083% thus 97.917% accurate) through the use of equation 5.5 again repeated here for convenience:

$$n = \frac{4N\sigma^2}{NB^2 + 4\sigma^2}$$

$$n = \frac{4 \times 414790 \times 4^2}{(414790 \times 0.5^2) + (4 \times 4^2)}$$

n = 255.84 ~ 256

5.3. Taking precautions to assure reliability of the collected data

As Sekhukhuneland is a typical rural region of South Africa and perfect Random Sampling is almost impossible one should try to obtain results as accurate as possible. The level of education was used as the most important variable and also to calculate the sample size earlier. The level of education for the population of Sekhukhuneland is therefore shown in Table 5. 2. To make a representative survey of Sekhukhuneland, the number of questionnaires that needs to be filled in should correlate to Stats SA's data to the same percentages for citizens in each group. For this purpose the needed questionnaires at each level of education are indicated in the right column of Table 5. 2.

Education			
Maximum educational level obtained	**Number of people**	**% Of Sekhukhuneland's population**	**Questionnaires needed**
No schooling	138204	38.62%	99
Grade 0	191	0.05%	0
Grade 1	1409	0.39%	1
Grade 2	2862	0.80%	2
Grade 3	11411	3.19%	8
Grade 4	21751	6.08%	16
Grade 5	19882	5.56%	14
Grade 6	18819	5.26%	13
Grade 7	23173	6.48%	17
Grade 8	22979	6.42%	16
Grade 9	18088	5.05%	13
Grade 10	19539	5.46%	14
Grade 11	21629	6.04%	15
Less than matric & certif./dip	802	0.22%	1
Matric only	20688	5.78%	15
Matric & certificate	305	0.09%	0
Matric & diploma	3109	0.87%	2
Matric & Bachelors degree	432	0.12%	0
Matric & Bachelors & diploma	84	0.02%	0
Matric & Bachelors & honours	18	0.01%	0
Matric & Masters degree	11	0.00%	0
Matric & Doctors degree	10	0.00%	0
Matric & Other qualification	232	0.06%	0
Unspecified	12225	3.42%	9

Table 5. 2. The level of education of the population of Sekhukhuneland

Questionnaires were created to test certain aspects of rural South Africa on the basis of the Telecommunication Technology Transfer Model defined in Chapter 4. An example of the questionnaire is shown in Appendix D. Qualified personnel asked the questions and interpreters were often used. The interviewer then also filled in the answers by the

interviewee on the questionnaire. The research was done using 258 questionnaires over a period of 10 days during July 2001.

6. ANALYSIS

The telecommunication industry (both fixed-line and mobile) has been analysed according to the Telecommunication Technology Transfer Model of Chapter 4. Through such an evaluation one can identify problems in the industry and determine weather the technology transfer model is attempting to solve them. The industry will now be described on the hand of blocks/ combinations of blocks within the model below.

6.1. Identification of Stakeholders or Interest Groups (1)

The survey done in Sekhukhuneland showed that the rural citizen was never included in the group of stakeholders. It is a very dangerous mistake to make when one wants to be certain that new technologies will be accepted when implemented and installed.

In this regard, Telkom is making use of stakeholders meeting (technical, Commercial, and Marketing) and a Technology Application Review Committee. The company is however not involving the traditional (rural community) in new designs, technology choices, and implementation. Telkom does allow inputs from the rural community through demand forecasting, marketing, sales, and international trends. Vodacom, on the other hand, doesn't involve the traditional (rural) community in new designs, technology, choices, and implementation at all.

The survey done in Sekhukhuneland provided a profile on the rural citizen. Such information can be very useful in determining the need for modifications of transferred technologies to interface with the local conditions. The profile is given below:

6.1.1. Advantages of Telecommunication to Rural Citizens

In the survey conducted in Sekhukhuneland the rural residents were asked to identify advantages telecommunication technology might have to offer them from their point of view. It is extremely important to know and understand the view of the rural community when technology is transferred. The following aspects were identified as advantages according to the rural community of Sekhukhuneland:

- A telephone is mostly used to socialize and keep in touch with friends/relatives living at hard-to-reach places saving travelling expenses.

- Telephones can, together with newspapers, be used as a job-seeking medium. The limiting factor accompanying this advantage is the illiteracy of many unemployed residents (only 22.48% of unemployed citizens can read and write). Telephones can however still provide up-to-date information on vacancies from relatives living in the cities without the former delay when waiting for a visit.

- In emergencies and illness, telephones can be used to summon police, ambulance or other needed services. Unfortunately two factors hinder people to benefit from this advantage. Firstly, the police are sometimes very slow to respond to the needs of the community and they are currently making use of a private "crime fighting body" called Mapogo. In the case of illness, a taxi is more often used to deliver the ill and injured to a hospital. Explaining to an ambulance your exact position in a township with limited records on street-names makes this request puzzling and

time-consuming. Telkom is also making use of aerial-photos and GPS systems (Global Positioning Systems) to locate houses for system maintenance. Secondly, the biggest problem limiting this advantage is the fact that many (12%) has been in an emergency situation before but couldn't use a telephone due to the fact that they where unaware of the contact telephone numbers to dial (As shown later in this chapter).

- Cellphones are often used in the self-employed situation (painters, plumbers, truck drivers ext.) for finding supplies and tendering for new contracts.

- It is time- and cost effective to order and do inquiries on availability of stock by telephone rather than travelling. It is especially helpful for "tuckshop" (Rural Café) owners.

- At nighttimes the safety in the rural community is unsure and residents can use a telephone instead of travelling, usually on foot, to contact relatives or friends.

- People can use a telephone to find items, which aren't randomly available (e.g. motorcar spares, electrical appliances, medicine, ext.). These items can be ordered through relatives working in big cities and be delivered with a visit.

- Through telephones, scholars can obtain information on tertiary study bursaries not always available in rural secondary schools. This advantage opens up a whole new world of opportunities to the rural community's youth. The fact that very little information is available at secondary schools makes this use almost a necessity.

- With a telephone at home, parents can be called from school when problems arise and can also be better informed on the progress of the child.

- Cellphones can be used in the case of a car-breakdown. Leaving a motorcar unattended (while seeking for a public telephone) is not advised because the car, or parts thereof, might get stolen.

6.1.2. Employment and Income

South Africa has a high unemployment rate and Sekhukhuneland is no exception. Figure 6.1 shows that 47% of the population is unemployed (according to research results).

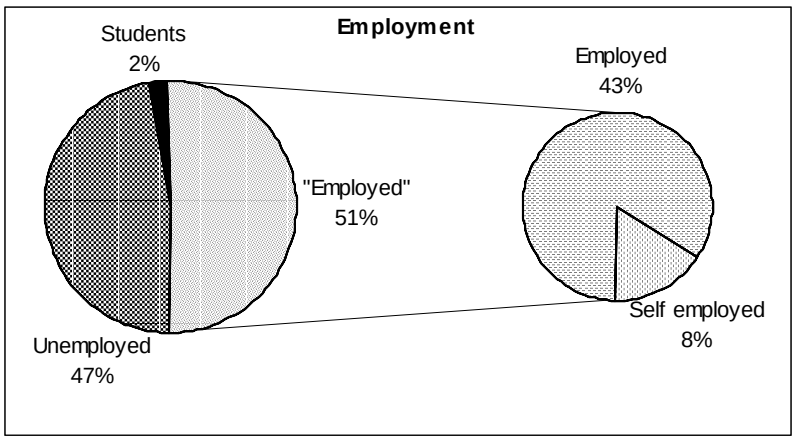


Figure 6.1. The employment status of Sekhukhuneland's population

Of the 51% employed citizens 8% had to put their entrepreneurial skills to work and create self-employment. This means that only 43% of the population were able to obtain official jobs at nearby farms, mines, or business centres. The opportunities for a career in Sekhukhuneland are limited and many move to bigger cities in search of better job opportunities. This causes a per-capita-income distribution shown in Figure 6.2.

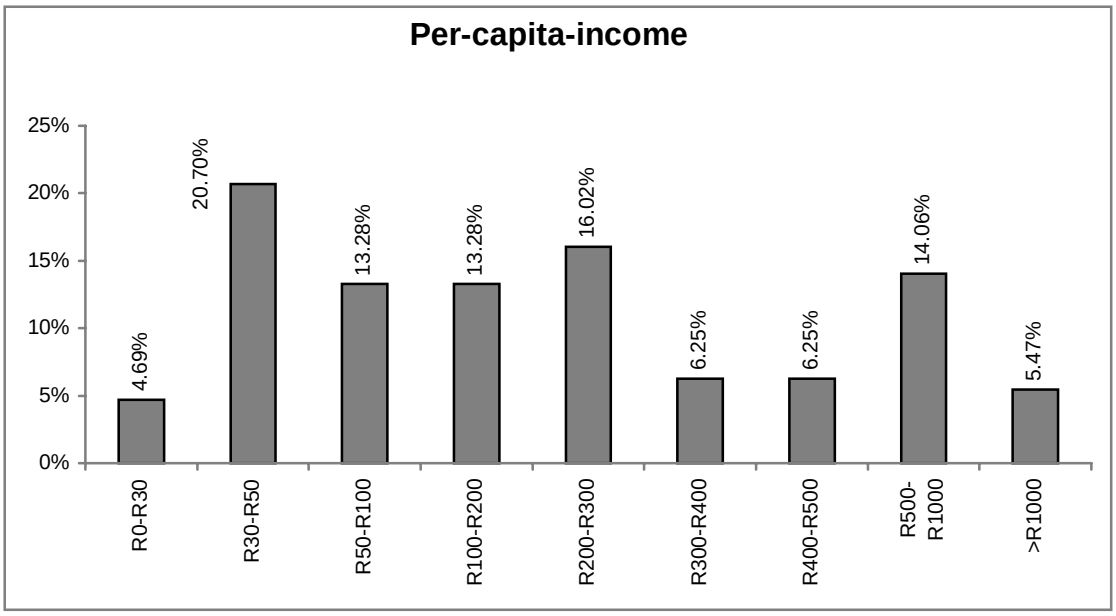


Figure 6.2. The per-capita-income distribution in Sekhukhuneland

The average household income in Sekhukhuneland is R1492.61 per month. Households have an average size of 6 people that brings the average per-capita-income to R260.55 per month per person. The size of families is predictable by the social status the community attach to having many children. The author would like to remind the reader that Sekhukhuneland were chosen as a region for research with one of its criteria being high level of household income. Many other rural areas in South Africa have much less to spend each month.

6.1.3. Housing

The type of housing that a person use can definitely play a role in the telecommunication technology used because it is also a shelter for the fixed line telephone device. Although Telkom does not put any restrictions on the type of dwelling, the citizen must have a permanent address. It does however acknowledge the fact that some dwellings impede the installation process.

It is therefore important to know what the population call home. Sekhukhuneland's rural community is still mainly living in informal/shack (40,47%) or traditional (14.97%) dwellings as indicated in Figure 6.3. Thanks to the RDP (Reconstruction and Development Program) program of the government, 33.07% of the population are already living in their own houses together with 8.65% renting a house. The remaining 1.95% is living in backyards, rooms, hostels, and flats while only 1.17% is homeless. The rural roads

infrastructure is totally unsuitable and Telkom is making use of aerial-photos and GPS systems (Global Positioning Systems) to locate houses for system maintenance.

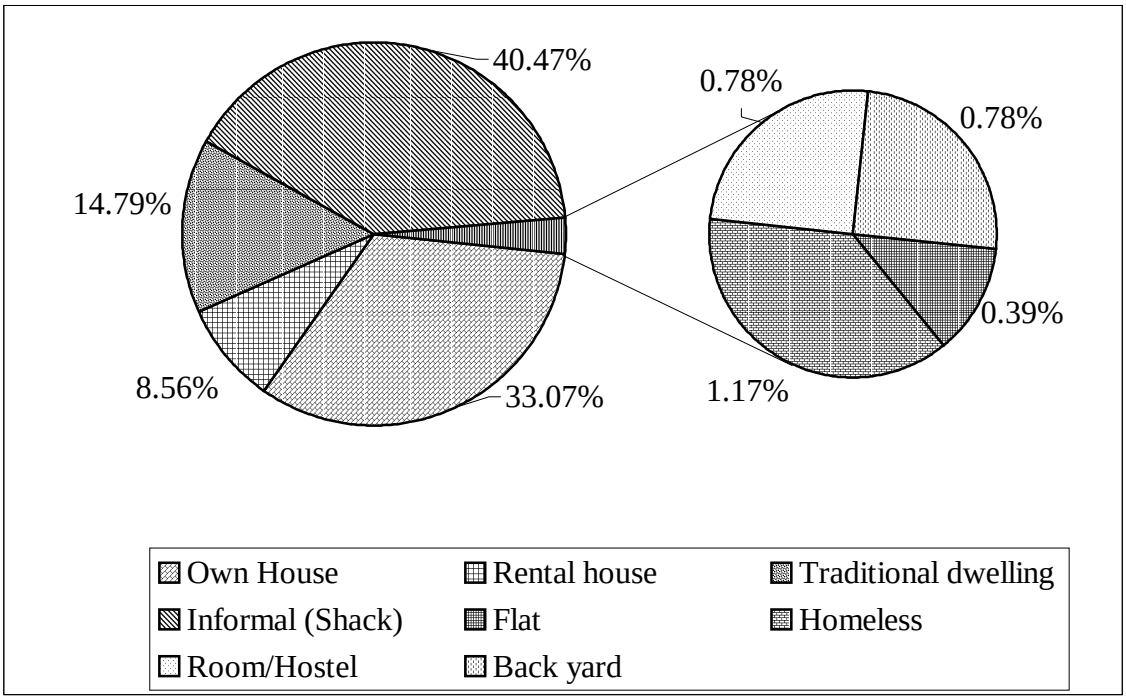


Figure 6.3. Housing in Sekhukhuneland

6.1.4. Level of Education

The level of education together with people's awareness on technology plays the most important role in the technology utilization and it is extremely important that one knows the educational profile of the end user (rural population). The awareness of the population will be dealt with later in this chapter. In Figure 6.4, the population of Sekhukhuneland's educational level is shown. The data collected in the survey correspond with the information collected in the national Census by Stats SA (The Statistical department of South Africa).

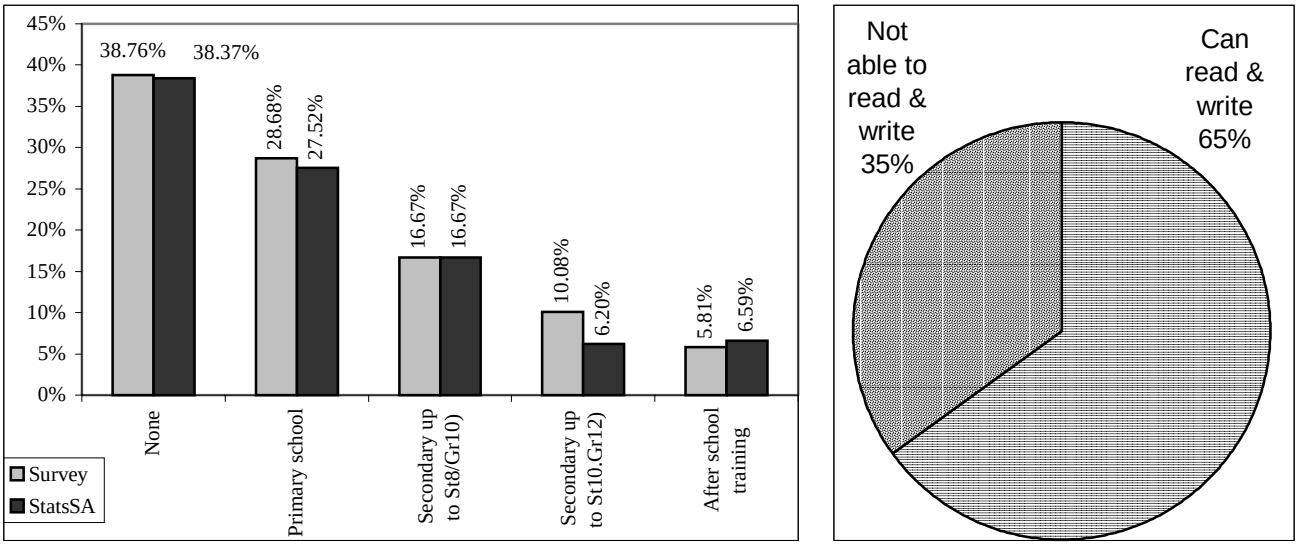


Figure 6.4. The level of education for the people of Sekhukhuneland

A significant proportion (38.76%) of the population have never had only official education. It does however seem that a bit of self education occurs when comparing the number of illiterate people to the number of people being able to read and write (see Figure 6.4). 28.86% of the population have acquired primary school education, 16.67% primary school education up till St8/Gr10, 11.63% primary school education up till St10/Gr12, while only 3.49% of the population have attended any past school studies. The impact that a citizen's level of education has on his or her ability to fully utilize the technology to their advantage will be shown later.

To know the type of person involved, one should always obtain as much information possible about him or her. A general profile of the Sekhukhuneland population is shown in Figure 6.5. Here one can see that more people, almost three times as many, have cellphones (28.29%) than fixed line telephones (10.85%). This is because of a misperception of the price difference for calls and the author will try to explain this phenomenon later during block 30 ("Install and implement technology, inform users, & implement it gradually in chosen regions") in the technology transfer model.

Only 6.59% of the population has ever used a computer. This can be attributed to the fact that many (38.76%) have never been to a school, as well as the fact that many schools have only recently obtained electricity. At home, already 66.28% of the population have electricity but only 4.65% uses a geyser for warm water, 31.01% an oven or an electric stove, 8.91% a microwave oven, and 17.05% for cellphone battery charging. This implies that the greater majority is using electricity only to light up their homes. This might be caused by the low per-capita-income (average of R260.55) of the population and that they simply cannot afford the other electrical appliances and these are still seen as luxuries.

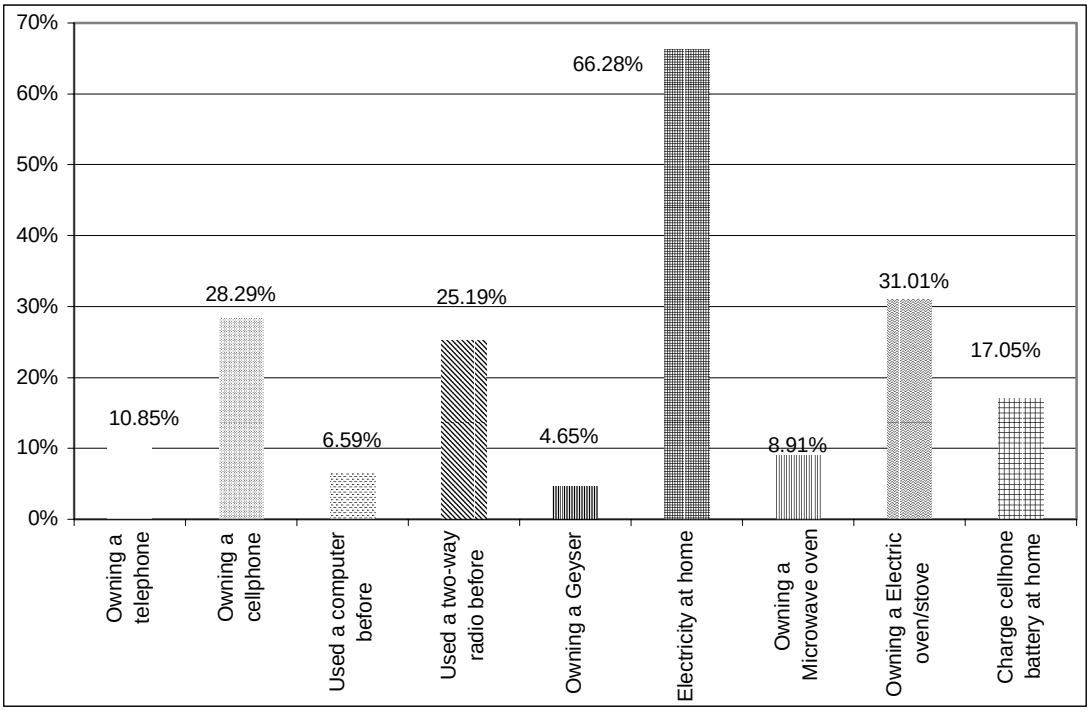


Figure 6.5. A general profile of Sekhukhuneland's population

Most citizens have electricity and because of the fact that some uninformed rural citizens still believe that electricity is needed at home before an application for a personal telephone can be placed. Telephones operate from an independent power source supplied by Telkom and the user doesn't need electricity in the dwelling for a fixed line telephone to be functional. This is but one example of poor customer awareness found in rural South Africa (Sekhukhuneland).

6.2. Identify and Define Development Problem (2)

This function in the technology transfer model is often fulfilled by the regulator, as is the case in South Africa. Actions to solve the defined development problem are then controlled through governmental regulations (discussed during block 4 of the technology transfer model "Determine all applicable governmental regulations and also conduct an impact analysis (4)" below).

The government acknowledge the critical importance of access to telecommunication to achieve certain social and economic development goals. Affordable telecommunication services for all, citizens and businesses throughout South Africa, should be the centre of the vision and the purpose of the policy.

The challenge is to get a fine balance between offering basic telecommunication services to underdeveloped areas (both urban and rural) and to furthermore offer a competitive high-level service to fulfil in South Africa's needs for economical growth. The vision should therefore incorporate these two apposing goals in an integrated network.

In 1994 the South African government realized that universal access to telecommunications services was a precondition to social and economic development. They studied the experiences of other countries and took note of the conditions and

preferences of the South African people regarding how best to embark upon a workable and supportable plan to ensure that telecommunications services would eventually become available to all South Africans [22].

A study conducted by SATRA's consultant (ITC Consortium) determined, among other findings, that the current telephony penetration level is sharply skewed towards white households [20] (i.e. only 2% of rural and 29% of urban black households have a dial-tone, while the 85% of white households have telephony). It follows that even when Telkom meets its obligation to roll out 2.6 million lines by the year 2001, 3.3 million of black households' will still remain without telephony [20]. The telecommunications companies in South Africa can make a huge difference in this area and their involvement is briefly discussed below.

Telkom: The Telkom Foundation has been proactively involved in improving the quality of life for South African communities, with a total commitment of R100 million over a five-year period [37]**.** The foundation focuses on education job creation and childcare.

Telecommunity is a program aimed at rural customers consisting of a mobile van-type vehicle that travels to rural communities offering customers the opportunity to order service, pay bills, and carry out most other service activities making Telkom accessible to more and more customers throughout South Africa. Telkom invested R10 million for installing first-time telephone lines free to 20 248 disadvantaged communities [37].

Telkom donated R25 million [37] to five disadvantaged universities for science and technology projects. They are: The University of the Western Cape, The University of the North, MEDUNSA, The University of Durban-Westville, and The University of Fort Hare. Over the past three years the Telkom Centre for Learning (CFL) has delivered more than 2,5 million learning days of training [58] to Telkom employees. During the periods 1997 to 2000, a total of 74,48% of these employees have been black, and have received training in the areas of management and life skills, technology, marketing and call centres.

Telkom's PrepaidFone enables customers on a tight budget to have absolute control of their expenditure on telephone charges. 471000 people [59] have signed up for PrepaidFone since 1998 when Telkom became the first communications service provider in the world to offer a prepaid phone service on a fixed network. A CallAnswer (a voicemail facility) service to PrepaidFone users is also available. PrepaidFone has got the following advantages for the rural area user [60]:

- The user makes all calls without being at risk of spending more than he/she can afford.
- No credit-check on application.
- Vouchers available at affordable prices: R35, R60, R100 and R150 [60].
- Optional PIN (Personal Identification Number) code is available for complete security.
- Service is available in Zulu, Xhosa, Sesotho, Afrikaans and English.

Vodacom: Knott-Craig had a vision for Vodacom to be dedicated on providing millions of previously disadvantaged South Africans with meaningful and affordable access to telephones for the first time. When Vodacom's license was issued, one of the conditions also was that cellular telephony would have to address the infrastructure imbalance

between the developed- and rural (traditional) sector of South Africa. Vodacom Community Services worked hard in disadvantaged communities to enable many people to make their first phone call ever. Members of the community were franchised and trained to become phone shop operators. The R100 million [22] community services project aimed to deploy 22 000 phones by mid 1999 and subsidize phone calls at half the commercial rate. Hospitals in townships became more effectively managed.

Vodacom had jointly developed a new community phone unit with Siemens and Psitek called a Sigi. These individual units pre-loaded with airtime paid for by the operator, would take Community Services another step closer to putting a phone service in place on every street corner in townships. Sterkspruit is a sprawling city with a population of 350 000, eleven schools and hundreds of businesses [22]. Until October 1996 Sterkspruit did not have one single telephone. The closest phone was 40 minutes away in the town of Zastron. In November 1996 Vodacom's phone shop operators in Sterkspruit, bought 50 Sigi's [22]. These have been deployed at taxi ranks, spaza shops and the Empinisweni hospital.

Vodacom community services put disadvantaged people in touch with their century, through its pilot telecentre project launched at a rural school in the Free State town of Senekal. Ithabiseng High School accommodates 2 073 children and 53 teachers [22]. The school has only six classrooms with electric power and operates from 07h00 to 21h00. The principal's office is the only one equipped with a phone line and a fax machine. In areas with no access to conventional telephone lines the Sigi-Pro can connect to fax machines and computers and then transmit voice and data traffic over Vodacom's cellular network. By upgrading many community phone shops into Telecentres similar to the one launched in Senekal, thousands of disadvantaged people will be able to walk into
Vodacom Telecentres to surf the net and communicate via e-mail and faxes.

In August 1999, Vodacom made cellular accessible to anyone who can afford R10 per month with the launch of R120 [22] Vodago Incomer voucher, dropping the entry level to its lowest level ever and making cellular accessible to low-income users. This product provides the subscriber with a one-year airtime window for free incoming calls and free calls to voicemail and emergency services.

MTN: In rural areas, MTN installed 7 500 GSM pre-paid community payphones [23], which include our unique, world first “hands-free” feature. Through this reliable and affordable service, people in these areas are able to enjoy improved social and economic well-being, as well as enhanced safety and security. MTN is currently pioneering a more advanced community phone set to revolutionize payment methods in business.

With MTN being the first South African network to launch the prepaid option in 1996, cellular access was put within the reach of a wide sector of the population, including the disadvantaged rural communities [24].

MTN is pro-active and dynamic, channelling funds and resources into the development of previously disadvantaged areas. As a result, 300 communities [38] throughout South Africa have been connected. The heavily subsidized Community Payphones Program has also created jobs, skills training, economic empowerment and social upliftment.

Cell C: Cell C has pledged to spend at least R1 billion [33] on contracts aimed at supporting black empowerment, employment equity, and human-resources development and training commitments. The pledge forms part of the Saudi-backed operator's license on receiving its operating license on June 26 [32] from the Independent Communications Authority of South Africa (Icasa). In terms of the pledge, Cell C and Icasa are to develop a joint economic plan. Cell C is also obliged to develop a customer service code of conduct which would be approved by Icasa, and to put measures in place to ensure that it interacts with customers in their preferred official languages [33]. The new Cell C network has also promised to provide remote or under-serviced areas with home zone services at discounted tariffs.

6.3. Define Needs (Short- and Long-term), Based on Cultural Value System, Availability of Resources, Socio-Economic Factors, etc. (3)

The telecommunications industry is not making use of the Need Capability matrix to determine the needs of the rural communities. The situation can still be improved by incorporating this method and actively evaluate their customers' desires. Almost no work is being done by the telecommunications industry to determine the capability of the rural community. Knowledge on the capability might enable the industry to make use of local unemployed citizens in the installation and implementation process.

Vodacom's phone-shop operators have formed an association to represent rural citizens and Vodacom has regular contact with the rural community in order to ascertain the needs of their rural customers. Vodacom does however also rely on the fact that the equipment in Vodacom's phone-shops are manufactured by Siemens and they undertake their own research and development to develop equipment most suited to the rural user.

Telkom is trying to determine the rural citizen's needs through demand forecasting, marketing, sales, and international trends. Telkom does however also try to provide all services everywhere and rural technologies therefore follow the normal network evolution.

6.4. Determine All Applicable Governmental Regulations and Conduct Impact Analysis (4)

In this section the fixed line telecommunication situation will be briefly discussed because of adequate information being available for an example of how governmental regulations can influence and function as a control mechanism in the industry.

Telkom feels that penalties should be in line with deployment cost and that it's targets should be in line with reality. Targets are not always balanced and not realistic to deployment and demand.

Regulator Influencing the South African Fixed-line Telecommunication Industry:

Since the promulgation of the Telecommunications Act of 1996, Telkom has faced significant challenges. Through Black Economic Empowerment strategies and the outsourcing of non-telecommunications infrastructure, Telkom has contributed to the government's achievements related to job creation, debt reduction, an improved public service and reduced inequalities in the communications industry [22]. According to Victor Moche (Group Executive) many of the accomplishments would not have been achieved

without the legislative framework that has been in place to guide the telecommunications sector.

A number of targets were spelt out in the license issued to Telkom in May 1997, which gives the Company the exclusive right to provide public switched telecommunications services (PSTS) for a five-year period. Penalties become payable should Telkom fail to achieve any of the 16 license targets [61].

In its first year of the exclusivity period Telkom achieved five of its 10 demanding service targets and all six of its network rollout targets, as specified in the license. The R3, 3 million [61] paid to SATRA (South African Telecommunications Regulatory Authority) in respect of the five targets it missed was calculated according to the formulas contained in the license. A comprehensive report on their performance during this period, the 1997/98 financial-year, was submitted to SATRA on 30 June 1998. This report included the penalty calculation of R3, 3 million, which Telkom paid in its 1998/99 financial year.

A penalty of R3, 3 million sounds alarming to any business no matter the size. Telkom however is in a position where the installation of a DECT system to provide service to a rural citizen costs in the region of R4 000 to R20 000 per customer depending on the geographical profile of the area. Many rural areas have a high churn-rate where clients often only pay between R80 – R120 before churn or don't pay anything and get disconnected after 3 months. When one considers the fact that during the 1997/98 financial-year Telkom connected over 20 000 rural user using DETC technology (between R 80 million and R400 million) the penalty of R3.3 million is not one of Telkom's biggest concerns. Telkom does however actively try to fulfil governmental regulations in fear of not being granted a fixed line telecommunication license if failing to meet the target proposed.

Telkom has submitted a report on its performance during the second year of its license, the 1998/99 financial-year. This was handed over to SATRA on July 1 1999 and showed a marked improvement in respect of service quality. Eight of the 10 service-quality targets having been exceeded. The two service targets not attained were missed by a very small margin, so although penalties will be payable, the overall amount will be significantly lower than for 1997/98. In addition, Telkom again achieved all six network-targets. At the same time it added, on average, over 1 370 new customers to its network every day [61].

The two targets the Company missed in 1998/99 related to the percentage of business and residential faults cleared in less than 48 hours, where it achieved an 85 percent and 82 percent rating respectively [61]. The two major contributing factors for having missed targets over the past two years include cable theft and a historical lack of adequate network maintenance.

The government then embarked on the path referred to as Phase I [22]. A good measuring stick, to assess how far South Africa has come in reaching its Phase I objectives, is to look at accomplishments pursuant to the list of Telkom objectives put forth in section 2 of the 1996 Telecommunications Act. The act has the following purpose:

6.4.1. Promote Universal and Affordable Provision of Telecommunication Services (a)

During the past three years, the Universal Service Agency (USA) has launched 75 [22] Telecentres, one each in the following Provinces: Northern Cape, Eastern Cape, Free State, Northern Provinces, Kwa Zulu Natal and Northwest. Telecentres provide a means and location for people residing in under-serviced villages to learn about and use telecommunications products and services.

The Act established the Universal Service Fund (USF) to provide Telkom with funds to extend its public switched telecommunication services to areas and communities, not being served.

The first three years of Telkom's transformation has resulted in a net increase of 1.6 million access lines [22]. Of these, just over 1 million lines were installed in under-serviced areas. In addition, residents located in 2 091 villages and 8,911 priority customers (hospitals, schools, and libraries) were provided with service for the very first time. In order to provide access to the hundreds of thousands of South Africans on the go, Telkom provided 86 107 public pay telephones.

6.4.2. Promote Provision of a Wide Range Telecommunication Services in the Interest of Economic Growth and Development of the Republic (b)

Telkom's license required it to upgrade its network from analogue facilities to digital technology by the year 2001 and has converted more than 98.7% of its access lines to digital technology by the end of March 2000. Digital technology now enables Telkom to provide products and services to customers including: CallAnswer, ForwardCall, WaitingCall, ConferenceCall, Direct-a-Call, IdentiCall, HomeFree, SpeedCall, Direct-a-Call, Billing for Caller Pays Paging, VoiceLink, and Prepaid Phone.

6.4.3. Make Progress Towards Universal Provision of Telecommunication Services (c)

At the end of Telkom's third year of exclusivity (2000), the Company has made substantial progress towards the provision of universal telecommunication services (see Table 6.1.) [22].

End of 2000 cumulative number of lines installed and targeted			
	Cumulative number of lines	**Target number**	**Exceeding target by**
New subscriber lines	1540176	1316466	223710
Public payphones	86107	68247	17860
Underdeveloped areas lines	998612	915863	82749
Villages provided with telephones for first time	2038	1710	328
Priority customers	13748	10820	2928

Table 6.1. Cumulative number of installed Telkom lined with targets (2000)

6.4.4. Encourage Investment and Innovation in Telecommunications Industry (d)

Restructuring of South Africa's telecommunications sector in 1996 brought about the Strategic Equity Partner (SEP in May 1997), a consortium of SBC & Telekom Malaysia, for Telkom. Along with an influx of technological expertise, the SEP invested over R5,7 billion for a 30% stake in Telkom, representing the largest direct foreign investment in post-apartheid SA [22]. The SEP brought with it human investment in the form of 75 full-time experts with continuous knowledge transfer. Over the last 3 years, from April 1997 to March 2000, Telkom has invested over R25 billion in new telecommunications infrastructure and services whilst continuing to upgrade the existing infrastructure. Telkom will continue to invest in new telecommunications infrastructure and services at an annual rate of R10 billion.

Telkom's infrastructure investment, along with implementation of digital technology, is providing customers with new and innovative ways to communicate and conduct business. Some examples include: Private Networks, Internet, Valued Added Network Services, Satellite Services, Cellular, and Radio Trunking.

6.4.5. Encourage Development of a Competitive and Effective Telecommunications Manufacturing and Supply Sector (e)

The PBX and corporate networking market in South Africa is extremely competitive. Numerous manufacturers and suppliers are competing in the market, such as: Siemens, Samsung, Teleboss, TR Services, Teleplus, Phillips, Plessey, Alcatel, Nortel Meridian, OmniLink, Dimension Data, Transtel, and Blue Sky [22].

6.4.6. Promote Development of Telecommunication Services, Which are Responsive to Needs of Users and Consumers (f)

Telkom established separate sales and employee organizations to address the needs of residents, small-to-medium sized businesses, corporate and public pay telephone customers has enabled Telkom to focus on the unique needs of each segment. Since the implementation of the Act, Telkom has introduced the following new and/or enhanced services for residences: CallAnswer, Caller Pays Paging, Smart Access, Remanufactured Telephone, International FreeCall, Prepaid phone Service, Voicelink, Automated Collect Call, Symphony Cordless Phone, WorldCall, Call Catcher, Traveler Services, SmartMoves, Welcome Kit, Telkommunity, and Dial Inn. Services for Businesses include: Large PABX, PRIMENET, Equant Services, Telkom/AT&T Frame Relay Service, QuickConnect, Analogue NTU, Channelised E1, CyberTrade, ISDN Advice of Charge, FaxAnswer, TeleVoting, and Sonnet [22].

6.4.7. Ensure That, In Relation To Provision of Telecommunication Services, The Needs of Local Communities and Areas are Duly Taken Into Account (g)

Telkom appreciates the diversity of many cultures in South Africa and has embarked on a program to consult with local leaders prior to entering an underserved area for the first time. Traditional leaders, mayors and/or local councillors are consulted, information and education forums are held for future customers, and site locations are discussed for public

pay phones and DECT mast sites [37]. In 1998 Telkom began a customer service campaign to conduct business in all eleven South African official languages.

The reader is furthermore referred to the Involvement and Assistance to Previously Under-served Rural Communities

6.4.8. Ensure that Needs of Disabled Persons Are Taken Into Account in the Provision of Telecommunication Services (h)

Telkom together with an advisory group identified categories of people for whom special provision must be made like: persons in wheelchairs, poor-sighted and blind persons, hard of hearing and deaf persons, aged and frail persons, and illiterate persons [22].

6.4.9. Ensure Compliance With Accepted Technical Standards in Provision and Development of Telecommunication Services (i)

6.4.10. Ensure Fair Competition Within Telecommunications Industry (j)

Licenses issued by the Minister and/or The South African Telecommunications Regulatory Authority (SATRA) contains fair trading practices, which should be complied with by the various operators upon issuance.

6.4.11. Promote Stability of Telecommunications Industry (k)

6.4.11.1 Rural telephone quality of service

Telkom is delivering an excellent service in the rural areas of Sekhukhuneland as indicated in Figure 6.6.

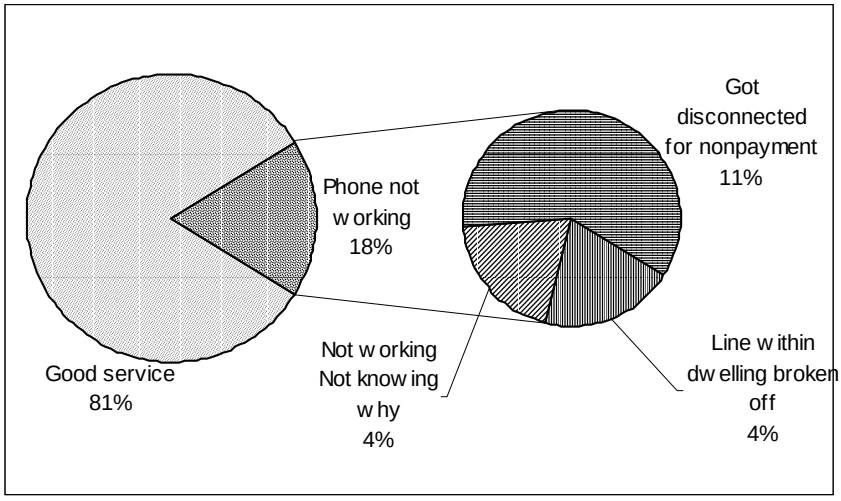


Figure 6.6. The quality of fixed-line telephone service in Sekhukhuneland

If one considers that 11% of the population owning a personal telephone got disconnected for non-payment the remaining 89% can be divided into two groups. One who never had any problems (81%) and the other 8% had problems but because of poor fault recovery awareness hadn't reported the problems yet. The licence target demands that Telkom repair

84% of all reported faults within 48 hours. Telkom is currently exceeding this licence demand. Awareness is one of the biggest problems limiting rural telecommunications as will be shown later. Telkom noted through service quality surveys that many faulty telephones in rural South Africa are cases of improper budgeting by the customer (service being temporarily ended due to overdue accounts) or vandalism on networks (cable, solar panels).

6.4.11.2. Ordering telephones

According to Telkom's statistics 92% of lines are installed within 28 days, and 99% in 120 days, after an order is accepted by Telkom (i.e. Telkom has the necessary infrastructure in place).

The survey done in Sekhukhuneland indicated that 22.87% of the population wanted a telephone but hasn't filled out an official application. They didn't understanding the procedure to follow and the regulations involved when applying for a telephone line. 13.57% have filled out an official application and awaits installation with an average waiting period of 626 days (1 year, 8 months, and 22 days) already.

6.4.12. Encourage Ownership and Control of Telecommunication Services By Persons From Historically Disadvantaged Groups (l)

It is Telkom's policy to promote Black economic empowerment by enabling Black Suppliers to meaningful participation. Telkom furthermore recognizes the previously disadvantaged communities and will provide businesses from such communities' preference in the procuring of goods and services. Over a year-and-a-half, beginning in May 1997, Telkom has started doing business with over 460 black suppliers. During the first 6 months of the fiscal year ending September 1998, Telkom has spent R256 million on emerging black businesses. A further R626 million [22] has been spent on large suppliers with a significant black shareholding.

Management and staff of Telkom are being transformed to reflect the racial and gender make-up of South Africa. People from historically disadvantaged groups are now very much involved in the ownership and control of Telkom. Telkom also hired its first black CEO, Sizwe Nxasana, in March 1998. In 1993, Telkom's Board of Directors consisted of 9 White and 3 Black men [22]. At the end of 2000 the picture looked significantly different. Telkom's Board of Directors consisted of 2 white men, 4 black men, 2 black women, and 2 representatives each respectively for Telekom Malaysia, Labour, and SBC.

Affirmative Action

In November 1993 Telkom negotiated an Affirmative Action Policy and Telkom has made a difference in areas such as race ratio's and gender distribution according to occupational levels.

Employment Equity Act, 1998

The purpose of the Employment Equity Act is to achieve equity in the workplace by promoting, in the first place, equal opportunity and fair treatment in employment through the elimination of unfair discrimination. And secondly, implementing affirmative action

measures to redress the disadvantages in employment experienced by Black people, women and people with disabilities [22], in order to ensure their equitable representation in all occupational categories and levels in the workplace.

6.4.13. Promote Empowerment and Advancement of Women in Telecommunications Industry (m)

Telkom had 13% female managers at the end of December 1999 and women also represented 23% of the total workforce [22]. Women have also been recruited as student engineers and technical bursary students in order to make the technical and engineering functions more representative.

6.4.14. Promote Small, Medium and Micro-Enterprises Within Telecommunications Industry (o)

Telkom applies a strategic intervention principle in the course of conducting its business, which includes advising Black Suppliers prior to tenders being issued in their product category. Large businesses supporting Black Suppliers and implementing acceptable Black Economic Empowerment policies are also given preference [22]. Telkom further tries, where appropriate to split contracts into smaller components, for instance, per region or item to enable Black Suppliers to participate. Telkom goes even further and involves itself through relaxing payment conditions to Black Suppliers by reducing the payment cycle to 10 working days [22], thus assisting them with their cash flow. As part of Telkom's capacity building initiatives some tenders have been set aside for the exclusive participation by Black Suppliers only.

6.5. Define Capabilities That the Company/Country Has in Specific Field (5)

Telkom currently has inter-firm R&D agreements with Tellumat, Dimension data, Plessey, and Siemens to name but a few strengthening their capabilities. These agreements are mostly contractual based.

The Telkom laboratories at Derdepoort Pretoria, consists of two sections [16]. One section is concerned with system evaluation, environmental engineering, and instrument services, while the other is concerned with hardware and software development. These laboratories design and develop telecommunication systems, terminals and related equipment for use by Telkom and other clients. In its R&D, Telkom maintains close contact with universities, technikons and the local industry to ensure the best utilization of resources.

Vodacom’s Joint Economic Development (JED) plan was based on the principles of boosting research and development. Achievements include R&D activities undertaken by Siemens and tertiary education investments of the SUNSAT micro-satellite research programme [63]. The research done by Siemens includes the development of Sigi's (Siemens GSM Telephone Interface), the world's first pre-paid GSM community phone, and vehicle tracking, a unit that can be installed in vehicles for multiple purposes besides tracking.

6.6. Form Mission, Goals and Objectives, Based on Needs, Capabilities, Expectations, Tradeoffs, Priorities and Aspirations (6)

A research project was conducted by MTN on telecentre needs and services in the Northern Province with the support of the International Development Research Centre (IDRC), a Canadian donor organisation. The research project attempted a community based information needs analysis at six telecentre sites in the Northern Province. The research is part of a wider process of developing the telecentre. The aims are: To determine which services are most wanted in rural areas, develop new services that are needed, build support for Telecentres and involve the community more closely in the running thereof, develop a plan that should make the telecentre successful (profitable and contributing to the community), establish a 'learning system' to measure the impact of the telecentre, and adapt it to be more successful.

Rural Citizens Spending Money

If one analyse the spending pattern of rural citizens one can grasp something of what the community needs and to what they would assign a high priority.

Telkom feels that a household with a monthly salary less than R300 cannot afford a personal fixed-line telephone. People are already spending to much as one shouldn't allocate more than 5% of one's monthly income to telecommunication. Currently the rural population of Sekhukhuneland is spending 12.06% of their monthly income on telecommunication (both fixed-line and mobile).

The mobile telecommunications industry is similar with eight in ten mobile phones sold to prepaid cards users such as township youths, market traders, taxi drivers, and street hawkers during 2000 in South Africa. While in Sekhukhuneland the rural citizens are still spending 5.1% of their monthly household income on beer, SAB (South African Breweries), the continents largest conglomerate, believes that beer sales are falling as consumers opt to spend their limited disposable income on calls [2]. This phenomenon also occurs in a wider sense as in Africa half the population survives on less than $2/day, while the average mobile bill is $1.16/day [2].

Rural citizens are spending more of their limited household income on telecommunication but still spending far too much on unproductive activities such as the national lottery. 4.77% of all households' income is being spent on the Lotto in Sekhukhuneland. The DA's (Democratic Alliance) chief spokesperson on trade and industry, Nigel Bruce said "the disgraceful situation of the state lottery monopoly is effectively taxing the poor, enriching the operating company and its foreign shareholders, and failing to disburse funds in any quantity, after a year of trading, to the charities it deprived of the ability to fund themselves". The Department of Trade and Industry Minister Alec Erwin hoped however to pay out R380-million [64] during the 2001 financial year to charities and other deserving institutions from the proceeds of the national lottery.

A problem does however exist that out of about 4 500 applications for funding received, only 215 applications for funding came from charities, 3 sports and recreation, and 6 for arts, culture and national heritage [65]. The national lottery operator, Uthingo, has also expressed concern at the prospect of over R70-million [66] in unclaimed prize money going back to it because winners have so far failed to come forward.

6.7. Define Standards to Choose & Evaluate Technology (7)

Standards needs to be defined to measure the impact transferred technologies have on South Africa's situation. The choice of a standard is crucial and should be considered carefully. Using quality of life as an indicator for South Africa seems to be an option but the best standard will differ for each application and a combination of several standards might be most appropriate.

In rural South Africa productivity is low and the transfer of technology may not easily improve it. Automation and high technology is not always the answer to the declining productivity in the case of LDCs. Living standard in rural areas re poor, malnutrition persists, and diseases like malaria and AIDS incapacitate the working force leading to the decline in productivity [7]. To improve productivity, the quality of life in the South African rural areas needs to be improved.

According to ASSA (the Actuarial Society of South Africa) 5,3 million people [67] were infected with HIV in South Africa during 2000, 236 000 were living with Aids, 139 000 people were estimated to have died of Aids (26 percent of all deaths in 2000), and about 64 000 babies were infected by their mothers. The ASSA's Aids and demographic models [68] called ASSA2000 projects that without change in behaviour or medical interventions, a further five million people can be expected to die of Aids over the next 10 years.

US ambassador to the United Nations (UN) Food and Agriculture Organisation (FAO), George McGovern, was furthermore concerned about the productivity of agriculture in Africa. He said that about 7 million farm-workers died in Africa of HIV/Aids since 1985 and more than two million children would be orphans at the end of the current decade [69].

6.8. Search and Generate a List of Different Potential Types of Technologies Which Will Best Satisfy LDC's Needs Given Its Capabilities, Maximizing Social Welfare, and Allocating Its Limited Resources Wisely & Conduct Technology Assessment to Determine the Future of Technology and Future Technologies (8 & 9)

Vodafone Group, the biggest wireless company in the world, is a shareholder in Vodacom. Generation of a list of alternative technologies to solve a problem will naturally start with its shareholder but Vodacom will consider any technology, even unavailable from Vodafone, as long as it is suitable to the South African situation and needs.

Methods used by MTN are unfortunately unavailable.

Telkom is making use of three different approaches to find available technologies before deciding on an alternative namely: RFI - Request For Information, RFP - Request For Proposal, and Technology Scan.

RFI - Request For Information

A RFI was sent out to technology suppliers when a certain problem arose (which must be solve internally in the company) to try and find a solution. This is not always the case that a new technology needs to be transferred to solve the problem but certain suppliers might include their new software updates of even new technologies in a possible solution.

RFP - Request For Proposal
In a RFP the suppliers are requested to put in a tender to solve the problem as an external contractor. A RFI can also be transformed into a RFP if no possible solutions to a problem can be found to be implemented by the company's own workforce.

Technology Scan
In a Technology scan, employees are actively searching for all possible technologies to solve a certain problem or fulfil a certain need. The Technology Scan is done using any medium (personal interviews, electronic mail, mail and telegrams, Internet, magazines, official documents, and other publications) possible.

Telkom do technology forecast in the form of continuous evaluation of international trends, technology lifespan trends, and cost recovery period calculations.

6.9. Identify Sources for Technology Transfer / Apply Management and/or Statistical Techniques to Narrow Down Possible Alternatives (10 & 11)

Telkom is making use of a full bidding process where no specific preference is given to any country or region.

Because of the fact that Vodacom is partly owned by Vodafone Group, this relationship naturally means that there is technology transfer between Vodacom and it's shareholder. Generally, Vodacom will use technology from any source as long as it is suitable to the South African situation and needs.

6.10. Evaluate and Develop Domestic Capabilities Needed for Technology Utilization (12-16)

Many LDCs such as South Africa is in a position where design and development occur in conceptual designs and setting compatible specifications to interface the new technology with the current infrastructure. Telkom is performing limited in-house research and development but they do have human capabilities to specify strict specifications assuring effective functioning of the technology in the bigger system. If the necessary manpower is not vested within the company partnerships can be formed with the utmost care being taken. If this coalition is not managed wisely it could worsen the dependency status of the LDC at a very high social and economical cost.

According to COSATU (Congress of South African Trade Unions) the government strategy of introducing foreign business management into state-owned enterprises as was done with Coleman Andrews at SAA (South African Airways) reflected a blind belief in the efficiency, effectiveness, and principles of private-sector management [70]. Andrews' contract leaded to corruption, and benefited only the rich minority, whilst doing nothing for the poor majority. This was also done at a very high economical cost. Public Enterprises Minister Jeff Radebe confirmed in the National Assembly that Coleman Andrews' salary package had been more than R200 million [70] during his two-and-a-half years as SAA chief executive. Radebe also said that nine expatriate consultants hired by Andrews earned a further R118 million [70].

This is a clear indication of what effects a coalition, when not managed wisely, can have on a LDC. The dependency status of South Africa was not improved through these examples and it was also done at a very high social and economical cost.

6.11. Select Technology and Technology Source (17 - 24)

Possible alternative technology sources were identified in block 10 and 11. Telkom Selection is based on international standards, cost, Black Economic empowerment, local content etc. In some cases (Radio technologies) the world operates in 3 regions where compatibility is the decisive parameter. In such cases only equipment compatible with Telkom's current technologies are evaluated which falls in line with Europe. If any other region makes equipment for South Africa, Telkom is willing to consider procuring from there as well.

Vodacom considers any technology, which will suit local conditions but specific preference is however given to technologies available to be supplier by their shareholder Vodafone. Vodacom is willing to use any technology from any source as long as it is suitable to the South African situation and needs. Information in this regard concerning MTN is unfortunately unavailable.

Both Telkom and Vodacom exclaim the fact that technologies should be first evaluated (both hardware and software) in terms of ease of adoption and the ability of South Africa to modify and develop its own technologies (block 17 of the technology transfer model). This also accounts for compatibility requirements that need to be fulfilled (18).

It does however sometimes happen that regulations influence the technology selection process. The DECT (Digital Enhanced Cordless Telecommunications) and TDMA (Time Division Multiple Access) systems aren't profitable to Telkom in connecting rural areas. This is because of the characteristics of rural areas such as: low population density and low-income groups normally with low profile call behaviour. The regulator does however force Telkom to conduct rural development and network extension for well-considered reasons. Unfortunately DECT and TDMA systems are the only technologies available to solve rural telecommunications infrastructural problems presently, and Telkom is currently also making use of it in Sekhukhuneland.

Telkom is evaluating transferred technologies on a quarterly or an annual basis depending on the type of technology involved (23). The guidelines and standards used have been defined previously in the transfer process.

6.12. Prioritise All Possible Regions and Choose Region(s) Which Will Benefit Most From Technology Application & Transfer Technology From Most Desirable Source (24, 25)

Service providers should aim at the right areas when doing network expansion or any technology applications in any region for the first time. This is often the case with technology application in rural areas and South Africa is no exception. Before the new and appropriate technology is actually transferred from the most desirable source (25), South Africa should determine the region where the technology will be installed and utilized. A few relationships were tested during the survey done in Sekhukhuneland for pre-installation prioritisation of regions. It was hypothesized that if differences in telephone

use could be explained on the basis of the different economic and social characteristics of the villagers, then it would be possible to predict which region, then without service, would benefit most from gaining service. Villages with a high potential to benefit should then be placed high on a priority list for new rural network investments. The results are shown below:

6.12.1. The Role of the Rural Citizen's Level of Education in Telecommunication Utilization

One of the research postulates was to examine the relationship between educational level of the end-user and personal telecommunication. The author will attempt to show that the end-user at a higher educational level will benefit more from a means to telecommunication than one at a lower level of education. It will also be shown that the need for a telephone or a cellphone increase with an increase in level of education.

When comparing level of education with a need for a means to telecommunication in Sekhukhuneland, a Chi-Square probability value of 0.0001 was found (high statistical significance). Figure 6.7 shows the distribution of the need for a means to telecommunication (defined here as a personal telephone/cellphone) for the population of Sekhukhuneland at different educational levels.

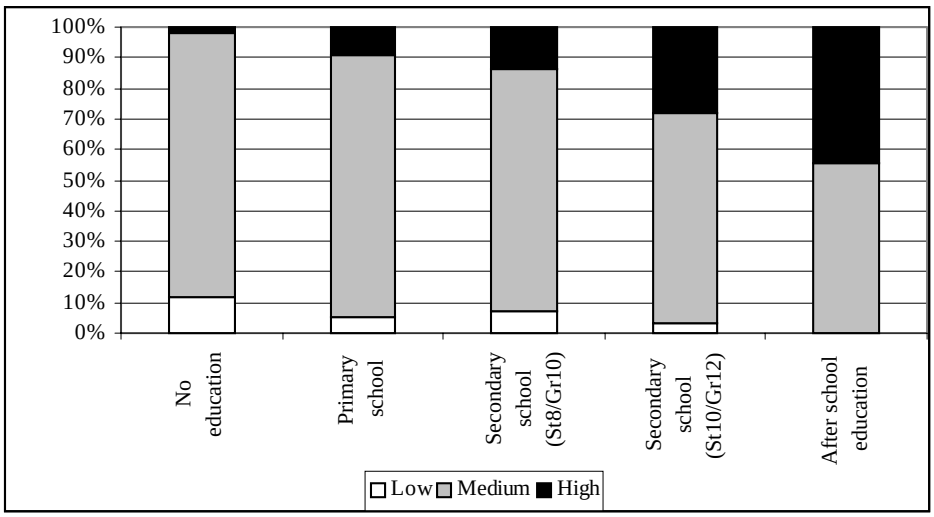


Figure 6.7. The need for telecommunication (fixed-line or mobile) for people at different levels of educational

It is clearly shown how the magnitude of the need increases with an increased level of education. The black indication-bars shows a high need for telecommunication while the grey and white bars show medium and low needs respectively. As the level of education increases so to does the proportion of people regarding telecommunication as highly needed (black indication-bars). The proportion of the population at each level, regarding the need for telecommunication as low, decreases with an increase in level of education. The people with a medium need for a means to telecommunication decrease as they get better literate to the advantage of the people with a high need for telecommunication.

This relationship can be stressed even further when looking at the percentage of people at each educational level, which prefer to have no telecommunication. Individuals whishing for no personal telephone/cellphone are shown in Figure 6.8.

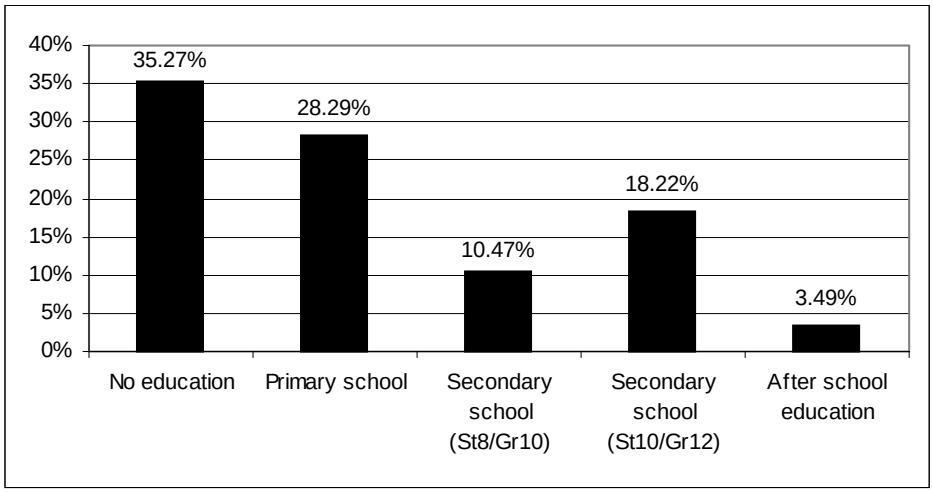


Figure 6.8. Percentage of the population whishing for no personal telecommunication at all

A Chi-Square value of 0.0485 shows statistic significance between the educational level and the characteristic of an individual disliking the idea of owning a personal telephone or cellphone. The percentage of people wanting neither a telephone nor a cellphone decreases from 35.27%, of the population who has never attended any formal education, to 3.49% of people with after school qualifications.

When one examines the educational level of people owning a telephone or a cellphone one finds the same indication. Figure 6.9 shows Sekhukhuneland's distribution of the population owning a telephone/cellphone in each of the different educational level groups.

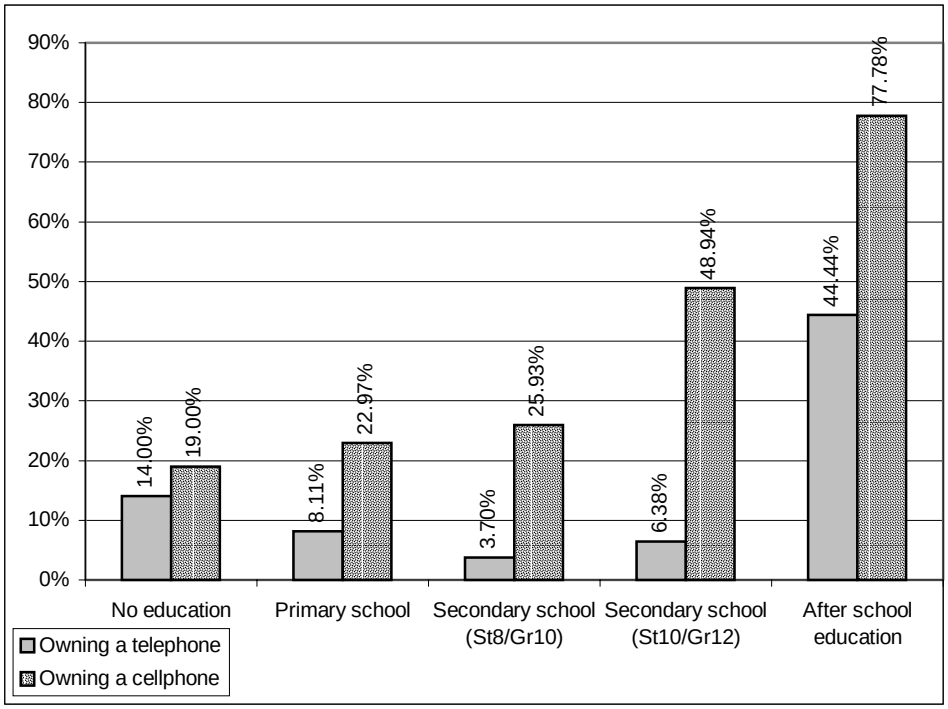


Figure 6.9. Education VS owning a cellphone or a telephone

The Chi-Square probability value for the relationship between level of education and owning a telephone indicated a statistical significance with a value of 0.0060 (Chi-Square<0.05). In the comparison of owning a cellphone with the rural citizen's level of education the statistical significance was extremely strong and Chi-Square calculations delivered a value of 0.0001. This means that the probability of someone owning a personal telephone or a cellphone in a specific region increases as his or her level of education increases.

6.12.2. The Role of Rural Citizen's Monthly Per Capita Income in Telecommunication Utilization

Telecommunication services like all other infrastructural services don't come for free and the cost definitely influences the technology utilization. It plays a role especially for rural citizens not earning high salaries. The average household income in Sekhukhuneland is R1492.61 per month but because of large families with an average size of 6 people the per capita monthly income is low at R260.55.

Figure 6.10 shows the relationship between the per capita monthly income of Sekhukhuneland's population and their need for telecommunication.

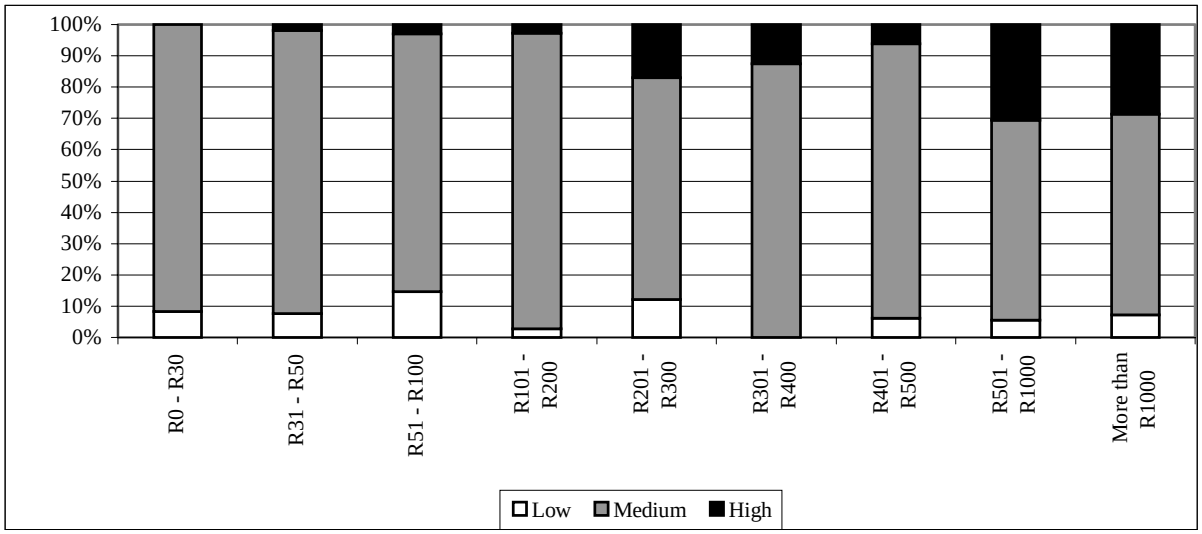


Figure 6.10. The need for telecommunication (fixed-line or mobile) for people at different levels of per capita income

Here, once again as in Figure 6.7, one can see an increase in the magnitude of the need for a means to telecommunication with an increase in per capita monthly income. The Chi-Square probability indicates a statistical significance with a value of 0.0017 when comparing per capita income to a need for telecommunication (fixed-line and mobile).

However, when evaluating the need for a personal telephone and a cellphone separately the results show that only cellphone use is clearly dependant on per capita monthly income. Figure 6.11 shows the distribution of the population in Sekhukhuneland owning a cellphone at different per capita monthly income levels.

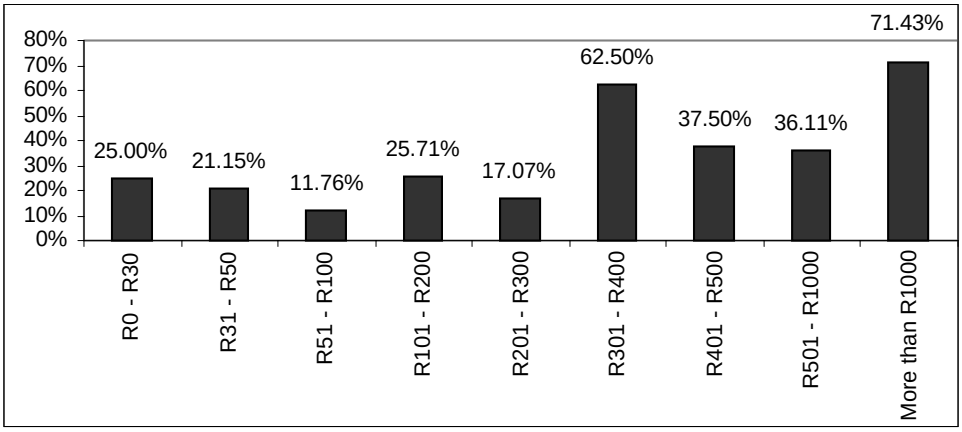


Figure 6.11. Per capita income as a function of owning a cellphone

With a Chi-Square probability value of 0.0001, owning a cellphone depends highly on ones per capita monthly income. Figure 6.11 shows that the percentage of people in respective per-capita-monthly-income-groups increase from 25% of people at a monthly per capita income less than R30.00 to 71.43% for people earning over R1000.00.

Evaluating fixed-line telephone together with per capita monthly income (see Figure 6.12) shows no statistical significance.

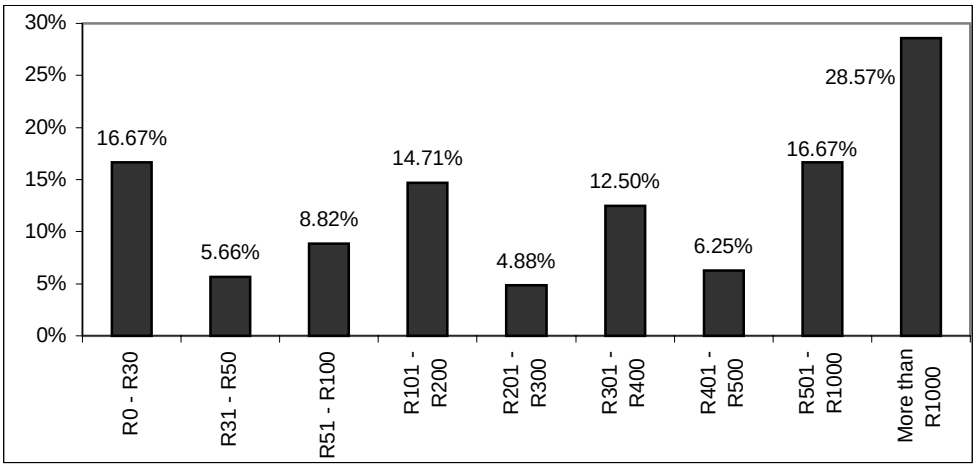


Figure 6.12. Per capita income as a function of owning a personal fixed line telephone

A Chi-Square value of 0.2513 indicates no statistical significance between owning a fixed-line telephone and income (per capita). This means that regions with a high per capita income is not necessarily better potential clients to fixed line telecommunication service providers than regions with a low per capita income. The reason for this phenomenon is twofold:

- Governmental regulations forces Telkom to install land lines without allowing the service provider to perform pre-implementation-evaluation on the client's monthly per capita income for churn rate predictions purposes (concerned with affordability), and

- Many rural citizens are not adequately informed on the call costs and they therefore prefer a mobile phone rather than a fixed-line telephone.

The rural citizens level of awareness on call costs is hindering the fixed-line technology utilization because many are not making use of telephones believing that cellphone calls are cheaper than fixed-line telephone calls (found in the research). Not enough is done to inform rural citizens on call costs. Because of the poor status of rural citizen call cost awareness many are not making use of telephones nor cellphones believing that they can't afford it without knowing the actual call costs.

Only 3.10% of the population knows the cost of both a fixed line telephone call and a cellphone call (see Figure 6.13). While only 9.69% of the population knows the cost of a fixed line telephone call, 44.19% complained. For cellphones, 8.53% of the population is informed and again a bigger percentage (20.16%) complains about cellphone call costs giving call costs as a reason for not having a cellphone.

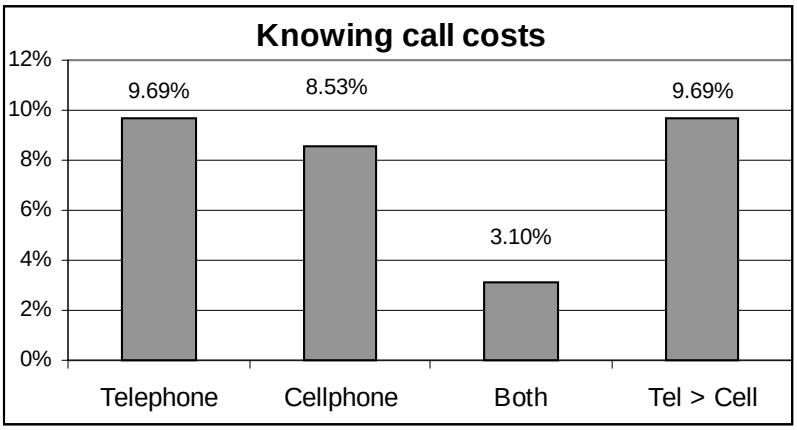


Figure 6.13 Rural citizens' knowledge on call-costs

Telkom informs the illiterate/uneducated rural citizen about the cost of a telephone call through a marketing campaigns and their sales force. This method is not effectively improving rural customer's price awareness when considering the fact that only 9.69% of the population knows the cost of a call on fixed line telephones.

In the mobile telecommunication industry much more can be done to inform users on call costs. Vodacom advertises its products and services on television and on radio. Vodacom does however feel that because it is a private company and not a public telecommunications operator, there is no obligation on Vodacom to inform the greater public about the cost of its services. This clearly explains why only 8.53% of the population is informed on cellphone call costs.

The problem indicated by the Chi-Square value of 0.2513 on statistical significance between owning a fixed-line telephone and income (per capita) can be caused by the fact that many rural citizens are under the impression cellphone costs are cheaper than fixed line call costs (rightmost bar in Figure 6.13). This lack of knowledge is partly responsible for the strong statistical significance indicated between owning a cellphone and an individual's per capita monthly income (Chi-Square probability value of 0.0001) Cellphone and telephone call costs are compared in Table 6.2 [84].

Service	**Peak Cost**	**Off-Peak Cost**
Fixed line to fixed line	R 1.24	R 0.62
Fixed line to mobile	R 1.60	R 0.86
From cellphone	R 2.60	R 0.75

Table 6.2. Long distance fixed line, and cellphone call costs [84]

The call costs of phoning from one fixed line to another are shown only for an even further explanation. Here one can see that Telkom (Fixed line to mobile) calls are cheaper than mobile phone (From cellphone) calls expect for Off-Peak calls to cellphones. Here fixed line telephones are more expensive than mobile phone call costs by only 14% compared to a 63% price difference during peak time. During weekdays Telkom offer a "mid-peak-period" (from 18:00 to 20:00), which is active during cellphone peak time with a cost of R1.14 (128% price difference). The fact that mobile phones are cheaper than fixed line

telephones for a specific time can cause confusion but if one also takes into account that mobile call costs are charged per minute and fixed line calls per second (from the second minute onwards), the last minute becomes cheaper only when the user uses more than 53 minutes thereof.

The main reason for rural citizens being under the misperception that cellphone calls are cheaper than fixed telephone calls is however because of Vodacom's Community Phone shops (Vodacom's public telephones). Many rural citizens make no distinction between calls from Vodacom Community Phone shops and privately owned cellphones.

The cost of calls from Vodacom Community Phone shops is subsidised by Vodacom (costing 70c/minute to the user) in line with their licence conditions, whereas the cost of Vodago calls is at the full commercial rate. In September 1993, one of the biggest challenges facing South Africa's new democratic government was a massive backlog in infrastructure. While the country's first-world component enjoyed the benefits of superb infrastructure, the majority were excluded. In Vodacom's GSM cellular license one of the conditions was that cellular telephony would have to address the imbalances of the past.

People in previously under-serviced areas (areas where there are less than one telephone line per hundred people) are clocking up over 70 million minutes of airtime a month from Vodacom's community phone shops. Consequently, Vodacom committed itself to deploying 22 000 subsidised telephones to be used by people in areas with the greatest need of telecommunications services. These areas are essentially traditionally under-serviced areas.

Affordable subsidised rates also become available through card operated payphones, installed at local shops, spaza, clinics, community centre and tribal offices, installed and maintained by MTN. Local entrepreneurs are appointed as card distributors in their area, creating additional income and wealth.

It is because of the fact that many rural citizens are ill informed and under the impression that cellphones are cheaper than fixed-line telephones, that only cellphones and not Telkom telephones are owned significant more as per capita monthly income increase. If the rural community is made better aware of the actual costs people will undergo a mind-shift from cellphones to fixed-line telephones. The total need to telecommunication will remain the same (as in Figure 6.10) and the population will still, according to statistics, be significantly in a greater need of telecommunication as their monthly per capita income-level rise. The cellphone industry can also benefit from launching a call cost awareness campaign because many (20.16%) rural citizens are uninformed on call prices, and blames high call costs for not having a cellphone.

To summarize: It is possible to predict which region will benefit most from technology improvements, or benefit most from gaining service for the first time. They should enjoy higher priority when doing rural network expansion. These are villages with:

- A high average level of education
- A high average monthly income (per capita)

6.13. Develop Appropriate Educational & Training Systems (26)

Rural schools are often ill equipped with infrastructure like running water, electricity and telephony. The telecommunication industry can uplift the situation by getting involved and by appointing high priority to rural educational institutions' installations and maintenance. The telecommunication companies of South Africa are actively involved in education and their involvement will briefly be explained below.

Telkom: To date Telkom is the largest sectoral trainer in South Africa. Telkom has positioned itself for competition through a highly progressive human resources development program which has seen more than 88% [58] of its employees trained each year through the Telkom Centre for Learning (CFL). A recent independent survey by PMR Magazine stated that Telkom was rated South Africa's most active company in terms of training and job creation. This statement was made with agreement of 25 trade union leaders [58], senior government officials and business associations such as the SACOB (South African Chamber of Business), AHI (Afrikaans Handels Intituut), and NAFCOC (National African Chamber of Commerce).

With Telkom's 88% training it rates better than the international benchmark of communications companies which offer training to 85% [58] of their employees annually. Currently Telkom is supporting over 1,500 students at tertiary education institutions in South Africa [37]. The bulk of these students are enrolled for engineering, information technology, marketing, and finance courses. During vacations, learners are given practical training and exposure to Telkom. In Telkom's bursary program [37], 65% of such students are black, 35% are white and 34% are female. Telkom furthermore increased its 5-year training budget by 150%.

In 1997, Telkom committed R2,3 billion [58] over a period of five years for training and human resource development at the Centre for Learning (CFL). To date, the Telkom Foundation has spent R13 million connecting 1,300 schools to the Internet in an effort to allow scholars access to technology. Each school receives a computer, a printer, free Internet dial-up connection, free monthly rental, R150 telephone rebate and training for two teachers. Telkom also donated R20 million to place more than 2000 computers in disadvantaged schools throughout the country, R30 million to a Maths, science & technology project for secondary schools, R20 million to fund university students whom cannot afford to pay tertiary course fees themselves through TEFSA (Tertiary Education Fund of South Africa), and R10 million for fifty full scholarships in the field of Engineering/IT at the Multimedia University in Malaysia.

Vodacom: In July 1999, former President Nelson Mandela attended an earth-turning ceremony in the former Transkei when Vodacom announced their plans on building a R7 million [22] school and clinic.

MTN: MTN is continually being developed through specialized staff training, as well as through alliances with international training and development companies. They furthermore have a long-term strategy, which includes the founding of a corporate university providing staff with shared ongoing knowledge resources.

MTN currently funds the Centre for Telecommunications Learning at the Peninsula Technikon in Cape Town, which produces some 30 engineers [23] and technicians each

year. MTN's sponsorship of SUNSTEP (the Stellenbosch University Schools Technology Education Project) introduces thousands of primary and secondary school pupils to electronics, encouraging them to choose Science and Technology as a career.

MTN is investing in a Science and Technology Centre at Century City in Cape Town and is planning for the installation of a Geosphere. The Geosphere is a huge globe of the world constructed from satellite images. It allows an almost unlimited number of educational computer programs to be projected onto it, covering topics such as demographics, environment, migrations, weather patterns and even simulations of the impact of development on our planet.

As a national sponsor of cricket and game sponsor of tennis, MTN promotes intensive development programs, and supports a vast range of other sports (soccer, rugby, corporate golf and netball).

6.14. Install and Implement Technology, Inform Users, & Implement it Gradually (27)

Telkom sometimes force manufacturers to develop equipment for local conditions on specific application of technology or modifications. Telkom provides the specifications for develop to local conditions. Telkom may provide local development and technical solutions for limited deployment but modifications to foreign technologies are seldom done "In-house". Normally manufacturers, local agents, or other 3rd parties modify transferred technologies. Examples thereof are: 48 Volt DC rather than AC power supply, lightning protection, and external housing (boxes).

One of the biggest problems in the technology transfer process however exists in the block 27 of the technology transfer model namely the informing of end-users. Aspects from Figure 4.7 from Chapter 4 are discussed below on the bases of the South African situation.

On the left hand side of Figure 4.7 the end user becomes involved through an awareness campaign. This involves user knowledge determination, informing and training sessions, and continuously observing changing needs to be integrated into easy-accessible information databases for future reference.

There are clear indications that both fixed line (Telkom) as well as mobile (MTN and Vodacom) telecommunication service providers are not effectively doing enough to inform the rural citizen on technology advantages and use. This is an aspect of the technology transfer process, hindering the technology utilization and one that needs adequate attention urgently. The situation about rural citizens' call-cost-knowledge for both fixed-line and mobile telephones has been discussed earlier.

6.14.1. Safety and Access to Telecommunication

The emergency service is extremely helpful in rural areas where people often don't have personal means of transport. The crime rate in rural areas are usually high and can lead to citizens being in need of emergency services.

More information needs to be given to rural citizens on the usage and advantages of telephones in case of an emergency. Figure 6.14 shows the population of Sekhukhuneland

and statistics on being in an emergency before. This could have been any emergency were the presence of the police could have drastically improved the situation.

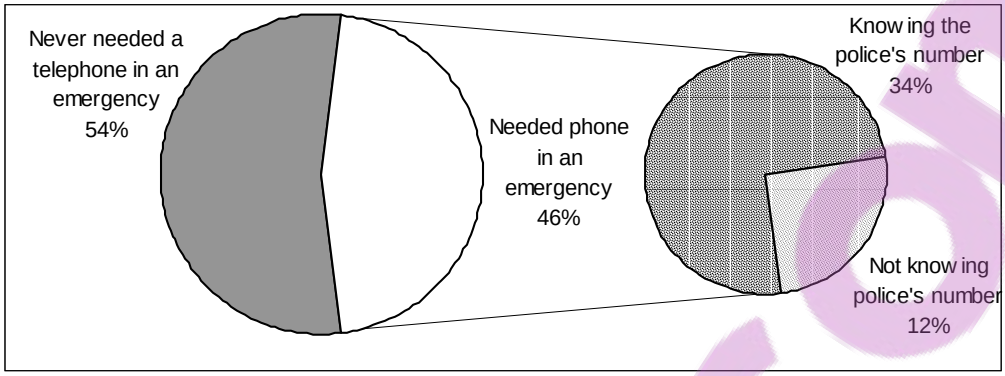


Figure 6.14. The knowledge on the police's telephone number of the people who needed a telephone in an emergency before in Sekhukhuneland

Figure 6.15 shows all people who needed a telephone in an emergency before in Sekhukhuneland. Of the population who was formerly confronted with an emergency situation 25% didn't know the police's number. Of the 75% aware of the police's telephone number, 12% didn't have access to a working telephone.

In other words, from the 34% of the total population who've been in an emergency and knew the telephone number for the police, 12% didn't have access to a working telephone. This means that 4.08% ($12\% \times 34\% = 4.08\%$) of the total population have been in an emergency situation where they knew the police's telephone number but had no access to a working telephone. For the remaining 95.92% of the population no technical or positional problems hindered them from making use of a telephone's advantage to use it during a mishap.

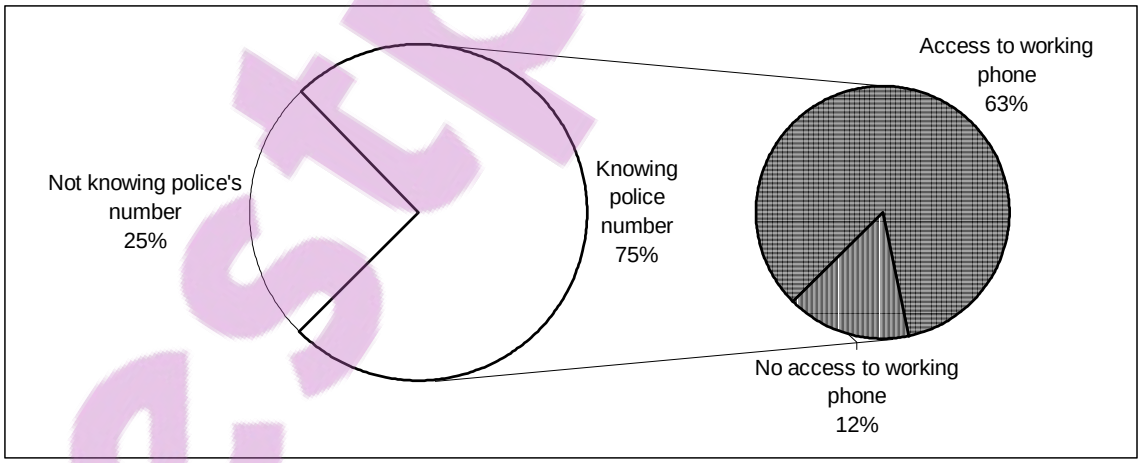


Figure 6.15. Of the proportion who needed a telephone in an emergency before, their access to a working telephone when knowing the police's telephone number

The biggest problem limiting this advantage in actual fact is that 12% of the population has previously been in an emergency situation but couldn't use a telephone because they lack

knowledge on the right telephone number. Technical or positional issues (4.08%) were therefore not largely to blame.

The situation in the mobile phone industry is even worse. Both mobile telecommunication service providers also offer a free emergency service. This service provides the user with access to a crisis centre (24 hours a day) able to analyse the situation and summon the needed emergency services (police, fire brigade, an ambulance, or other emergency help). This service is free and easy to access by dialling 112 even without a SIM card or PIN number.

MTN and Vodacom use this service for material and informing distribution on advantages of their free access to emergency services. While the emergency 112-service can have many advantages to the rural citizen, only 4.11% of the MTN customers and 16.44% of the Vodacom customers were aware of the service and its benefits.

6.14.2. Fixed-line Telecommunication

Not enough is done to effectively inform rural citizens. Telkom inform rural citizens about new services and products through their marketing campaigns and sales force. Telkom doesn't conduct any periodic research to determine rural citizens' knowledge on available services and products. Demand forecasting, marketing, sales force, and international trends are used to determine needs and capabilities of the rural community. Call centres at Telkom function as a database to store inputs from the rural community during the use of an existing technology, which can provide useful information and feedback when designing new systems/processes.

6.14.2.1. Telkom's Services From Which Rural Citizens Can Benefit

Telkom "PrepaidFone" is a private residential service, which is the world's first prepayment service on a fixed-line telephone network [71]. "PrepaidFone" is also a service identified by Telkom as being one from which rural citizen can benefit.

Telkom's Prepaid Phones holds the following advantages to the rural citizen [72]:

- No credit vetting is done when applying for this service.
- No need for a postal address.
- Add money to balance by means of a recharge voucher
- Weekly rental deducted from account being cheaper than normal personal phone rental
- No monthly bills that might be higher than what a rural citizen budgeted for.
- Optional PIN code will allow user to control the use of the telephone. Through "MultiPIN" additional users can be added to one PrepaidFone line
- Free call baring
- Voice prompts in: Zulu, Xhosa, Afrikaans, English and Sesotho.
- Affordable recharge vouchers (in R35, R60, R100 and R150 denominations)

Despite all these wonderful advantages, many rural citizens are poorly (or not at all) informed. Only 31% of the population are informed about Telkom's prepaid telephone service (see Figure 6.16).

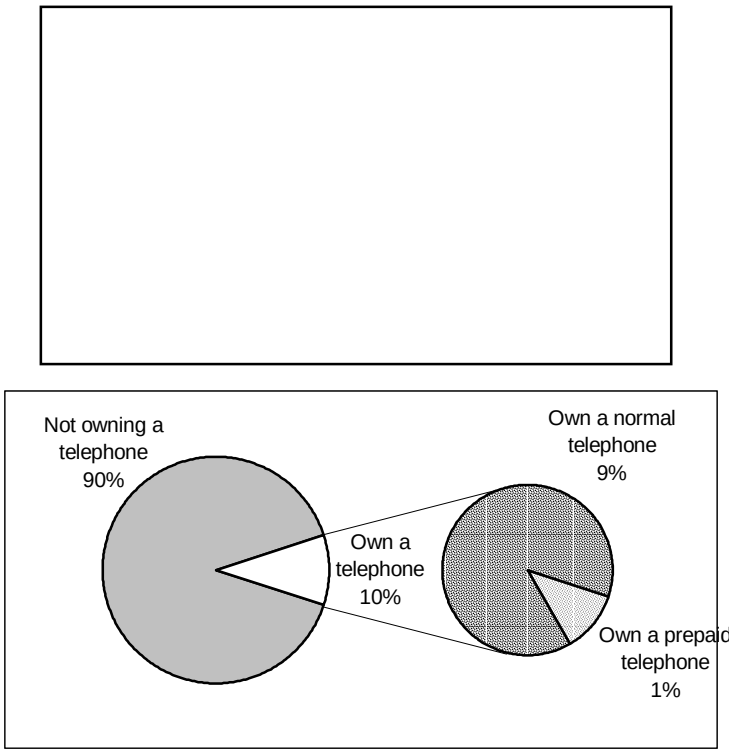


Figure 6.16. Use and knowledge of Telkom's prepaid telephones under rural citizens

Figure 6.16 show that although many know about the service, many still remain uninformed about the advantages it holds. Without knowledge on the "PrepaidFone" advantages, very little (only 10% of the telephone owning population) are benefiting from it.

Telkom's PrepaidFone is unfortunately not the only service from which rural citizens can benefit where limited awareness is hindering the utilization and effective advantages. Interviews conducted with corporate personnel from Telkom, indicated a few services that are viewed by the company as being services from which rural citizens can benefit. These products were designed because of a market survey that indicated a specific need amongst rural citizens. These products are also aimed at people with a low income-level to lower necessary financial commitment. The products also maximise communication services with minimum capital outlay. These include the following:

- ***Homefree*** - a personal 0800 number enabling family members, when away from home, to call home from any telephone in South Africa 24 hours a day without paying a cent. Charges are billed to the Homefree account. An optional caller PIN feature also offers added security [73].

- ***BlockCall*** - prevents some category calls (National & international calls, International calls only, Cellular & Telkom Premium Rate services, Telkom Premium Rate services & International calls & Cellular, Telkom Premium Rate services & International calls, or all outgoing calls) from being made, with PIN protection, without affecting incoming calls preventing unauthorised use of telephone leaving emergency and free call numbers still connected [74].

- ***Call Answer*** - a voice-mail facility that answers calls and takes messages for a user being out or busy with another call. No extra equipment needed, no maintenance (lightning cannot damage mailbox), assured confidentiality (PIN protected), and takes messages even when telephones or lines are faulty [75] (often the case in rural areas).

- ***WorldCall*** - WorldCall products namely the WorldCall Charge Card, WorldCall Universal Card, WorldCall Automatic, and WorldCall Operator Assist enables the user to stay in touch when travelling in South Africa or overseas by simply dialling an access number from almost any tone-dial phone [76].

- ***Phonecard*** - a pre-paid, fixed value microchip card enabling users to make calls from green Telkom Cardphones (public payphones) without the need for cash (coins). Available in denominations of R15, R20, R50, R100 and R200 [77].

The survey conducted in Sekhukhuneland found that some people didn't want a personal fixed line telephone at home because of not having control over telephone calls made from the phone by children, relatives, and/or friends. The BlockCall service will solve the problem instantly at an affordable price. Potential clients may also fear being responsible for costs occurred when collect calls are made to their personal telephones. This again is only a threat because of people not being adequately informed when using the technology.

The drawback however is that very little effective customer awareness is present about these products/services. Figure 6.17 shows the percentages of the population, which are informed about the products and their advantages. The information diffusion into the rural area for Phonecards was an exception and done extremely successful having 72.87% of the population familiar with the product and its advantages. For all other products less than 6.20% were informed about advantages or familiar with them at all. Once again the level of knowledge the user has obtained about products and services is limiting the advantages to both the rural citizen as well as the service provider.

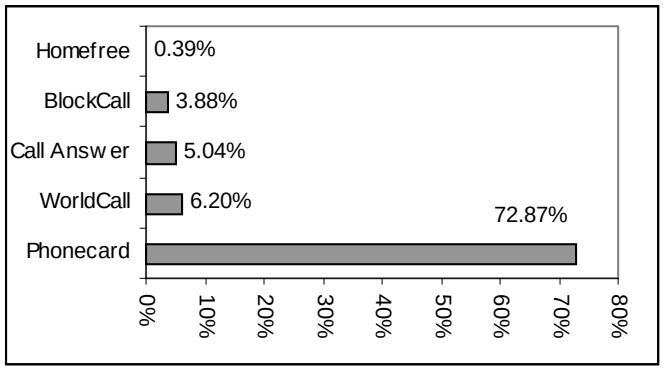


Figure 6.17. The level of knowledge for Sekhukhuneland's population on products/services from which rural citizens can benefit

Telkom Internet is another service indicated by Telkom as being a service from which rural citizens can benefit. This might be the case but with the low per capita monthly income levels and low level of education 93.41% have never touched a computer. The majority of the population are therefore not computer literate and this fact limits the advantages that Telkom Internet has to offer.

6.14.3. Mobile Telecommunication

Vodacom conducts research on the views and attitudes of all people falling within its confidential target market. It will be shown below that inadequate awareness is present with rural citizens on services and aspect concerning mobile telecommunication.

6.14.3.1. SMS (Short Message Service)

SMS (Short message service) is almost a cellphone equivalent of paging or e-mail. Sending an SMS is straightforward and nowadays very user-friendly. Sending an SMS is very useful for sending a message in one direction, at a reduced cost, while not being able to make or receive voice calls [78].

Vodacom informs rural users on the use of SMS through commercial advertisements broadcasted on radio and television in both rural and urban areas. Very little rural citizens are however aware of SMS let alone the advantages it holds. The knowledge of SMS is limiting the use and thus the practical effective advantages thereof. Of the rural population owning cellphones, 34.25% are completely uninformed about SMS and while 64.39% are familiar with SMS, 35.62% never used the service because they did not know or understand how. A fraction of only 28.77% cellphone owning citizens are therefore able to use SMS.

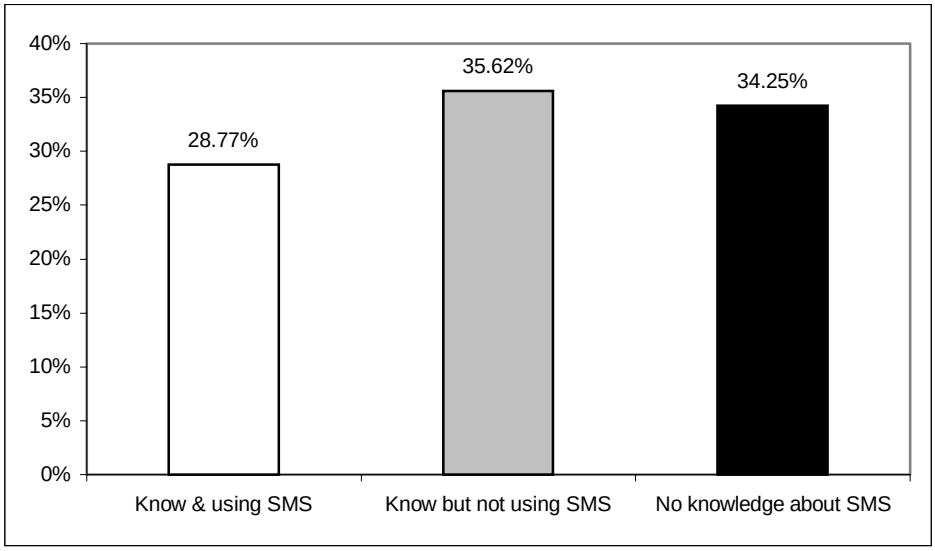


Figure 6.18. The rural citizen's use and knowledge of SMS (Short Message System)

The SMS situation (Figure 6.18) is a perfect example of how a lack of knowledge on a specific technology can limit advantages to the end-user.

6.14.3.2. Knowledge on charging cellphone batteries

Rechargeable batteries power mobile phones. These need to be taken care of by following definite guidelines, which will ensure efficiency and maximize battery-life. Guidelines include [79]:

- Never charge batteries for more than a week
- Do not leave chargers connected to the AC power supply when not in use
- Temperature extremes affect batteries' ability to charge. Always try to keep batteries between 15˚C – 25˚C.
- Only charge battery when battery is fully discharged
- Fully charge battery before disconnecting charger

Many rural citizens are uninformed about these guidelines (especially the last two) and shorten their batteries' life expectancy by charging incorrectly. This limits the utilization of technology over time and shortens its lifespan. Figure 6.19 shows the rural citizens level of knowledge on battery care and use. More than halve (52.94%) of cellphone users are uninformed about proper battery use and care guidelines.

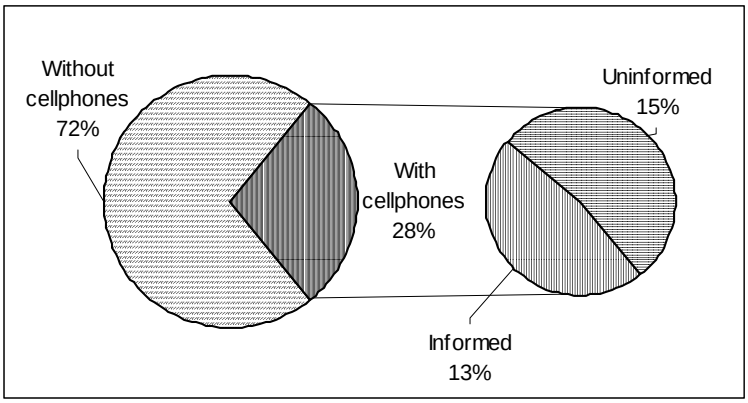


Figure 6.19. Knowing how to charge a battery

Aspects that might however also limit charging conditions are the type of dwelling or access to electricity. Many (40.47%) still live in informal dwellings (Shacks), with little thermal isolation. Informal houses can have internal temperatures reaching over 35˚C. Not having access to electricity is another aspect that can affect charging patterns. Rural entrepreneurs are charging cellphone batteries for citizens without electricity at home at 500% profit margins whilst also not following charging guidelines.

6.14.3.3. Use of Bank Cards for Airtime Purchase

Vodacom claims that it is informing rural citizens about the use of plastic-bank-cards for purchasing airtime. In Sekhukhuneland, 49% of the population owns bank accounts. Of this fraction 56.69% have Standard Bank accounts, 18.90% are banking with First National Bank (FNB), and 10.24% at ABSA. Others are Nedbank, General Post Office, Peoples Bank, and NBS.

Some 0.79% is under the impression that they are banking with United Bank and 0.79% with Allied Bank, who have merged together with other banks to form ABSA. Another 0.79% indicated E-Bank, which does not exist in South Africa. This indicates that rural

citizens are not always actively using their bank accounts. The reason therefore can be social where rural citizens distrusts activities they don't understand or cannot see.

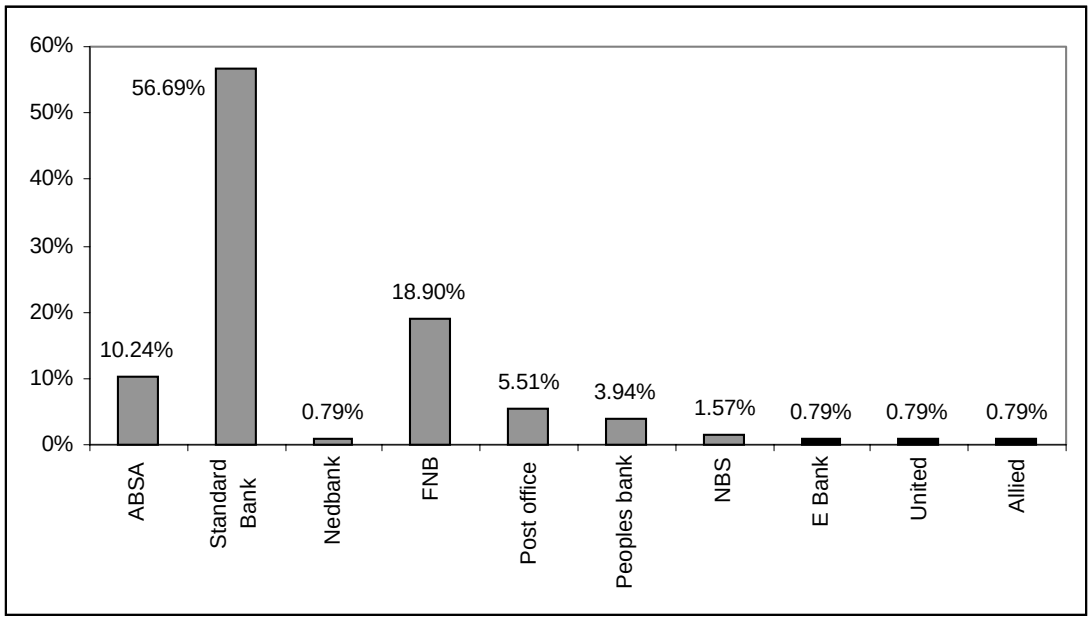


Figure 6.20. Sekhukhuneland's banking preference

Buying airtime for a prepaid cellphone is now also possible using his/her bankcard together with an ATM (Automatic Teller Machine). ABSA and First National Bank (FNB) are offering a service that enables users to purchase airtime for prepaid cellphone users making use of the MTN network. Standard Bank and Nedbank offer this service to Vodacom clients. This enables users to purchase airtime any time of day and night. It does often happen that a tuckshop run out of airtime cards and then the villagers have to wait for new supplies. Using one's plastic bankcard eliminates this problem. Rural citizens also often work difficult hours and ATM machines can then be very useful to acquire vouchers after-hours.

The users are however not informed enough about using this technology to their advantage. Vodacom advertises being able to purchase airtime, using ATMs through whatever medium Vodacom's Advertising department feels will reach the target market. The survey conducted in Sekhukhuneland indicated that all cellphone owners in the rural areas also own bank accounts. Of the population 28.29% owns cellphones from which 60.27% owns prepaid cellphones. Out of the prepaid cellphone owners, only 2.27% has ever used their bankcards to purchase airtime for mobile phones (see figure 6.21).

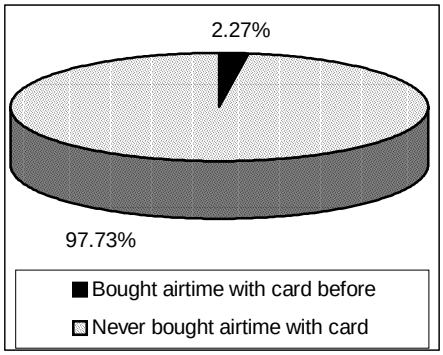


Figure 6.21. Profile of prepaid cellphone owners on purchasing airtime with plastic bankcards at an ATM

Knowledge on bankcard usage for airtime recharging is limiting this part of technology utilization to rural citizens.

6.14.3.4. Cellphone Maintenance & Repair

The effective utilisation of the technology depends to a large extent fully on the level of knowledge vested within the user. The information obtained by a user can also extend or shorten the life of a cellphone (see battery care above). This include aspects such as replacing batteries or repairing the cellphone physically when components go faulty (aerial, LCD (liquid crystal display), cellphone covers, ext.) The survey conducted in Sekhukhuneland indicated that 67% knows where to buy new cellphone batteries. Knowledge on repairing a cellphone is at a lower level where 50.39% knows where to repair a cellphone, 35.94% are uninformed, and 13.67% are under the impression that a broken cellphone can't be repaired (see Figure 6.22).

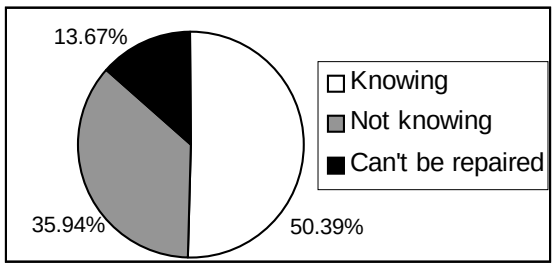


Figure 6.22. Cellphone maintenance knowledge for rural citizens in Sekhukhuneland

This means that 13.67% of the population will dispose of a cellphone when a technical failure occurs. In the case of a technical failure, rural citizens might not be in a financial position to replace the cellphone but would still be able to repair it. If not financially able, the uninformed population (35.94%) will terminate the use of their cellphones (if not informed by the 50.39%). This shortens the effective usable period of a cellphone.

This section has shown that the knowledge of the rural citizen can seriously hinder telecommunication technology for the end-user as well as the fixed-line and mobile service providers. Rural telecommunication will never be effectively operated without active

"hands-on" awareness campaigns and the industry is cutting it's own throat by not supplying adequate attention in this matter.

6.15. Conduct Technological/Need Assessments and Forecasts & Evaluate Transferred Technology (28-36)

Telkom is evaluating current transferred technologies on a quarterly or an annual basis depending on the type of technology involved. Telkom has qualified human resources able to perform limited in-house research and development and set specifications to assure effective functioning in the current infrastructure. When the situation arise where the need change and the technology is made absolute, suppliers, manufacturers, local agents, or other 3rd parties modify transferred technologies. It seldom happens that Telkom staff modifies a technology to suit changed and newly defined need.

Telecommunications and South Africa's Needs Concerning the Natural Environment

Environmental issues are becoming ever increasingly important. During 2000, more than 400 million phones were sold globally, a 45% increase on 1999. In 2001, mobile phone leaders expect over 500 million units to be sold worldwide [80]. Because cellular phones are not yet recyclable, manufacturers cannot re-use the rare metals for future phones. Plans are however already underway to allow for limited recycling. Environmental issues are becoming more important to South Africans. The telecommunication industry are also involved and the influences on each of the service providers are briefly discussed below.

***Telkom*:** Telkom actively deploys technology with a low environmental impact, especially in ecologically sensitive areas such as Cape Point in the Western Cape and in the Kruger National Park. Telkom took its environmental commitment even further by implementing an Environmental Management System (EMS) that spans the full spectrum of their operations in 1998. Telkom's environmental system, based on ISO 14001 standards [58], is aimed at ensuring that, in their drive to provide all South Africa's people with access to a telecommunications network, the environment is not negatively impacted. The system includes integrating environmental consideration into all of Telkom's planning activities and business decisions.

Vodacom: In an effort to limit the impact of cellular technology on the environment, Vodacom in Cape Town erected (March 1997 [22]) the first cellular mast in the world to be disguised as a cocas primosa palm tree. The entire structure is recyclable, making it a truly 'green' tree. The masts have even been disguised as a lighthouse in Port Elizabeth and as techno pine trees in Johannesburg.

During April an archaeological find was unearthed during the construction of a Vodacom base station at Willow Glen in Pretoria. Our environmental policy includes a commitment that Vodacom will minimize the impact of its installations on the cultural and historical landscape. When the bones were discovered, indications were that they could be archeologically significant. The University of Pretoria's Physical Anthropology research group was called in and continued their research on the find enabled by a grant from Vodacom.

Vodacom announced that it received the international ISO 14001 environmental management certification in July 1999 [22]. To keep this prestigious certification, Vodacom has the following three obligations to fulfil:

- Proactive legal compliance with environmental legislation
- Prevention of pollution
- Improvement of our environmental performance

MTN: MTN was the first cellular telecommunications company to receive the prestigious ISO 14001 for their Environmental Management System [23]. The MTN Cape Whale Route was recently awarded the British Airways Tourism for Tomorrow Award for its development of eco-tourism. Environmental programs in the Cape include the Jackass Penguin, the Black Oyster Catcher and the conservation of Cape Flora. MTN is also a sponsor of the Endangered Wildlife Trust, contributing to key projects such as the Wild Dog, Hyena, Kalahari Lion and Rhino Darting Programs.

7. Conclusions and Suggestions

7.1. Suggestions

A few problems were found in the South African telecommunication industry during the research analysis (Chapter 6). This chapter will attempt to make some suggestions and conclusions on how the situation can be improved based on the technology transfer model (discussed in Chapter 4).

Telecommunications technology transfers can be improved through the use of a technology transfer model but the industry needs to follow a simultaneous-situation-improvement-plan (discussed in Section 7.1.2). The current suggested plan for South Africa thus involves two separate paths, which could be done in parallel as indicated in Figure 7.1. (Dotted-line block). The one path is focussed on the technology transfer and the other on the current situation in the country and how it is hindering the transfer model's success. These are:

- The Model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa (discussed in Chapter 4)

- A simultaneous-situation-improvement-plan

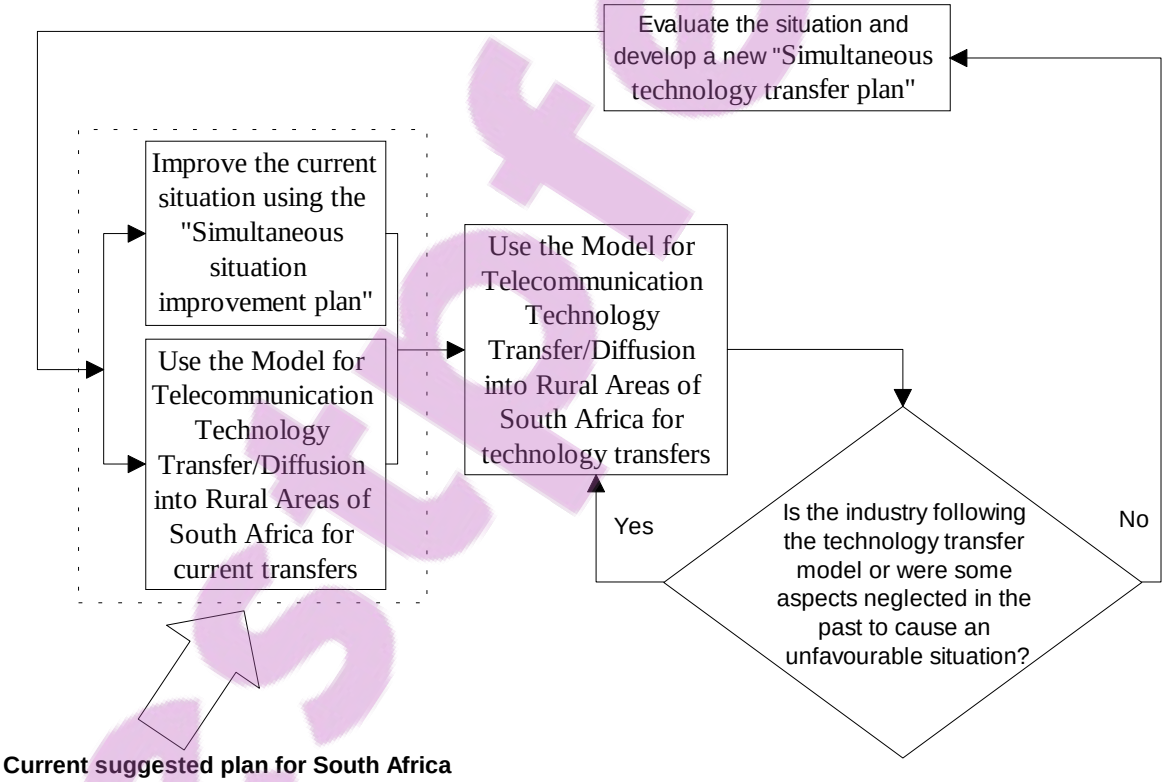


Figure 7.1. Improving the current situation of the telecommunications industry and future technology utilization through managing the technology transfer process according to the telecommunications technology transfer/diffusion model

After the initial parallel paths-strategy was followed the telecommunications industry can continue to transfer technology into rural South Africa following the technology transfer model (discussed in Chapter 4 - summarized in Section 7.1.1.)

The country's situation should however continuously be evaluated on the basis of the transfer model (Chapter 4) and the question asked whether the industry is following or followed the technology transfer model in all its aspects correctly or whether an unfavourable situation was created as a result of some aspects being neglected. If such a condition does occur the country should do a detailed evaluation of all aspects hindering the transfer model's success. A "simultaneous-situation-improvement-plan" should be developed and once again be performed in parallel with the transfer model on the way forward until the situation is corrected (see Figure 7.1).

The two suggested tactics for a current way forward is discussed below in Section 7.1.1 and Section 7.1.2.

7.1.1. The Model for Telecommunication Technology Transfer/Diffusion Into Rural Areas of South Africa

The Model for Telecommunication Technology Transfer/Diffusion into Rural Areas of South Africa forms the core of this dissertation that provides the industry with systematic guidelines including both parties (source and receiver). Technology transfer is a complex process that, if not managed wisely, can become a burden on national development. When transferring technology from one country/company to another, at different levels of technological know-how, the process holds many problems that need to be overcome. Problems exist and a proactive solution for future technology transfers is needed to avoid unsuccessful allocation of resources. Bracketed numbers refer to the blocks in the model shown in Figure 4.1 and Figure 4.2 (Chapter 4).

The policy maker identifies the stakeholders to form a team that evaluates and recommends to the policy maker the appropriate technology to transfer. Through this method the stakeholders' views and their cultural values are accounted for. It is extremely important to view the end users as stakeholders and to incorporate their ideas and needs into the transfer of technology (1). The development problem needs to be defined with a clear outlay of all the factors/problems that limit the overall growth or development of the involved country/company (2).

The needs of a country should be determined (3) using the Need-Capability Matrix as discussed in Chapter 3 (Section 3.3). The government furthermore delimit the borders of the telecommunications playfield through regulations and this influences the industry and it needs to be aware of all these regulations (4). One also needs to focus on strengths and not weaknesses and (5) therefore the model suggests the determination of capabilities (also a part in the Need Capability matrix).

Once a country knows its needs, capabilities, strengths, weaknesses, and limitations, it can form goals and objectives to solve the defined development problem (6). The evaluation of technology does not only become important after installation but needs planning through set standards. These standards are also useful to select a specific technology (7). Before selecting a technology a list of alternative technologies (8) and technology sources (10) must be generated together with technology assessment and forecasting (9), using

techniques such as: technological progress functions (S-curves), trend extrapolation, the Delphi method, and scenario development. A systematic approach is then suggested to narrow down the list (11).

The LDC should (12-16) evaluate its own ability to fulfil supportive tasks (energy provision, information management, maintenance, expansion, adoption, or supplying needed inputs) and plan accordingly through the use of Space maps (see Section 4.12). Then can the LDC select a technology and a technology source (17 - 24). Firstly, the hardware and software needs to be evaluated in terms of ease of adoption and ability of LDC to modify and develop its own technology (17). Thereafter input/output relationships are established and the AHP applied to obtain normalized weights (18) for ranking technologies by priorities (19-21). Goal compatibility is achieved between the MNC and the LDC through and process, which eliminates unwanted conflicting viewpoints on all three aspects of the technology triangle (Appendix A) as shown in Figure 4.6 (Chapter 4). This concludes the selection process of a technology source (22).

The technology transfer model suggests setting guidelines and standards (23) for achieving goals and evaluating the technology's success based on the defined needs and objectives. Regions are then also prioritised to select areas that will benefit most from the technology application (24 & 25). This aspect is described in more detail in Section 7.1.2.1. (Focus on right areas when doing rural network expansion or investments). The industry must realize that it can also play a role in assuring well-educated citizens through supporting the creation of appropriate educational and training systems (26) (also see Improve the quality of rural education in section 7.1.2.2.). With the gradual installation process of the newly transferred technology (see Figure 4.7. in Chapter 4), users need to be informed (27) as described in section 7.1.2.2. (Improve the awareness status of rural citizens).

A technological/need assessment and forecasting is conducted (28) with a continuous evaluation of the technology (29-36) to assure that the technology is fulfilling the need and helping the country to achieve its goals.

7.1.2. South Africa's Current Suggested "Simultaneous-Situation- Improvement-Plan"

Problems were found in five areas, which need attention before the technology transfer process will drastically improve the situation. A prescribed path is laid out for the preparation of the country's situation before the technology transfer model can be of use.

As described in Chapter 3, the literature suggests one of three basically different strategies to be followed:

1. ***Appropriate Technology for Current Infrastructure:*** Adapt the project fully to the local conditions

2. ***Compensate for Deficiencies in Current Infrastructure With Organizational Resources:*** Dedicate some of the organization's resources to compensate for the deficiencies of the given infrastructure

3. ***General Change of Infrastructure Corresponding to Technological Change:*** A course of general change in the infrastructure corresponding to the technological change is considered

In South Africa strategy 2 seems to be the best option to follow. It is actually a combination of the first and the last and can thus be broken up in these two interdependent strategies. Suggestions for a future strategy to follow, apart from the technology transfer model, are graphically presented in Figure 7.2.

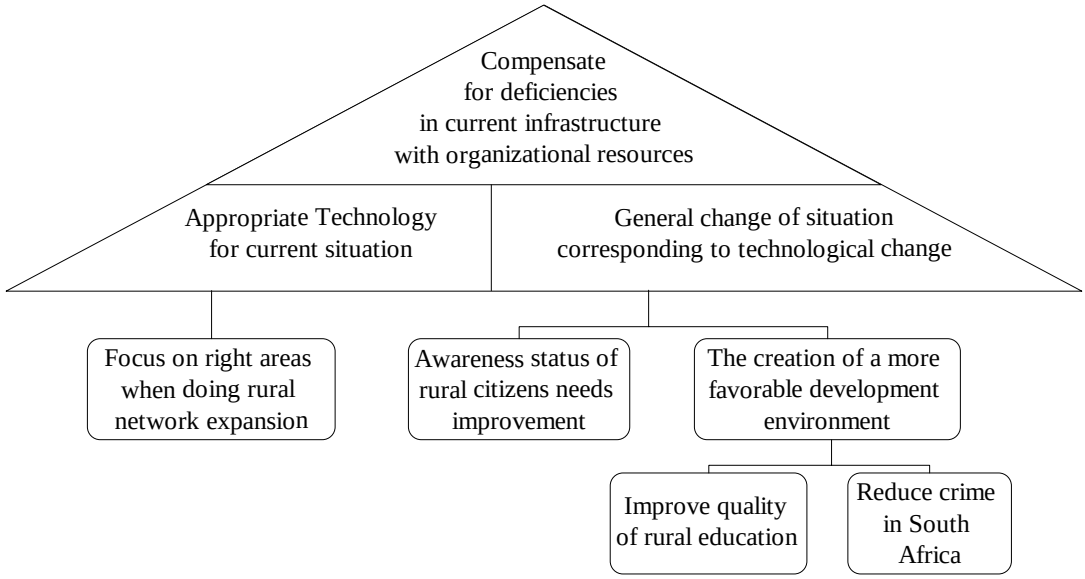


Figure 7.2. The "simultaneous-situation-improvement-plan" suggested for the South African telecommunications industry

Each aspect of the simultaneous-situation-improvement-plan will be discussed below.

7.1.2.1. "Appropriate Technology for Current Situation"

Focus on Right Areas When Doing Rural Network Expansion or Investments

A few relationships were tested during the survey done in Sekhukhuneland for pre-installation prioritisation of regions. Results showed that one could, on the basis of the different economic and social characteristics of citizens, explain how to prioritise regions. It is thus possible to predict which region will benefit most from technology improvements, or benefit most from gaining service for the first time. Villages with a high potential to benefit should enjoy a higher priority and they are:

- Villages with a high average level of education
- Villages with a high average monthly income (per capita)

Villages or regions should thus be evaluated before any technology installations are done and then be placed higher on a priority list for future rural network investments. It should however be stressed that the awareness of rural citizens is hindering technology utilization and should be improved with this aspect before the fixed-line service providers can include the second prioritisation parameter (monthly per capita income) as explained in Chapter 6.

7.1.2.2. General Change of Situation Corresponding to Technological Change

Improve Awareness Status of Rural Citizens

The telecommunications industry should drastically plan to inform rural citizens since this was found to be the area where the most attention is needed. This aspect is included in the technology transfer model in block 27 but because of its status, it needs separate attention. It furthermore shows that this problem needs to be corrected before the transfer model (Chapter 4) will be valuable. It is however a task to be fulfilled not only by the industry but the authorities also has an active role to play. The government must first understand the advantages the telecommunication sector has to offer national development before they will participate in any awareness campaign, which will filter through the message to rural communities.

Insufficient awareness exists and it is limiting the advantages to rural South Africa as well as utilization and advantages to the telecommunication industry. Aspects that need better awareness includes:

- Knowledge on emergency services telephone numbers and their use
- Knowledge on fixed-line products from which rural citizens can benefit most
- Knowledge on SMS (Short message service)
- Knowledge on charging cellphone batteries
- Knowledge on use of Bank Cards for airtime purchase
- Knowledge on cellphone maintenance and repair

There are a number of mediums that can be used for effectively diffusing information on telecommunication into rural South Africa. The effectiveness of each medium differs and must be considered before an awareness campaign is launched. Media such as radio, television, posters on street, magazines, information flyers, newspapers, and even schoolteachers, to name but a few, could improve the situation of an ill-informed rural population in the country. One extremely important aspect that first needs consideration is the language used in the awareness uplifting process.

Language of awareness campaign

To inform people, the selected language plays a critical role. To cater for South Africa's diverse population, the Constitution provides for 11 official languages, namely Afrikaans, English, IsiNdebele, IsiXhosa, IsiZulu, Sepedi, Sesotho, Setswana, SiSwati, Tshivenda and Xitsonga [15]. According to Census '96, IsiZulu is the mother tongue of 22.9%, followed by IsiXhosa (17.9%), Afrikaans (14.4%), Sepedi (9.2%), and English (8.6%). To inform people effectively, one must evaluate small areas and conduct an informing campaign in the most spoken language for the specific area.

Telkom is actively working towards this goal already conducting business in all eleven official languages. A query in any language can be responded upon at the "Call Centres" and the "Services Prompts" is supporting clients in any of the following languages: Afrikaans, English, IsiXhosa, IsiZulu, Sesotho. MTN offer services in English and IsiZulu making them understandable to at least 32.1% of the population in their mother tongue while many of the other black languages also understand Zulu. Vodacom however conducts all their business only in English (9.2% of the population's mother tongue), which makes it difficult for them to be understood by all and definitely highly insensitive towards aiming for an informed customer.

Once the language for informing in a region is determined the medium should be selected. The choice on a medium is probably the most important determinant together with the appropriate language and both will determine the effectiveness of the awareness campaign. Different mediums will be briefly mentioned below with a short discussion on each and it's applicability.

Different Mediums for Informing Rural Citizens

Newspapers, posters on street, magazines, and information flyers as a medium for informing people: Newspapers, posters on street, magazines, and information flyers are all very successful mediums used in the developed sector. The only drawback is that people can only be reached using writing if they can actually read. This unfortunately is not the case for many (34.88%) of the rural citizens. According to Census '96 figures, 38.62% of the population in Sekhukhuneland has never been to school. Other mediums should thus be considered. Another drawback is that the cost of a newspaper or a magazine is out of reach for many of the people living in the rural areas, and only a limited percentage can thus be reached this way.

Schoolteachers: The educational system can play a definite role informing children. Through informing children, information can filter through to the parents and that way the whole community can be reached. There is however a problem with the educational system itself in South Africa. Children are often not being educated on the needed academic information let alone telecommunication information. Corruption has unfortunately also been experienced in the unproductive educational system. A 2-hour educational day is a common phenomenon at some secondary schools.

Nationwide strikes in education are also hindering development, which the country can't afford. Strikes in education will cost the country a high price socially because children will pay the price. Matric results are suffering as a result thereof [81].

Television: Television can be a very effective way to inform people on telecommunications. Both senses, hearing and seeing are reached and the recipient can be introduced into all the advantages that telecommunication has to offer. The SABC (South African Broadcasting Commission) are broadcasting some 98 news bulletins in all 11 official languages weekly [15]. Unfortunately the cost of a television set is out of reach for more than half the community living in the rural areas, and only a limited percentage (46.12%) can thus be reached this way. The need for a television license and electricity at home is another limiting factor because many people living in rural areas still cannot afford electricity let alone a license, and operating a television set on battery power is not very efficient.

Radio: Currently the SABC (South African Broadcasting Commission) has 19 radio stations under its control, attracting some 20 million listeners daily. Two of these stations, Radio Bop and CKI FM were inherited from the former homelands of Bophuthatswana and Ciskei respectively [15]. Different languages are being used when Radio Zulu Xhosa and Radio Seshoto were established on the 1st of June 1960. The SABC also introduced a radio service targeting the Khoi population in August 2000.

75.58% of the people living in the rural areas of South Africa own a working radio and this might be the most effective media for informing people. Using batteries as a power source for a radio is much more effective than with a television set and this fact puts a radio in reach of many rural citizens.

More than 80 community stations have been licensed since 1995 [15]. The minister of Communications is contributing by providing infrastructure in needy areas. Some R6.5 million [15] has been allocated for this program in the 2000/01 financial-year. Priority will be given to the Northern Province, Kwazulu-Natal and Eastern Cape, which have been identified for the first phase of integrated sustainable rural development.

The needed infrastructure for establishing a community radio station is however not always available. In Sekhukhuneland, a BSC Computer Science graduate explained that he is trying to start a community radio station but has difficulty in doing so because of not having Internet access that makes the attempt almost impossible.

Government Should Ensure a Favourable Development Environment

The government does not do everything in its power to create a favourable atmosphere for technological development but have strict regulations and policies in place to penalize the telecommunication industry if they don't perform adequately. The situation in a country must often be evaluated from the perspective of a foreign investor who is additionally disadvantaged by relying on largely second-hand information.

Improve Quality of Rural Education

The "People" component of the technology triangle (see Appendix A) is often ill educated and its hindering technology utilisation. Without a high average level of literacy, rural South Africa will never be able to modify or adjust transferred technology for optimisation to local conditions which will make the utilisation uncompetitive in the international market. South Africa can, through creation of a continuous learning culture conduct sustainable development to become technological self-sufficient.

The quality of the South African educational system in rural areas is unfortunately insufficient. During the survey conducted in Sekhukhuneland, signs of unproductiveness were found, as a two-hour school day seemed normal to some secondary schools.

A clear indication of a doubt in the quality of rural schools is the "Denel Bridging Programme". Kentron (a division of Denel) is a manufacturer of tactical missiles, precision-guided weapons, unmanned aerial vehicles, and sighting or observation systems in South Africa. They have developed their Bridging Program for disadvantaged students with limited tertiary education prospects. The Denel Bridging Programme is housed at

Kentron College, on the premises of Kentron in Irene, Centurion near Pretoria. The aim of the College is to provide an annual bridging course for students from previously disadvantaged communities [83]. During the Program students re-do Grade 12 Mathematics, Physical Science or Accounting and upgrade their marks. They also get taught basic communication, leader, and other personal skills. Upon successful completion of the course, participants may qualify for a bursary to study in Electronic/Mechanical Engineering or Auditing.

While the telecommunications industry has committed itself to be actively involved in education and training (Discussed in Chapter 6: Develop appropriate educational and training system (26)) the government should focus much more on improving the quality of the educational system in South Africa.

Reduce Crime in South Africa

The reduction of crime in South Africa falls under the creation of a more favourable development environment for which the government can be held responsible to a large extend. This does not imply that the telecommunications industry has no action to fulfil. The industry can in turn, also improve the situation and the author is happy to say that it is actively involved at the moment (explained below). While the industry is doing almost everything in its power the government is not doing enough at all. The state is blaming other countries for "poaching" doctors and teachers but not acknowledging the push factors.

The point that should be stressed is to keep focussing on crime reduction. The involvement of the different telecommunication companies in South Africa's crime reduction will briefly be explained below.

Telkom:
Telkom finds the impact of crime on the company as extremely high and a strategy is followed to counteract crime. Currently Telkom is at a position where the amount and size of theft incidents decline even with network growth.

Telkom offers free emergency number dialling to their customers. These include numbers for ambulance services, fire brigade, police, hospitals and rescue services [84]. The public is also made aware of these numbers in the White Pages Telkom Directory.

Copper cable theft is a huge problem in South Africa. In addition to the inconvenience caused to customers, cable theft costs Telkom an estimated R28 million annually [58]. To ease this problem, Telkom is connecting large parts of South Africa using advanced radio-based telecommunications technology called DECT (Digital Enhanced Cordless Telecommunications). Services made available for better safety by Telkom includes: UrgentCall (UrgentCall allowing the user to make a pre-programmed call by lifting the handset 5 seconds), SpeedCall (SpeedCall makes a call by dialling only a few digits, instead of dialling the complete telephone number), and IdentiCall (Lets the user see the caller's number before answering).

Vodacom:
At the end of 1994, as South Africans were planning their end of year holidays, Vodacom was rolling out its network on 3 000 km's [22] of national highway. This strategy made

cellphones increasingly essential for personal safety. By the beginning of 1995, Vodacom expanded its emergency service to launch Vodacom 702 Cellwatch, broadcasting incidents of stolen or hijacked vehicles.

Vodacom hit back harder at cellphone thieves during 1998 with an initiative to encourage the public to blacklist cellphones when stolen and to discourage them from buying stolen cellphones. Blacklisting has the effect of rendering cellphones inoperable on GSM networks around the world. Vodacom educated the public with an information line (124 from cellphones or 082 124 from a Telkom phone [22]), which details the correct procedure for blacklisting a cellphone. Vodacom has also placed a blacklist information sticker on all prepaid starter packs.

Vodacom Group CEO Alan Knott-Craig committed Vodacom to upgrading and maintaining the Alexandra Police Station and the adjoining Magistrates Courts, a project that cost R15 million [5]. The aim is that people should not be risking their lives because they do not have access to the proper equipment and facilities, especially when there are others who do. By upgrading the Alexandra police station and magistrate's courts, Vodacom has undertaken to renovate, refurbish and maintain them for at least three years. This includes the installation of telecommunications and IT equipment. Now that the restoration is complete, Alexandra enjoys a modern, well-equipped policing facility that has had a profoundly positive effect on the morale of police officers and the community. One of the new features is a trauma centre in which victims of crime are counselled and statements taken in private.

On March 22, 2001 Vodacom pledged a further R1,4-million [5] to the Alexandra Police Station as part of its commitment to work in partnership with government to fight crime. The Chief Executive of Vodacom, Mr. Alan Knott-Craig, and the Chairman of the Vodacom Foundation, Ms Joan Joffe, made the donation, which will be used to provide essential maintenance and services, at the Alexandra Police Station.

Vodacom has also implemented several security devices for its prepaid vouchers to prevent fraud. These include: sealed vouchers in a clear plastic cover together with holograms, expiry dates, and unique card numbers printed on the back of the cards. This way it is almost impossible to sell used or forged cards to the public as new unused ones.

Vodacom spent a further R5 million sponsoring the printing of 7.5 million "Passports to Safety", which are anti-crime brochures containing useful information to help beat crime. Vodacom is a patron of Business Against Crime (Gauteng) and donated R1 million in this regard. Vodacom donated R250 000 to a program aimed at rehabilitating prisoners by teaching them how to read and write.

MTN:
One of MTN's exclusive value-added services includes CareCall. This service is a peace-of-mind line that complements the112 Emergency number [24]. MTN offer coverage along most of South Africa's national highways ensuring better safety on the roads.

The MTN Centre for Crime Prevention Studies (CCPS) at Rhodes University ended the year on a high note by scooping a coveted emPower Award at the 11th Annual PMR (Professional Management Review) Awards ceremony in Johannesburg. The emPower Awards recognize organizations that demonstrate excellence in contributing to the

reconstruction and development of South African society. Many of South Africa's leading companies and organizations enter for the awards each year. For the 2000 Awards, entries were judged in the following categories: War Against Crime, Black Economic Empowerment, Environmental Protection, Primary Health Care, Job Creation and Training and Social Upliftment. Cellular giant MTN entered the CCPS in the War Against Crime category [85].

Cell C:
Cell C (not yet an active cellular service provider) said in a statement that additional services to be provided include: directory, information, emergency, messaging and operator assisted services [32].

7.2. Conclusions

Telecommunication can no longer remain just as a luxury to the few privileged in big civilised cities and a dream to the rural citizens. If this way of thinking is continued, South Africa will indeed pay a very high price. The question is not whether rural telecommunication is needed but rather how to go about making rural telephony available. The telecommunication technology transfer model tries to answer this question and supply guidelines on how to enable rural telecommunication to be socially and hopefully economically profitable in the future.

If it weren't for the developed sector in South Africa the necessary support activities would not have been present and the underdeveloped sector would have difficulty in becoming a contributing element in sustainable growth. The country's developed sector can't keep on carrying the underdeveloped sector and also expect to stay a role-player in the highly competitive international market. Rural South Africa should also start playing its part and the only way this can be done is through the necessary infrastructure that includes telecommunications.

The telecommunications industry is covering many of the aspects highlighted in the technology transfer model and technologies are currently transferred to South Africa fairly satisfactory. However, many areas still exist where much can be done to make it more effective and more rewarding to society as well as the industry. A number of aspects are present within the industry's power, which are not up to standard at all and should get special attention urgently. The government also has a vital role to play to ensure sustainable growth and to allow telecommunications to play its part in national development.

Future research can be done to determine the magnitude of the problem of rural education's quality. The national situation should be evaluated and a systematic solution derived on a program to follow that will improve the situation.

Appendix A: Technology definition

A broad definition of technology can graphically be given by an illustration shown in Figure A1.

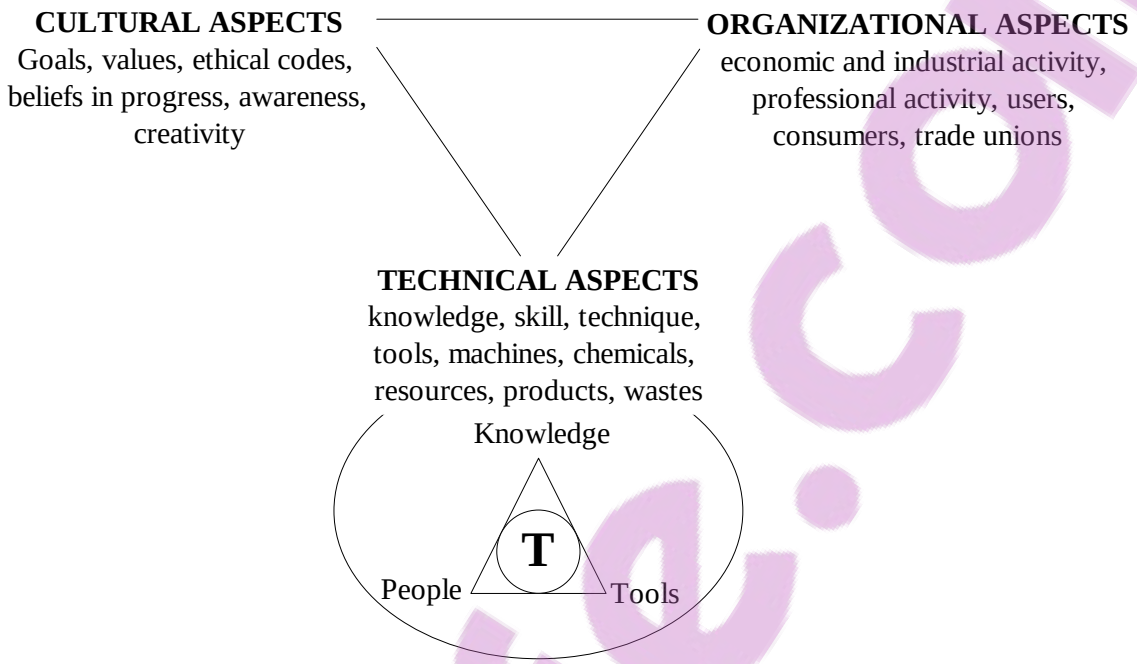


Figure A1. The broad definition of technology

The definition of technology used during this dissertation was a bit more narrowed down and can be seen as a definition under the "Technical Aspects" of Figure 1A. The other aspects are however also indirectly accounted for through people and stakeholders that come from a certain background and who has a specific culture. They also function within an organizational system and evaluate subsystems on the basis of economic and other indicators/standards.

The definition of technology, referred to as the "Technology Triangle" in this dissertation, can graphically be given by an illustration shown in Figure A2.

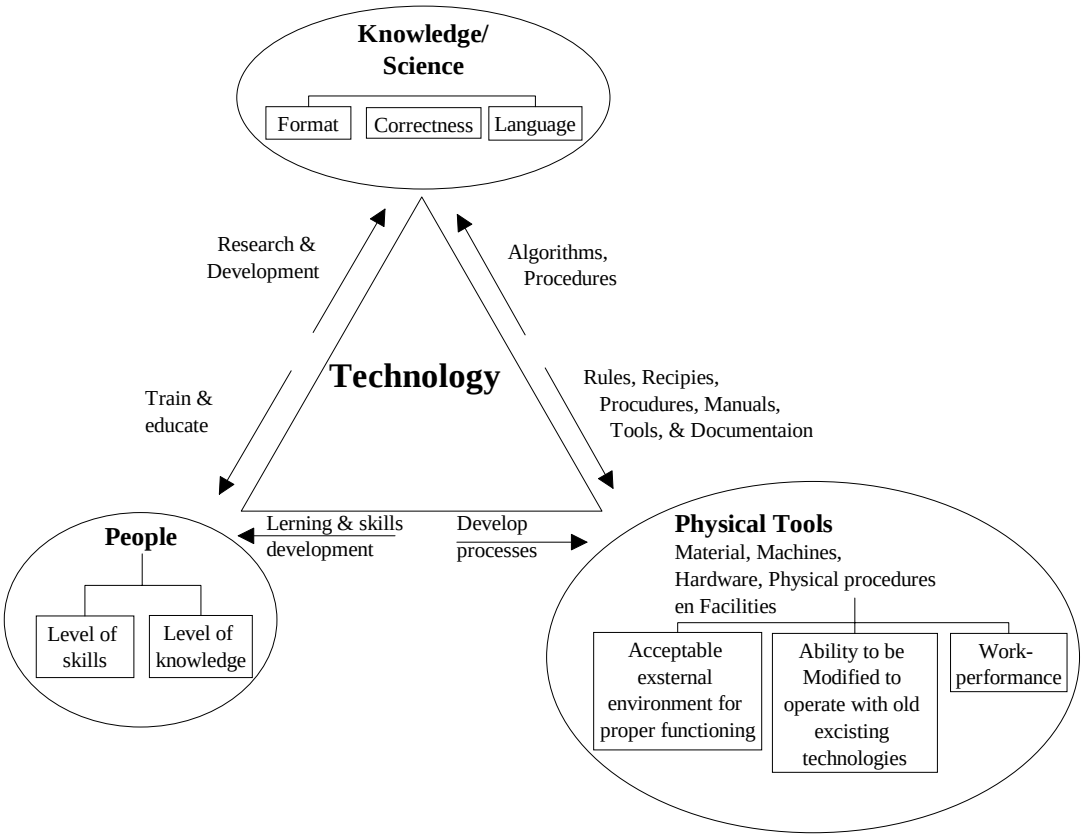


Figure A2. A Diagrammatic Definition of Technology (The technology triangle)

The triangle of technology has three interdependent and interacting components namely: People, Technical Knowledge, and "Tools" or hardware. The effectiveness of the technology utilization depends largely on the interaction between the three components. The fact that the three components are unique for each country or company needs to be stressed here. These differ at:

Technical Knowledge: The format, correctness, and language of the knowledge being used by a country might differ from another. Some countries rely on CD ROM drives with Internet based updated information which provides very up-to-date and correct data that is available and easy to access. Other countries still use stores with records on paper and confusing registries. This might become a very important advantage/disadvantage especially for a fast moving technology like telecommunications.

People: People involved, definitely plays an extremely important role. Their level of education and technological skill level can determine the ability to fully utilize the technology and also to modify it for operation with other existing and older technologies. Without the right people the technology will never be utilized fully.

Physical Tools: Physical tools are referred to as material machinery, hardware, physical procedures and facilities. Conservatively, this component is considered as the most important aspect of the technology because a direct value in Rands can be attached to it. This is a very dangerous mistake to make because all three components deserve equal importance. A country/company's ability to afford plays a role but this does not necessarily determine the effectiveness of the technology utilization process.

Appendix B: Chi-Square

The Chi-square probability value was used to indicate statistical significance and will be briefly discussed below

The Chi-square test (or $\chi 2$) is a test for assessing the statistical significance of cross-tabulated variables. This is based on a comparison between the observed cell frequencies of a cross-tabulation or joint contingency table with the frequencies that would be expected if the null hypothesis of no relationship were in fact true. The key to the calculation of the χ^2 statistic is to obtain these expected frequencies [87].

If two variables are statistically independent, within categories of the independent variable in a contingency table, there are identical proportions of the dependant variable. Similarly, within each category of the dependant variable the same proportion of the independent responses occurs.

If two variables, X and Y, are statistically independent, the formula for the expected frequency in row I and column j is [87]:

$$\hat{f}_{ij} = \frac{(f_{i.})(f_{.j})}{N} \qquad \textbf{(B1)}$$

Where:

$\hat{f}_{ij}$ = The expected frequency of the cell in row i and column j.

$f_{i.}$ = The total in the i^{th} row marginal.

$f_{.j}$ = The total in the j^{th} column marginal.

N = The grand total, or sample size of the entire table.

If $\hat{f}_{ij}$ is the expected frequency under the null hypothesis and f_{ij} is the observed frequency for the same cell, the value of the statistic for the table is found by the formula [87]:

$$\chi^2 = \sum_{i=1}^{R}\sum_{j=1}^{C}\frac{(\hat{f}_{ij} - f_{ij})^2}{\hat{f}_{ij}} \qquad \textbf{(B2)}$$

Where:
C = Number of Columns.
R = Number of rows.

The difference between the observed and expected frequencies in a cell is first squared (to remove the minus signs) and divided by the expected frequency for that cell. After this operation has been performed for all cells, the results are summed for all cells of the table.

The outcome of the chi-square test has a value that can be translated to a probability through the use of a Chi-square table. For the variables to be statistically dependant on one another the value of the probability should be less than 0.05 (χ^2<0.05). This is also the test value that was used through the data analysis for the survey done in Sekhukhuneland. For more information about the Chi-square test (χ^2) the reader is referred to Bohrnstedt, [87].

Appendix C: Research region selection

Total sumary for all magisterial districts						Number of people
1 Western Cape						3956875
Ranked out of 10 for	Population	Education	Expenditure	Total ranked	Sufficient cellphone coverage	Number of people
101 Bellville	4	4	8	5		274080
102 Goodwood	4	4	6	5		314197
103 Cape	3	3	7	4		184700
104 Simonstown	1	1	7	3		76025
105 Wynberg	6	6	6	6		543322
106 Mitchellsplain	9	9	3	7		728914
107 Kuilsrivier	3	3	6	4		253512
108 Paarl	2	2	4	3		153324
109 Stellenbosch	1	1	5	2		79468
110 Somerset West	1	1	7	3		65433
111 Strand	1	1	6	3		56486
112 Wellington	1	1	5	2		45225
113 Bredasdorp	1	1	5	2		24539
114 Caledon	1	1	4	2		80210
115 Hermanus	1	1	5	2		30093
116 Heidelberg	1	1	4	2		12296
117 Swellendam	1	1	4	2		33179
118 George	2	2	5	3		113227
119 Knysna	1	1	4	2		61376
120 Mossel bay	1	1	5	2		58272
121 Riversdal	1	1	4	2		26257
122 Calitzdorp	1	1	3	2	No	7578
123 Ladismith	1	1	3	2	No	13612
124 Oudtshoorn	1	1	4	2		78705
125 Uniondale	1	1	3	2		9564
126 Ceres	1	1	3	2		51188
127 Montagu	1	1	4	2	No	23359
128 Robertson	1	1	3	2		34565
129 Tulbagh	1	1	3	2		30415
130 Worcester	2	2	4	3		133194
131 Hopefield	1	1	5	2		10110
132 Malmesbury	2	2	4	3		120909
133 Piketberg	1	1	4	2		38750
134 Vredenburg	1	1	5	2		46902
135 Moorreesburg	1	1	4	2		13885
136 Clanwilliam	1	1	4	2		28799

1 Western Cape (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked	Sufficient cellphone coverage	Number of people
137 Van Rhynsdorp	1	1	4	2	No	14062
138 Vredendal	1	1	4	2	No	31030
139 Beaufort West	1	1	4	2	No	34695
140 Laingsburg	1	1	3	2		5913
141 Murraysburg	1	1	2	1	No	5998
142 Prince Albert	1	1	3	2	No	9508
2 Eastern Cape						**6302525**
201 Albert	1	1	3	2		16240
202 Aliwal North	1	1	3	2		28529
203 Lady Grey	1	1	2	1	No	7204
204 Steynsburg	1	1	2	1	No	7655
205 Venterstad	1	1	2	1	No	5715
206 Hofmeyer	1	1	2	1		4933
207 Barkley-East	1	1	2	1	No	11056
208 Elliot	1	1	2	1	No	16391
209 Indwe	1	1	2	1		9503
210 Maclear	1	1	2	1	No	19398
211 Wodehouse	1	1	2	1	No	13257
212 Cathcart	1	1	2	1		13723
213 Komga	1	1	2	1		14085
214 Molteno	1	1	2	1	No	11819
215 Queenstown	1	1	4	2		68324
216 Sterkstroom	1	1	2	1	No	7607
217 Stutterheim	1	1	2	1	No	32538
218 Tarka	1	1	2	1		7526
219 East-London	4	4	4	4		296294
220 King William's Town	1	1	5	2		28094
221 Albany	1	1	4	2	No	77656
222 Alexandria	1	1	2	1		24075
223 Adelaide	1	1	2	1	No	15001
224 Bathurst	1	1	2	1		32283
225 Bedford	1	1	2	1		11215
226 Fort Beaufort	1	1	2	1	No	27120
227 Somerset East	1	1	2	1	No	28075
228 Kirkwood	1	1	2	1		33810
229 Cradock	1	1	3	2	No	36199
230 Middelburg	1	1	3	2	No	21672
231 Aberdeen	1	1	2	1		8498

2 Eastern Cape (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
232 Graaff-Reinet	1	1	3	2		38539
233 Pearston	1	1	1	1		4865
234 Jansenville	1	1	2	1	No	10518
235 Steytlerville	1	1	2	1	No	5354
236 Willowmore	1	1	2	1	No	11735
237 Hankey	1	1	2	1		26651
238 Humansdorp	1	1	4	2		50421
239 Joubertina	1	1	2	1		14354
240 Port Elizabeth	9	9	4	7		775255
241 Uitenhage	3	3	4	3		196165
242 Mdantsane	3	3	2	3		222888
243 Zwelitsha	3	3	1	2	No	238806
244 Hewu	1	1	1	1		59626
245 Keiskammahoek	1	1	1	1	No	35727
246 Mpofu	1	1	1	1	No	15574
247 Victoria East	1	1	1	1	No	54476
248 Middeldrift	1	1	1	1	No	46238
249 Peddie	1	1	1	1		60737
250 Bizana	3	3	1	2	No	196386
251 Butterworth	2	2	2	2		96215
252 Elliotdale	1	1	1	1	No	74165
253 Engcobo	2	2	1	2	No	166838
254 Flagstaff	2	2	1	2	No	118686
255 Idutywa	1	1	1	1		93292
256 Kentani	1	1	1	1	No	89183
257 Libode	2	2	1	2	No	131776
258 Lusikisiki	3	3	1	2	No	247423
259 Maluti	2	2	1	2	No	150691
260 Mt Ayliff	1	1	1	1		81074
261 Mt Fletcher	2	2	1	2	No	113506
262 Mt Frere	2	2	1	2	No	120494
263 Mqanduli	2	2	1	2	No	129596
264 Ngqueleni	2	2	1	2		152303
265 Nqamakwe	1	1	1	1	No	85404
266 Port St Johns	1	1	1	1		68139
267 Qumbu	2	2	1	2		103895
268 Cofimvaba	2	2	1	2		101883
269 Tabankulu	2	2	1	2	No	126336

2 Eastern Cape (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
270 Tsolo	2	2	1	2		103791
271 Tsomo	1	1	1	1	No	61187
272 Umtata	3	3	2	3		261126
273 Willowvale	2	2	1	2	No	104045
274 Cala	1	1	1	1	No	52473
275 Lady Frere	2	2	1	2	No	169328
276 Sterkspruit	2	2	1	2	No	112057
277 Umzimkulu	2	2	1	2	No	165422
278 Ntabathemba	1	1	1	1		22390
3 Northern Cape						**840321**
301 Namakwaland	1	1	3	2	No	72711
302 Calvinia	1	1	2	1	No	19614
303 Sutherland	1	1	3	2	No	3821
304 Williston	1	1	3	2	No	4501
305 Carnarvon	1	1	2	1	No	9733
306 Prieska	1	1	2	1	No	20170
307 Britstown	1	1	2	1		6067
308 Colesberg	1	1	2	1		17614
309 De Aar	1	1	3	2		28880
310 Hanover	1	1	2	1		4743
311 Hopetown	1	1	3	2		13576
312 Noupoort	1	1	2	1	No	7752
313 Philipstown	1	1	2	1	No	9432
314 Richmond	1	1	2	1		6608
315 Gordonia	2	2	3	2	No	149221
316 Kenhardt	1	1	2	1	No	14129
317 Barkley-West	1	1	2	1		39211
318 Hartswater	1	1	3	2		36837
319 Herbert	1	1	2	1		28855
320 Warrenton	1	1	2	1		24239
321 Kimberley	3	3	4	3		206069
322 Kuruman	1	1	4	2	No	26957
323 Postmasburg	1	1	3	2	No	59165
324 Hay	1	1	2	1	No	12063
325 Fraserburg	1	1	3	2	No	4335
326 Victoria-West	1	1	2	1	No	14018

4 Free State						2633504
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
401 Boshof	1	1	1	1	No	26767
402 Jacobsdal	1	1	2	1		9872
403 Koffiefontein	1	1	2	1	No	11636
404 Fauresmith	1	1	2	1	No	9177
405 Petrusburg	1	1	2	1		9845
406 Odendaalsrus	2	2	2	2		94654
407 Virginia	1	1	2	1		79085
408 Welkom	3	3	3	3		251699
409 Bothaville	1	1	2	1		53240
410 Bultfontein	1	1	1	1	No	29584
411 Heilbron	1	1	2	1	No	39302
412 Hennenman	1	1	2	1		26855
413 Hoopstad	1	1	1	1	No	22630
414 Koppies	1	1	1	1	No	17772
415 Kroonstad	2	2	3	2		108829
416 Parys	1	1	2	1		48747
417 Theunissen	1	1	1	1		38063
418 Ventersburg	1	1	1	1	No	13594
419 Vredefort	1	1	1	1		15027
420 Viljoenskroon	1	1	1	1		52551
421 Wesselsbron	1	1	1	1		31812
422 Bethlehem	1	1	3	2		88570
423 Ficksburg	1	1	2	1		47067
424 Fouriesburg	1	1	1	1	No	15528
425 Frankfort	1	1	2	1		47616
426 Harrismith	1	1	2	1		61980
427 Lindley	1	1	1	1	No	38549
428 Reitz	1	1	2	1	No	28965
429 Senekal	1	1	2	1		40169
430 Vrede	1	1	1	1	No	35067
431 Brandfort	1	1	2	1		22686
432 Clocolan	1	1	1	1	No	19285
433 Dewetsdorp	1	1	2	1		13093
434 Edenburg	1	1	2	1		7047
435 Excelsior	1	1	1	1	No	17310
436 Jagersfontein	1	1	2	1		6574
437 Ladybrand	1	1	2	1		30669
438 Marquard	1	1	1	1	No	17379

4 Free State (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
439 Philippolis	1	1	2	1	No	6653
440 Reddersburg	1	1	2	1		6117
441 Trompsburg	1	1	2	1		5378
442 Wepener	1	1	1	1	No	13208
443 Winburg	1	1	1	1		15253
444 Botshabelo	2	2	1	2		177971
445 Bloemfontein	4	4	4	4		350504
446 Smithfield	1	1	1	1	No	7040
447 Bethulie	1	1	2	1	No	11765
448 Rouxville	1	1	2	1	No	10495
449 Zastron	1	1	1	1	No	16721
450 Sasolburg	2	2	4	3		102006
451 Thaba 'Nchu	1	1	1	1		77455
452 Witsieshoek	4	4	1	3	No	304643
5 KwaZulu-Natal						**8417021**
501 Durban	7	7	6	7		566120
502 Inanda	9	9	4	7		794167
503 Pinetown	5	5	5	5		442948
504 Chatswoth	3	3	5	4		189885
505 Camperdown	3	3	3	3		200339
506 Richmond	1	1	2	1		64868
507 Pietermaritzburg	7	7	4	6		573843
508 Umzinto	3	3	2	3		238805
509 Ixopo	2	2	1	2	No	131632
510 Alfred	2	2	1	2		125833
511 Port Shepstone	3	3	3	3		225918
512 Mount Currie	1	1	3	2	No	44871
513 Underberg	1	1	2	1	No	16175
514 Polela	1	1	1	1	No	79537
515 Impendle	1	1	1	1	No	38125
516 Kranskop	1	1	1	1	No	50971
517 Lions River	1	1	4	2		53289
518 New Hanover	1	1	2	1		87223
519 Mooi river	1	1	3	2		22563
520 Umvoti	1	1	2	1	No	88128
521 Bergville	2	2	1	2		110831
522 Estcourt	2	2	2	2		159376
523 Kliprivier	3	3	3	3		198095

5 KwaZulu-Natal (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
524 Weenen	1	1	1	1	No	21632
525 Dannhauser	1	1	2	1		74561
526 Dundee	1	1	3	2	No	85332
527 Glencoe	1	1	3	2		31322
528 Newcastle	4	4	4	4		303723
529 Utrecht	1	1	3	2	No	25300
530 Babanango	1	1	1	1	No	40597
531 Ngotshe	1	1	2	1	No	35223
532 Paulpietersburg	1	1	2	1	No	60591
533 Vryheid	1	1	4	2		88323
534 Eshowe	3	3	2	3	No	214654
535 Hlabisa	3	3	2	3		198180
536 Lower Umfolozi	3	3	4	3		241837
537 Mthonjaneni	1	1	2	1		72327
538 Mtunzini	3	3	3	3		198898
539 Ubombo	2	2	1	2	No	132302
540 Lower Tugela	2	2	2	2		177460
541 Umbumbulu	3	3	2	3		194192
542 Umlazi	4	4	3	4		339715
543 Ndwedwe	2	2	1	2		144172
544 Mapumulo	2	2	1	2	No	150169
545 Nkandla	2	2	5	3	No	135081
546 Nqutu	3	3	1	2	No	189097
547 Msinga	2	2	1	2	No	163736
548 Mhlabathini	2	2	2	2		146413
549 Nongoma	3	3	1	2		188959
550 Ingwavuma	2	2	1	2	No	171919
551 Simdlangentsha	1	1	2	1		87762
6 North West						**3354825**
601 Huhudi	2	2	1	2		100033
602 Kudumane	2	2	1	2	No	143866
603 Vryburg	1	1	3	2		60523
604 Phokwani	3	3	1	2	No	201273
605 Mmabatho	3	3	2	3	No	255249
606 Madikwe	2	2	2	2		132893
607 Lichtenburg	2	2	3	2		129980
608 Delareyville	2	2	1	2		151446
609 Schweizer-Reneke	1	1	2	1		45816

6 North West (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
610 Wolmaransstad	1	1	2	1		79910
611 Christiana	1	1	3	2		36032
612 Klerksdorp	4	4	4	4		334501
613 Ventersdorp	1	1	2	1		31728
614 Potchefstroom	2	2	5	3		166704
615 Mankwe	3	3	2	3		203217
616 Rustenburg	5	5	3	4		370913
617 Brits	2	2	3	2		165414
618 Ga-Rankuwa	5	5	2	4		423312
619 Temba	4	4	2	3		322014
7 Gauteng						**7348423**
701 Pretoria	8	8	9	8		692348
702 Soshanguve	3	3	3	3		242727
703 Wonderboom	4	4	7	5		319798
704 Johannesburg	9	9	7	8		760791
705 Randburg	4	4	7	5		362481
706 Alberton	5	5	4	5		410257
707 Benoni	5	5	5	5		366343
708 Boksburg	3	3	6	4		263179
709 Germiston	2	2	9	4		164252
710 Kempton Park	5	5	4	5		446106
711 Brakpan	2	2	5	3		171363
712 Heidelberg	1	1	4	2		83013
713 Nigel	2	2	5	3		106120
714 Springs	2	2	7	4		163304
715 Krugersdorp	3	3	6	4		208284
716 Oberholzer	2	2	4	3		166568
717 Randfontein	2	2	5	3		133032
718 Roodepoort	4	4	8	5		279340
719 Westonaria	2	2	4	3		160763
720 Bronkhorstspruit	1	1	4	2		35523
721 Cullinan	1	1	2	1		82601
722 Vereeniging	4	4	5	4		342704
723 Vanderbijlpark	6	6	4	5		483360
724 Soweto	10	10	4	8		904165
8 Mpumalanga						**2800711**
801 Amersfoort	1	1	2	1		30151
802 Bethal	1	1	3	2		50950

8 Mpumalanga (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
803 Carolina	1	1	2	1		27836
804 Ermelo	2	2	3	2		122436
805 Piet Retief	1	1	3	2		62682
806 Standerton	1	1	3	2		87435
807 Volksrust	1	1	4	2		30824
808 Wakkerstroom	1	1	2	1	No	36130
809 Kriel	1	1	5	2		24519
810 Balfour	1	1	3	2		37173
811 Hoëveldrif	2	2	4	3		159138
812 Delmas	1	1	4	2		49741
813 Belfast	1	1	3	2		24280
814 Groblersdal	1	1	4	2		35541
815 Middelburg	2	2	5	3		145399
816 Waterval Boven	1	1	3	2		9501
817 Witbank	3	3	5	4		215323
818 Moutse	2	2	2	2		140887
819 Barberton	1	1	2	1	No	74255
820 Lydenburg	1	1	3	2	No	37462
821 Nelspruit	1	1	6	3		58205
822 Pelgrimsrust	1	1	2	1	No	37776
823 Witrivier	1	1	5	2		20102
824 Eerstehoek	2	2	1	2		154930
825 Nkomazi	3	3	2	3	No	249591
826 Nsikazi	4	4	2	3		352351
827 Mdutjana	2	2	2	2		126850
828 Mkobola	2	2	2	2		115860
829 Mbibana	1	1	2	1		53548
830 Kwamhlanga	2	2	2	2		151483
831 Moretele	1	1	2	1		78354
9 Northern Province						**4929368**
901 Letaba	1	1	4	2	No	66693
902 Messina	1	1	3	2	No	29827
903 Phalaborwa	1	1	8	3	No	30533
904 Pietersburg	1	1	10	4		63901
905 Soutpansberg	1	1	8	3	No	33991
906 Potgietersrus	1	1	4	2	No	49719
907 Waterberg	1	1	4	2	No	56488
908 Ellisras	1	1	5	2	No	21613

9 Northern Province (Continued)						
Ranked out of 10 for	Population	Education	Expenditure	Total ranked		Number of people
909 Thabazimbi	1	1	4	2	No	55411
910 Warmbad	1	1	4	2		49814
911 Malamulela	2	2	1	2		170155
912 Hlanganani	2	2	2	2		121081
913 Namakgale	1	1	3	2		48712
914 Mhala	4	4	2	3		295707
915 Ritavi	2	2	2	2		151618
916 Giyani	3	3	2	3	No	209721
917 Lulekani	1	1	2	1		37536
918 Bolobedu	3	3	2	3		198620
919 Sekgosese	2	2	1	2		105279
920 Bochum	2	2	1	2	No	160649
921 Mokerong	**5**	**5**	**2**	**4**	**No**	**406608**
922 Seshego	4	4	2	3		327035
923 Thabamoopo	4	4	2	3		356017
924 Nebo	4	4	2	3		303707
925 Sekhukhuneland	**5**	**5**	**1**	**4**	**No**	**414790**
926 Naphuno	2	2	2	2		152455
927 Mapulaneng	3	3	2	3		247992
928 Dzanani	2	2	2	2		170538
929 Mutali	1	1	1	1	No	68403
930 Thohoyandou	4	4	2	3		343710
931 Vuwani	2	2	2	2		181042

Appendix D: Rural Citizen Questionnaire

University of Pretoria

The following questionnaire is completely confidential and the information provided will be used for academic purposes only. At no point what so ever will the information be presented to the public with any connection to the individual involved.

General Questions

For office use only

Respondent number: ☐☐☐ V 1 ☐☐☐ 1 - 3

Repetition number: ☐ of ☐ example:1 of 2 V 2 ☐☐ 4 - 5

Village name ☐☐☐☐☐☐☐☐☐☐☐ V 3 ☐☐☐ 6 - 8

General Questions	For office use only
Interview Date: D ☐☐ / M ☐☐ / Y 2 0 ☐☐	9 - 14 V 4 ☐☐☐☐☐☐
Sex: ☐1 Male ☐2 Female	V 5 ☐ 15
1 How old are you? ☐☐ years	V 6 ☐☐ 16 - 17
2 In what type of house are you living?	
☐1 Back yard	V 7 ☐ 18
☐2 Own House	
☐3 Rental house	
☐4 Traditional dwelling	
☐5 Room/Hostel	
☐6 Informal (Shack)	
☐7 Flat	
☐9 I'm homeless	
3 For how long have you lived here? ☐☐ years ☐☐ months	V 8 ☐☐☐☐ 19 - 22
4 Are you currently employed?	
☐1 Yes ☐3 Student	V 9 ☐ 23
☐2 No ☐4 Self employed	
5 What's the level of education that you have obtained?	
☐1 None **☐4 St6(Gr8) - St9(Gr11)**	**V 10** ☐ **24**
☐2 Gr1 - St3(Gr5) **☐5 St 10(Gr12) Matric**	
☐3 St4(Gr6) - St5(Gr7) **☐6 Higher**	
6 Can you read and write?	
☐1 Read	V 11 ☐ 25
☐2 Write	V 12 ☐ 26
7 Have you ever used a computer? ☐1 Yes ☐2 No	V 13 ☐ 27

General Questions	For office use only
8 If you have a job, what is you job title? _____	
9 How much money do you earn?	
[0] Less than R250 per month	V 14 [ ] 28
[1] Between R250 and R500 per month	
[2] Between R500 and R800 per month	
[3] Between R800 and R1500 per month	
[4] Between R1500 and R2000 per month	
[5] Between R2000 and R2500 per month	
[6] Between R2500 and R3000 per month	
[7] Between R3000 and R4000 per month	
[8] More than R4000 per month	
10 How many people are living in your house and are dependant on your salary?	
[ ][ ] male	V 15 [ ][ ] M 29 - 30
[ ][ ] female	V 16 [ ][ ] F 31 - 32
11 Have you ever used a two-way-radio (e.g.. security guard)?	
[1] Yes [2] No	V 17 [ ] 33
12 Do you have electricity in your house?	
[1] Yes [2] No	V 18 [ ] 34
13 Indicate which of the following items do you own:	
[1] TV (television set)	V 19 [ ] 35
[2] Radio (FM and AM)	V 20 [ ] 36
[3] Car	V 21 [ ] 37
[4] Electric oven or an electric stove	V 22 [ ] 38
[5] Geyser	V 23 [ ] 39
[6] Microwave oven	V 24 [ ] 40
14 Why would you encourage your friend to get a **telephone**? What advantages does a telephone have to offer you?	
1 _____	V 25 [ ][ ] 41 - 42
2 _____	V 26 [ ][ ] 43 - 44
3 _____	V 27 [ ][ ] 45 - 46
15 How often do you hear of a crime in this area?	
[1] Every day	V 28 [ ] 47
[2] Once a week	
[3] Once a month	
[4] Almost never	

General Questions	For office use only
16 What kinds of crime exist in this area?	
1 Theft	V 29 [ ] 48
2 Vandalism	V 30 [ ] 49
3 Rape	V 31 [ ] 50
4 Murder	V 32 [ ] 51
5 Drugs	V 33 [ ] 52
6 Corruption and blackmail	V 34 [ ] 53
7 None	V 35 [ ] 54
8 Other Specify: _____	V 36 [ ][ ] 55 - 56
17 Have any crime ever been committed against you?	
1 Yes 2 No	V 37 [ ] 57
18 What would you do if you see a crime being committed?	
1 Run away	V 38 [ ] 58
2 Do nothing and mind my own business	V 39 [ ] 59
3 Try to stop the crime myself	V 40 [ ] 60
4 Call Police	V 41 [ ] 61
5 Go report this at the police station	V 42 [ ] 62
6 Go to a family member/fiend and tell him/her	V 43 [ ] 63
7 Call a family member or a friend	V 44 [ ] 64
8 Call the Vodacom emergency number	V 45 [ ] 65
9 Call the MTN emergency number	V 46 [ ] 66
10 Other Specify: _____	V 47 [ ][ ] 67 - 68
19 Which of the following numbers do you know or have in your address book or cellphone?	
1 Police	V 48 [ ] 69
2 Ambulance	V 49 [ ] 70
3 Fire department	V 50 [ ] 71
4 Hospital	V 51 [ ] 72
5 MTN emergency number	V 52 [ ] 73
6 Vodacom emergency number	V 53 [ ] 74
7 The poison information line	V 54 [ ] 75
20 Have you ever needed a telephone in an emergency?	
1 Yes 2 No	V 55 [ ] 76
21 If yes, was it possible to use a phone?	
1 Yes 2 No	V 56 [ ] 77
22 How badly do you need a telephone or cellphone?	
1 Not at all	V 57 [ ] 78
2 That would be nice	
3 I would have difficulty living without one	

General Questions	For office use only
23 What other means of communication do you have?	
[1] A 2-way radio (like a security guard)	V 58 [ ] 79
[2] Mail a letter	V 59 [ ] 80
[3] Telegram	V 60 [ ] 81
[4] Public Telephone in the village	V 61 [ ] 82
[5] Public Cellphone in the village	V 62 [ ] 83
[6] E-mail	V 63 [ ] 84
[7] Other Specify:	V 64 [ ][ ] 85 - 86
24 Has anyone ever asked you how you'd like a telephone or cellphone to work, or which services you'd like that are not available yet?	
[1] Yes [2] No	V 65 [ ] 87
25 Which one do you prefer	
[1] Telkom telephone	V 66 [ ] 88
[2] MTN Cellphone	V 67 [ ] 89
[3] Vodacom Cellphone	V 68 [ ] 90
[4] None	V 69 [ ] 91
26 How long would can one call with R30 during the week?	
[ ][ ] minutes on a **cellphone**	V 70 [ ][ ] Cell 92 - 93
[ ][ ] minutes on a **Telkom telephone**	V 71 [ ][ ] Tel 94 - 95
[ ] I don't know at all	V 72 [ ] 96
27 How much money do you spend on the Lotto?	
R [ ][ ][ ][ ] per month	V 73 [ ][ ][ ][ ] 97 - 100
28 How much money do you spend on Beer or other liquor?	
R [ ][ ][ ][ ] per month	V 74 [ ][ ][ ][ ] 101 - 104

Telkom Questions	For office use only
29 Have you ever used a Telkom telephone yourself before?	
[1] Yes [2] No	V 75 [ ] 105
30 How far do you live from the nearest telephone?	
[1] One in my home [4] Less than 10km	V 76 [ ] 106
[2] Less than 1km [5] Less than 25km	
[3] Less than 5km [6] More than 25km	
31 Have you ever heard of **Telkom's** PrePaid Telephone?	
[1] Yes [2] No	V 77 [ ] 107
If yes, how far is the nearest shop selling PrePaid recharge cards for a **Telkom phone** from your house?	
[ ][ ][ ] km Shop name: _____	V 78 [ ][ ][ ] km 108 - 110

Telkom Questions	For office use only
32 Which of the following services have you heard about?	
[0] Phonecard	V 79 [ ] 111
[1] WorldCall	V 80 [ ] 112
[2] Direct-a-Call	V 81 [ ] 113
[3] SpeedCall	V 82 [ ] 114
[4] UrgentCall	V 83 [ ] 115
[5] IdentiCall	V 84 [ ] 116
[6] Call Answer	V 85 [ ] 117
[7] WaitingCall	V 86 [ ] 118
[8] BlockCall	V 87 [ ] 119
[9] Homefree	V 88 [ ] 120
33 Have you ever had a telephone yourself at home?	
[1] Yes [2] No	V 89 [ ] 121
34 Do you currently have a Telkom telephone at home?	
[1] Yes [2] No	V 90 [ ] 122
35 If you don't have a telephone yourself, what would have to change before you get a Telkom telephone?	
[1] **Calls** have to become cheaper	V 91 [ ] 123
[2] **Telephones** have to become cheaper	V 92 [ ] 124
[3] Telkom must come and install a telephone	V 93 [ ] 125
[4] The network has to be extended to my village first	V 94 [ ] 126
[5] Telkom said that it is not possible at the moment	V 95 [ ] 127
[6] Other Specify: _____	V 96 [ ][ ] 128 - 129
36 If there was a service that enables you to call for free but you'll have to listen to an advertisement every 30 seconds on the telephone, would you want this?	
[1] Yes [2] No [3] I don't understand	V 97 [ ] 130
T 37 For how long have you had your **Telkom phone** now?	131 - 136
[ ][ ] years [ ][ ] months [ ][ ] weeks	V 98 [ ][ ][ ][ ][ ][ ]
T 38 How much do you spend on your **Telkom telephone** ?	
R [ ][ ][ ][ ] per month	V 99 [ ][ ][ ][ ] 137 - 140
T 39 Is your **Telkom telephone** a **PrePaid** telephone?	
Yes [1] No [2]	V 100 [ ] 141
T 40 How did you get this telephone?	
[1] It was offered to me by a Telkom person	V 101 [ ] 142
[2] I applied for it	V 102 [ ] 143
[3] It was in the house when I moved in	V 103 [ ] 144
[4] I connected it myself	V 104 [ ] 145
[6] Other	V 105 [ ][ ] 146 - 147

Telkom Questions	For office use only
T 41 If you do have a telephone, is it working properly?	
1 Yes	V 106 [ ] 148
2 No	
3 It is only working sometimes because:	
4 Telkom disconnects me if I don't pay	V 107 [ ] 149
5 Because of cable theft	V 108 [ ] 150
6 My phone or line gets damaged by weather a lot	V 109 [ ] 151
7 My phone or line gets vandalized often	V 110 [ ] 152
8 Other Specify: _____	V 111 [ ][ ] 153 - 154
T 42 If your telephone is not working at all, why not?	
1 I didn't pay and I got disconnected	V 112 [ ] 155
2 The telephone broke	V 113 [ ] 156
3 The line outside my home is broken	V 114 [ ] 157
4 A line within my home is broken off	V 115 [ ] 158
5 I don't know	V 116 [ ] 159
T 43 If there is a problem with your phone, is it reported?	
2 No 1 Yes, I reported the fault to:	V 117 [ ] 160
3 Telkom customer service branch	V 118 [ ] 161
4 Telkom worker on site	V 119 [ ] 162
5 The landlord	V 120 [ ] 163
6 The municipal office	V 121 [ ] 164
7 I called Telkom	V 122 [ ] 165
8 Other. Indicate: _____	V 123 [ ][ ] 166 - 167
T 44 If your **phone** works, When last did you have a problem?	168 - 173
[ ][ ] Days ago [ ][ ] Weeks ago [ ][ ] Months ago	V 124 [ ][ ][ ][ ][ ][ ]
[ ] More than a year	V 125 [ ] 174
T 45 If your Telkom **telephone** is broken, why haven't you got a new one?	
1 Telkom has not given me a new one yet	V 126 [ ] 175
2 I can not afford a new telephone	V 127 [ ] 176
3 I don't know where to buy a new phone	V 128 [ ] 177
4 Other Specify _____	V 129 [ ][ ] 178 - 179
T 46 How often is your Telkom telephone not working?	
[ ][ ][ ] times per	V 130 [ ][ ][ ] 180 - 182
1 week 2 month 3 year	V 131 [ ] 183
4 The service is good	V 132 [ ] 184

Telkom Questions	For office use only
T 47 For how long (on avarage) at a time is your **telephone** not working?	
☐☐ hours	V 133 ☐☐ 185 - 186
☐☐ days	V 134 ☐☐ 187 - 188
☐☐ weeks	V 135 ☐☐ 189 - 190
☐☐ months	V 136 ☐☐ 191 - 192
☐ I never had a problem	V 137 ☐ 193
T 48 If there is a problem with your **telephone** and you did report it, how long ago was the fault reported	194 - 199
☐☐ years ☐☐ months ☐☐ weeks	V 138 ☐☐☐☐☐☐
49 If you don't have a **Telkom telephone,** why not?	
1 I don't afford a phone	V 139 ☐ 200
2 I don't know how to use a phone	V 140 ☐ 201
3 I don't want one	V 141 ☐ 202
4 I use my neighbor's phone	V 142 ☐ 203
5 I prefer a public telephone	V 143 ☐ 204
6 I use a cellphone	V 144 ☐ 205
7 I want one. I'm waiting for installation	V 145 ☐ 206
How long ago did you apply for a phone?	
☐☐ years	V 146 ☐☐ 207 - 208
☐☐ month	V 147 ☐☐ 209 - 210
☐☐ weeks	V 148 ☐☐ 211 - 212
☐☐ days	V 149 ☐☐ 213 - 214
Other reason for not having a telephone: _____	V 150 ☐☐ 215 - 216
_____	V 151 ☐☐ 217 - 218
_____	V 152 ☐☐ 219 - 220
50 How much money do you spend on a Telkom **public payphone?**	
R ☐☐☐☐ per month	V 153 ☐☐☐☐ 221 - 224
T 51 If you had a telephone but you canceled the service, Why?	
_____	V 154 ☐☐ 225 - 226
_____	V 155 ☐☐ 227 - 228
T 52 When will you cancel your service with Telkom?	
1 If my **telephone** brakes & I have to replace it myself	V 156 ☐ 229
2 When Telkom **stops** its **PrePaid** service	V 157 ☐ 230
3 Not easily. **I'm satisfied** with the service.	V 158 ☐ 231
4 Only with unrealistic price increases.	V 159 ☐ 232
5 When I can't afford it	V 160 ☐ 233

Cellphone Questions	For office use only
53 Have you ever used a cellphone? [1] Yes [2] No	V 161 [ ] 234
54 Do you currently have your own cellphone? [1] Yes [2] No	V 162 [ ] 235
C 55 Which of the following are you using? [1] MTN Contract [2] Vodacom Contract [3] MTN's Pay as you go [4] Vodacom's Vodago (Prepaid) [5] I don't know	V 163 [ ] 236
56 Which of the following services have you heard about? [1] MTN's Pay as you go [2] Vodacom's Vodago	V 164 [ ] 237 V 165 [ ] 238
C 57 Have you ever send an SMS to someone? [1] Yes [2] No [3] I don't know about SMS	V 166 [ ] 239
58 Does your neighbour have a cell-phone? [1] Yes [2] No	V 167 [ ] 240
59 Who is your neighbor's service provider [1] MTN [2] Vodacom [3] I don't know	V 168 [ ] 241
60 If you don't have a cellphone, what would have to change before you get a cellphone? [1] **Calls** have to become cheaper [2] **Cellphones** have to become cheaper [3] MTN or Vodacom must allow me to get a **contract** [4] Other Specify: _____	V 169 [ ] 242 V 170 [ ] 243 V 171 [ ] 244 V 172 [ ][ ] 245 - 246
C 61 What make of cellphone do you have? [1] Alcatel [2] Ericsson [3] Motorola [4] Nokia [5] Siemens [6] Bosh [7] Phillips [8] Other Specify: _____	V 173 [ ][ ] 247 - 248
C 62 What is the model of your phone? (ex. 8110, S10, ext.) [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]	249 - 254 V 174 [ ][ ][ ][ ][ ][ ]
C 63 If you have a cellphone, how much do you spend on it? R [ ][ ][ ][ ] per month	V 175 [ ][ ][ ][ ] 255 - 258

Cellphone Questions	For office use only
C 64 Did you buy your cellphone brand new or as second hand?	
[1] Brand new [2] Second hand	V 176 [ ] 259
65 Do you have a bank account with a plastic card?	
[2] No [1] Yes, at:	V 177 [ ] 260
[3] ABSA	V 178 [ ] 261
[4] Standard Bank	V 179 [ ] 262
[5] Nedbank	V 180 [ ] 263
[6] First National bank	V 181 [ ] 264
[7] Other bank. Please specify:	V 182 [ ][ ] 265 - 266
At: _____	
C 66 If you have a bank account with a plastic card at one of the banks mentioned above, have you ever used this plastic card to buy airtime for a prepaid cellphone?	
[1] Yes [2] No	V 183 [ ] 267
C 67 Where do you charge the battery	
[1] At home	V 184 [ ] 268
[2] At a friend	V 185 [ ] 269
[3] At a business	V 186 [ ] 270
[4] At my work	V 187 [ ] 271
[5] Other Specify: _____	V 188 [ ][ ] 272 - 273
C 68 How often do you charge your cellphone battery?	
[1] Every Day [4] Every 4 Days	V 189 [ ] 274
[2] Every 2 Days [5] Every 5 Days	
[3] Every 3 Days [6] Once a week	
[7] Infrequently	
69 Where can one buy a new cellphone or battery for his/her cellphone? At:	
1 _____	V 190 [ ][ ] 275 - 276
2 _____	V 191 [ ][ ] 277 - 278
3 _____	V 192 [ ][ ] 279 - 280
70 Where can one buy Pay as you go, or Vodago airtime recharge vouchers for a prepaid cellphone?	
1 _____	V 193 [ ][ ] 281 - 282
2 _____	V 194 [ ][ ] 283 - 284
3 _____	V 195 [ ][ ] 285 - 286
71 How far away from your home is the nearest shop to buy recharge cards for a cellphone?	
[ ][ ][ ] km	V 196 [ ][ ][ ] km 287 - 289

Cellphone Questions	For office use only					
72 Where can one get a broken cellphone repaired?						
1 _____	V 197			290	-	291
2 _____	V 198			292	-	293
3 _____	V 199			294	-	295
C 73 How do you get information on a cellphone or anything concerning a cellphone that you don't understand						
1 Friend	V 200		296			
2 MTN customer service centre	V 201		297			
3 Vodacom customer service centre	V 202		298			
4 Newspaper, Magazine	V 203		299			
5 Posters on street	V 204		300			
6 Other Specify: _____	V 205			301	-	302
C 74 When will you cancel your service from MTN or Vodacom						
1 Not easily. **I'm satisfied** with the service.	V 206		303			
2 Only with unrealistic price increases.	V 207		304			
3 If my cellphone brakes and I have to replace it myself	V 208		305			
4 When MTN or Vodacom stops its **PrePaid** service	V 209		306			
5 When I **can't afford** it any more	V 210		307			

I voluntarily granted my permission for participation in this project as explained to me. I understand:

* My right to choose whether to participate in the project or not,
* That the information furnished will be handled confidentially,
* And that the results of the investigation may be used for the purposes of publication.

Signed: _____ Date: 2001 / M M / D D

Thank you for your cooperation

Appendix E: MTN Questionnaire

Model for Telecommunication Technology

Transfer to the Rural Sector of South Africa

Research project for fulfillment of requirements for a Masters degree in Technology Management.

Heinie Pieterse

Department of Engineering en Technology Management

Faculty of Engineering

University of Pretoria

Notice:
Please note that the information furnished will be handled confidentially,
and that the results of the investigation may be used for the purposes of publication.

Questionnaire for corporate personnel in MTN

University of Pretoria

Name: _____

Contact number: | | | | | | | | | | |

Company: MTN

Address of interview: _____

_____

_____

Code: | | | | |

D M Y

Interview Date: | | / | | / | 2 | 0 | | |

Job title: _____

Questions:

1 Why would you encourage a rural citizen to get a cellphone?
What advantages does a cellphone have to offer him/her?

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

2 In which languages does MTN offer services in South Africa? (Please indicate services as well)

Languge(s)	Service

3 From which of the following products/services offered by MTN can the rural citizen benefit most?

- ☐ Pay as you go (MTN's prepaid service)
- ☐ Anytime Companion contract
- ☐ Anytime Off-peak contract
- ☐ Share Time contract
- ☐ Other. Please specify:

4 Please indicate if there are other services planned for the future which will focus on the rural community user

5 Why can people living in the rural areas benefit from especially these products/services (indicated in previous 2 questions)?

- ☐ These products were designed because of a market survey that indicated a specific need among rural citizens
- ☐ These products are aimed at people with a low level of literacy
- ☐ These products are aimed at people with a low income
- ☐ The services are useful because rural people use:
  - ☐ Computers
  - ☐ Fax machines
  - ☐ Answering machines
  - ☐ Electronic mail
  - ☐ Public payphones
- ☐ Other: Specify: _____

_____

_____

_____

_____

6 Do you think that these services/products as indicated above is affordable to the rural community?

☐ Yes ☐ No

Comment:

_____

_____

_____

_____

_____

_____

_____

7 I think that people living in the rural areas in South Africa are spending (considering % of their salary):

- ☐ too much on telecommunication (Telkom telephones and cellphones)
- ☐ too little on telecommunication
- ☐ about the right percentage of their salary on telecommunication

8 How much would you personally say, should people spend (of their salary) on on telecommunication (Telkom telephones and Cellphones)?

☐☐ % to a maximum of R☐☐☐☐☐,☐☐

9 How much should a household earn before they can afford a prepaid cellphone?
R ☐☐☐☐ per month

10 How much should a household earn before they can afford a contact cellphone?
R ☐☐☐☐ per month

11 How does MTN inform the illiterate (uneducated) rural citizen about the cost of a telephone call?

12 Please provide information on MTN's activities/(current network and involvement) in Sekhukhuneland (the magisterial districts) and future MTN's involvement in the near future.

1 Number of base stations within this area ☐☐

2 Number of planned base stations within this area ☐☐

3 Total land area with coverage in Sekhukhuneland (signal >-102dBm)
☐☐☐☐ km^2

4

5

6

7

8

13 What is the main reason for people to cancel cellphones or not renewing contracts?

14 How far should a person with a cellphone stay from the nearest outlet selling recharge vouchers?

☐☐☐ km

Comment: _____

_____

_____

_____

15 How does MTN educate the illiterate (uneducated) rural citizen about new services and products?

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

16 Do you think people in rural areas are aware of the needed information for cellphone use?

☐ Yes ☐ No

Comment: _____

_____

_____

_____

_____

_____

17 Does MTN conduct research periodically to determine the knowledge that a rural citizen has on available services and products

☐ Yes ☐ No

If yes, how do you do this?

18 Is MTN informing people in rural areas about the use of SMS (Short message service)?

☐ Yes ☐ No

Comment:

19 Is MTN informing people in rural areas about use of SMS (Short message service)?

☐ Yes ☐ No

Comment:

20 What do you think is the main reason for a rural citizen not having a cellphone?

21 How is MTN informing people on the advantages of their free access to emergency services?

22 Is MTN informing people about the use of plastic bank cards for the purchase of airtime?

☐ Yes ☐ No

23 At which banks' ATMs are the option available to buy airtime with a plastic card?

24 Why only these banks?

25 Which banks are included in the future provision of this service?

26 Where are the most technologies for MTN transferred from?

☐ USA	☐ Other Eastern country
☐ Canada	☐ Asia
☐ Europe	☐ Africa
☐ Japan	☐ Southern Africa
☐ New Zeeland	☐ Australia
☐ Other: Specify:	

27 If there were other suppliers for MTN's core technologies previously , please indicate who and explain briefly why you changed suppliers

☐ USA	☐ Other Eastern country
☐ Canada	☐ Asia
☐ Europe	☐ Africa
☐ Japan	☐ Southern Africa
☐ New Zeeland	☐ Australia
☐ Other: Specify:	

Briefly explanain your answer for question nr. 27 :

28 What are the criteria MTN uses when deciding which country or company to transfer technology from?

29 Up until which stage of the technology utilization is MTN involving the technology supplier, or do you have sufficient skills available within the company to implement and modify the technology to suit local conditions?

30 Are work done to adapt foreign technology to local conditions?

☐ Yes ☐ No

(If Yes) How and by whom?

Give examples if possible for your answer in the previous question:

31 Does MTN have sufficient internal skills to modify and adapt foreign technologies to local conditions?

☐ Yes ☐ No

If no, how do you go about adapting transferred technologies to local existing ones and install new technologies operational to interface with them

32 In which format does MTN prefer information about transferred technology supplied by the technology source?

- [ ] CD
- [ ] Paper
- [ ] Electronic mail
- [ ] Fax
- [ ] Pre-recorded audio
- [ ] Audio via telephone
- [ ] Personal informing sessions
- [ ] Other: Please specify

33 How does MTN ensure that the current technology is meeting the ever-changing needs of the rural segment in South Africa?

34 How do you go about doing forecasts on technologies and their lifespan

35 How does MTN go about determining the Needs, Capabilities, Problems, Aspirations, and Expectations of the rural community?

36 Once the needs for a new technology is determined/defined, how does MTN go about generating a list of possible technologies that might fulfill these needs

37 With whom does MTN have inter-firm R&D agreements?

38 Have technology ever been transferred into rural areas of South Africa with limited advantages (or even disadvantages) to MTN and(or) the rural citizen?

☐ Yes ☐ No

If yes, can you give some examples (and explain why if possible):

39 Which people are involved in the decision-making process of technology transfer/diffusion into SA's rural areas ?

- ☐ MTN Marketing segment
- ☐ MTN's Public Relations Officer (PRO)
- ☐ Government
- ☐ International suppliers
- ☐ Local suppliers
- ☐ Police department in rural areas
- ☐ Social Workers working in rural areas
- ☐ People living in rural communities
- ☐ Rural businesses
- ☐ Rural schools
- ☐ Other Please specify: _____

_____

_____

_____

_____

40 Is MTN involving the traditional (rural) community in new designs, technology choices, and implementation?

☐ Yes ☐ No

(If Yes) How do you do this?

_____

_____

_____

_____

_____

41 Does MTN have a database to store inputs from the rural community during the use of an existing technology which can provide useful information and feedback when designing new systems/processes?

☐ Yes ☐ No

If Yes, how do you do this and how do you get info on problems in rural areas?

_____

_____

_____

42 How and how frequently does MTN evaluate a transferred technology it is using?

43 How does MTN identify the stakeholders to determine participants in the technology transfer decision-making process?

44 How does crime affect the way your company operates?

1	No impact at all
2	Noticeable but very little still
3	Crime does occur but it is endurable
4	High but a strategy is not currently followed to counteract crime
5	High and a strategy is currently followed to counteract crime
6	Extremely high and a strategy is followed to counteract crime

45 How is MTN helping to make SA a safer place (reduce crime)?

1 CareCall (a peace-of-mind line that complements the

112 Emergency number)

2 Rolled out the network on national highway

3 Directions 22522 service for people who lost their way

4 Legal assistance 0839099099

5

6

7

8

9

10

11

12

46 How much money does MTN lose each year due to crime (including its devotion towards crime prevention)?

- ☐ less than R100 000
- ☐ R100 000 to R500 000
- ☐ R1million to R2million
- ☐ R2m to R5m
- ☐ R5m to R10m
- ☐ R10m to R50m
- ☐ R50m to R100m
- ☐ R100m to R 500m
- ☐ R500m to R1billion
- ☐ more than a billion rands

Because of:

- ☐ Theft
- ☐ Vandalism
- ☐ Internal Corruption
- ☐ Other. Please specify:

47 Do you think the demands of the government on MTN are reasonable and wise?

- ☐ Yes
- ☐ No they are to strict
- ☐ No they are to easy to satisfy
- ☐ No they have a negative effect on the company's objectives

Comment (Please explain your answer briefly):

48 Which aspects of the governmental policy needs revising and why?

49 Is MTN of the opinion that the educational system in South Africa is effective and able to follow the needs of the industry sufficiently?

☐ Yes ☐ No

Please explain your answer briefly:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

50 Would you like to receive feedback on the outcome of this research project?

☐ Yes ☐ No

☐ Give me feedback via E-mail at the following address:

E-mail address: _____

51 Would you like to be invited to the final presentation of this project?

☐ Yes ☐ No

Let me know of the presentation date and time through:

Contact telephone no: | | | | | | | | | Work

| | | | | | | | | Cellphone no

E-mail address: _____

Thank you for participating in this research project

Appendix F: Vodacom Questionnaire

Model for Telecommunication Technology

Transfer to the Rural Sector of South Africa

Research project for fulfillment of requirements for a Masters degree in Technology Management.

Heinie Pieterse

Department of Engineering en Technology Management

Faculty of Engineering

University of Pretoria

Notice:
Please note that the information furnished will be handled confidentially,
and that the results of the investigation may be used for the purposes of publication.

Questionnaire for corporate personnel in Vodacom

University of Pretoria

Name: _____

Contact number: | | | | | | | | | | |

Company: Vodacom

Address of interview: _____

_____

_____

Code: | | | | |

Interview Date: D D / M M / 2 0 Y Y

Job title: _____

Questions

1 Why would you encourage a rural citizen to get a cellphone?
What advantages does a cellphone have to offer him/her?

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

2 In which languages does Vodacom offer services in South Africa? (Please indicate services as well)

Languge(s)	Service

3 From which of the following products/services offered by Vodacom can the rural citizen benefit most?

- ☐ Vodago (Vodacom's prepaid service)
- ☐ Weekend +
- ☐ Talk Business Call
- ☐ Talk Frequent Call
- ☐ Talk 100+
- ☐ Messenger
- ☐ Other. Please specify:

4 Please indicate if there are other services planned for the future which will focus on the rural community user

5 Why can people living in the rural areas benefit from especially these products/services (indicated in previous 2 questions)?

- ☐ These products were designed because of a market survey that indicated a specific need among rural citizens
- ☐ These products are aimed at people with a low level of literacy
- ☐ These products are aimed at people with a low income
- ☐ The services are useful because rural people use:
  - ☐ Computers
  - ☐ Fax machines
  - ☐ Answering machines
  - ☐ Electronic mail
  - ☐ Public payphones
- ☐ Other: Specify: _____

_____

_____

_____

_____

6 Do you think that these services/products as indicated above is affordable to the rural community?

☐ Yes ☐ No

Comment:

_____

_____

_____

_____

_____

_____

_____

7 I think that people living in the rural areas in South Africa are spending (considering % of their salary):

- ☐ too much on telecommunication (Telkom telephones and cellphones)
- ☐ too little on telecommunication
- ☐ about the right percentage of their salary on telecommunication

8 How much would you personally say, should people spend (of their salary) on on telecommunication (Telkom telephones and Cellphones)?

☐☐ % to a maximum of R☐☐☐☐☐,☐☐

9 How much should a household earn before they can afford a prepaid cellphone?
R ☐☐☐☐ per month

10 How much should a household earn before they can afford a contact cellphone?
R ☐☐☐☐ per month

11 How does Vodacom inform the illiterate (uneducated) rural citizen about the cost of a telephone call?

12 Please provide information on Vodacom's activities/(current network and involvement) in Sekhukhuneland (the magisterial districts) and future Vodacom's involvement in the near future.

1 Number of base stations within this area = 9,
2 Number of planned base stations within this area = 4,
3 Total land area with coverage in Sekhukhuneland = 3753km^2 (signal > -102dBm)
4
5
6
7
8

13 Why does it cost 70c to make a call at a public phone from Vodacom in Sekhukhuneland but still R2.85 for a Vodago client in peak time?

14 What is the main reason for people to cancel cellphones or not renewing contracts?

15 How far should a person with a cellphone stay from the nearest outlet selling recharge vouchers?

km

Comment:

16 How does Vodacom educate the illiterate (uneducated) rural citizen about new services and products?

17 Do you think people in rural areas are aware of the needed information for cellphone use?

☐ Yes ☐ No

Comment:

18 Does Vodacom conduct research periodically to determine the knowledge that a rural citizen has on available services and products

☐ Yes ☐ No

If yes, how do you do this?

19 Is Vodacom informing people in rural areas about use of SMS (Short message service)?

☐ Yes ☐ No

Comment:

20 What do you think is the main reason for a rural citizen not having a cellphone?

21 How is Vodacom informing people on the advantages of their free access to emergency services?

22 Is Vodacom informing people about the use of plastic bank cards for purchasing airtime?

☐ Yes ☐ No

23 At which banks' ATMs are the option available to buy airtime with a plastic card?

24 Why only these banks?

25 Which banks are included in the future provision of this service?

26 Where are the most technologies for Telkom transferred from?

☐ USA	☐ Other Eastern country
☐ Canada	☐ Asia
☐ Europe	☐ Africa
☐ Japan	☐ Southern Africa
☐ New Zeeland	☐ Australia
☐ Other: Specify:	

27 If there were other suppliers for Telkom's core technologies previously , please indicate who and explain briefly why you changed suppliers

☐	USA	☐	Other Eastern country
☐	Canada	☐	Asia
☐	Europe	☐	Africa
☐	Japan	☐	Southern Africa
☐	New Zeeland	☐	Australia
☐	Other: Specify:		

Briefly explanation your answer on question nr. 27 :

28 What are the criteria Vodacom uses when deciding which country or company to transfer technology from?

29 Up until which stage of the technology utilization is Vodacom involving the technology supplier, or do you have sufficient skills available within the company to implement and modify the technology to suit local conditions?

30 Are work done to adapt foreign technology to local conditions?

☐ Yes ☐ No

(If Yes) How and by whom?

Give examples if possible for your answer in the previous question:

31 Does Vodacom have sufficient internal skills to modify/adapt foreign technologies to local conditions?

☐ Yes ☐ No

If no, how do you go about adapting transferred technologies to local existing ones and install new technologies operational to interface with them

32 In which format does Vodacom prefer information about transferred technology supplied by the technology source?

- ☐ CD
- ☐ Paper
- ☐ Electronic mail
- ☐ Fax
- ☐ Pre-recorded audio
- ☐ Audio via telephone
- ☐ Personal informing sessions
- ☐ Other: Please specify

33 How does Vodacom ensure that the current technology is meeting the ever-changing needs of the rural segment in South Africa?

34 How do you go about doing forecasts on technologies and their lifespan

35 How does Vodacom go about determining the Needs, Capabilities, Problems, Aspirations, and Expectations of the rural community?

36 Once the needs for a new technology is determined/defined, how does Vodacom go about generating a list of possible technologies that might fulfill these needs

37 With whom does Vodacom have inter-firm R&D agreements?

38 Have technology ever been transferred into rural areas of South Africa with limited advantages (or even disadvantages) to Vodacom and(or) the rural citizen?

☐ Yes ☐ No

If yes, can you give some examples (and explain why if possible) please:

39 Which people are involved in the decision-making process of technology transfer/diffusion into SA's rural areas ?

- ☐ Vodacom Marketing segment
- ☐ Vodacom's Public Relations Officer (PRO)
- ☐ Government
- ☐ International suppliers
- ☐ Local suppliers
- ☐ Police department in rural areas
- ☐ Rural areas social workers
- ☐ People living in rural communities
- ☐ Rural businesses
- ☐ Rural schools
- ☐ Other Please specify:

40 Is Vodacom involving the traditional (rural) community in new designs, technology choices, and implementation?

☐ Yes ☐ No

(If Yes) How do you do this?

41 Does Vodacom have a database to store inputs from the rural community during the use of an existing technology providing useful information and feedback when designing new systems/processes?

☐ Yes ☐ No

If Yes, how do you do this and how do you get info on problems in rural areas?

42 How and how frequently does Vodacom evaluate a transferred technology it uses?

43 How does Vodacom identify the stakeholders to determine participants in the technology transfer decision-making process?

44 How does crime affect the way your company operates?

1	No impact at all
2	Noticeable but very little still
3	Crime does occur but it is endurable
4	High but a strategy is not currently followed to counteract crime
5	High and a strategy is currently followed to counteract crime
6	Extremely high and a strategy is followed to counteract crime

45 How is Vodacom helping to make SA a safer place (reduce crime)?

1 Blacklisting stolen cellphones
2 A project upgrading and maintaining the Alexandra Police Station and the adjoining Magistrates Courts
3 Vodacom rolled out its network on 3 000 km's of national highway
4 Vodacom 702 Cellwatch
5 Netcare 082 911
6 Emergency 121
7
8
9
10

46 How much money does Vodacom lose each year due to crime (including its devotion towards crime prevention)?

- ☐ less than R100 000
- ☐ R100 000 to R500 000
- ☐ R1million to R2million
- ☐ R2m to R5m
- ☐ R5m to R10m
- ☐ R10m to R50m
- ☐ R50m to R100m
- ☐ R100m to R 500m
- ☐ R500m to R1billion
- ☐ more than a billion rands

Because of:

- ☐ Theft
- ☐ Vandalism
- ☐ Internal Corruption
- ☐ Other. Please specify: _____

_____

_____

_____

_____

_____

47 Do you think the demands of the government on Vodacom are reasonable and wise?

- ☐ Yes
- ☐ No they are to strict
- ☐ No they are to easy to satisfy
- ☐ No they have a negative effect on the company's objectives

Comment (Please explain your answer briefly):

_____

_____

_____

_____

_____

48 Which aspects of the governmental policy needs revising and why?

_____

_____

_____

_____

49 Is Vodacom of the opinion that education in South Africa is effective and able to follow the needs of the industry sufficiently?

☐ Yes ☐ No

Please explain your answer briefly:

_____

_____

_____

_____

_____

_____

_____

_____

_____

50 Would you like to receive feedback on the outcome of this research project?

☐ Yes ☐ No

☐ Give me feedback via E-mail at the following address:

E-mail address: _____

51 Would you like to be invited to the final presentation of this project?

☐ Yes ☐ No

Let me know of the presentation date and time through:

Contact telephone no: | | | | | | | | | Work

| | | | | | | | | Cellphone no

E-mail address: _____

Thank you for participating in this research project

f

Appendix G: Telkom Questionnaire

Model for Telecommunication Technology

Transfer to the Rural Sector of South Africa

Research project for fulfillment of requirements for a Masters degree in Technology Management.

Heinie Pieterse

Department of Engineering en Technology Management

Faculty of Engineering

University of Pretoria

Notice:
Please note that the information furnished will be handled confidentially,
and that the results of the investigation may be used for the purposes of publication.

Questionnaire for corporate personnel in Telkom

University of Pretoria

Name: _____

Contact number: | | | | | | | | | | |

Company: Telkom

Address of interview: _____

_____

_____

Code: | | | | |

Interview Date: D D / M M / 2 0 Y Y

Job title: _____

Questions:

1 Why would you encourage a rural citizen to get a telephone?
What advantages does a telephone have to offer him/her?

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

2 In which languages does Telkom offer services in South Africa? (Please also indicate the services)

Languge(s)	Service

3 From which of the following products/services offered by Telkom can the rural citizen benefit most?

- ☐ **WorldCall** (Staying in touch when traveling in SA or overseas)
- ☐ **ForwardCall** (Divert calls to a number of your choice)
- ☐ **Direct-a-Call** (Rent a number in another location and have calls diverted to your home or office telephone
- ☐ **SpeedCall (**Make a call by dialing only a few digits, instead of complete numbers)
- ☐ **UrgentCall** (After picking up the handset not dialing for 5 seconds, the system automatically dials a pre-programmed number)
- ☐ **IdentiCall (**lets you see who's calling you)
- ☐ **Call Answer** (takes messages)
- ☐ **WaitingCall (**lets you answer an incoming call while you're on the phone)
- ☐ **BlockCall (**prevents outgoing calls without affecting incoming calls)
- ☐ **Homefree** (A 0800 number for family members away from home to call you without paying. Charges are billed to the Homefree account)
- ☐ **Phonecard** (a pre-paid, fixed value microchip card)
- ☐ Other. Please specify:

4 Please indicate if there are other services that are planned for the future which focusses ##

5 Why can people living in the rural areas benefit from especially these products/services (indicated in previous 2 questions)?

- ☐ These products were designed because of a market survey that indicated a specific need among rural citizens
- ☐ These products are aimed at people with a low level of literacy
- ☐ These products are aimed at people with a low income
- ☐ The services are useful because rural people use:
  - ☐ Computers
  - ☐ Fax machines
  - ☐ Answering machines
  - ☐ Electronic mail
  - ☐ Public payphones
- ☐ Other: Specify:

6 Do you think that these services/products as indicated above is affordable to the rural community?

☐ Yes ☐ No

Comment:

7 How much is MTN paying for a minute when using the Telkom network for a call?
R ☐☐, ☐☐ per minute
How was this determined?

8 How much is Vodacom paying for a minute when using the Telkom network for a call?
R ☐☐, ☐☐ per minute
How was this determined?

9 Is Telkom planning on providing a service for local calls from one fixed line to another less than 50km away for free (as is done in some developed countries) in the future?
☐ Yes ☐ No

Comment:

10 I think that people living in the rural areas in South Africa are spending (considering % of their salary):
☐ too much on telecommunication (Telkom telephones and telephones)
☐ too little on telecommunication
☐ about the right percentage of their salary on telecommunication

11 How much would you personally say, should people spend (of their salary) on on telecommunication (Telkom telephones and telephones)?
☐☐ % to a maximum of R☐☐☐☐☐,☐☐

12 How much should a household earn before they can afford a prepaid telephone?
R ☐☐☐☐ per month

13 How much should a household earn before they can afford a contact telephone?
R ☐☐☐☐ per month

14 How does Telkom inform the illiterate (uneducated) rural citizen about the cost of a telephone call?

15 What is the main reason for people to cancel telephones?

16 Does the type of house that a person lives in play a role in the need for a Telkom telephone at home?

☐ Yes ☐ No

Comment:

17 Does Telkom have restrictions on the type of house a person has to live in before he/she can qualify for a Telkom telephone at home?

☐ Yes ☐ No

Comment:

18 Does a client need electricity at home before he/she can get a telephone in rural areas?

☐ Yes ☐ No

19 How does Telkom educate the illiterate (uneducated) rural citizen about new services and products?

20 Do you think people in rural areas are aware of the needed information for telephone use?

☐ Yes ☐ No

Comment:

21 How does Telkom inform the illiterate (uneducated) rural citizen about Telkom's Prepaid telephones?

22 Does Telkom conduct research periodically to determine the knowledge that a rural citizen has on available services and products

☐ Yes ☐ No

If yes, how do you do this?

23 How far ideally should a person with a telephone stay from the nearest outlet selling Telkom prepaid vouchers?

☐☐☐ km

Comment:

24 What do you think is the main reason for a rural citizen not having a telephone?

25 If so, what do you think is the main reason a rural citizen's telephone is not working?

26 Concerning Telkom policy, how long is it allowable for a Telkom telephone not to work in a rural area?

27 Concerning Telkom policy, how long should a person in a rural area be waiting from the moment an application for a private phone installation is made until the phone is actually installed and operational?

28 From where are the most technologies for Telkom transferred?

☐	USA	☐	Other Eastern country
☐	Canada	☐	Asia
☐	Europe	☐	Africa
☐	Japan	☐	Southern Africa
☐	New Zeeland	☐	Australia
☐	Other: Specify:		

29 If there were other suppliers for Telkom's core technologies previously , please indicate who and explain briefly why you changed suppliers

☐	USA	☐	Other Eastern country
☐	Canada	☐	Asia
☐	Europe	☐	Africa
☐	Japan	☐	Southern Africa
☐	New Zeeland	☐	Australia
☐	Other: Specify:		

Briefly explain your answer on question nr. 29 :

30 What are the criteria that Telkom uses on deciding which country or company to transfer technology from?

31 Up until which stage of the technology utilization is Telkom involving the technology supplier, or do you have sufficient skills available within the company to implement and modify the technology to suit local conditions?

32 Is work done to adapt foreign technology to local conditions?

☐ Yes ☐ No

(If Yes) How and by whom?

Give examples if possible for your answer in the previous question:

33 Does Telkom have sufficient internal skills to modify/adapt foreign technologies to local conditions?

☐ Yes ☐ No

If no, how do you go about adapting transferred technologies to local existing ones and install new technologies operational to interface with them

34 How does Telkom ensure that the current technology is meeting the ever-changing needs of the rural segment in South Africa?

35 How do you go about doing forecasts on technologies and their lifespan

36 In which format does Telkom prefer information about transferred technology supplied by the technology source?

- [ ] CD
- [ ] Paper
- [ ] Electronic mail
- [ ] Fax
- [ ] Pre-recorded audio
- [ ] Audio via telephone
- [ ] Personal informing sessions
- [ ] Other: Please specify

37 Are the DECT and TDMA systems profitable for Telkom in connecting rural areas?

☐ Yes ☐ No

Why do you say so?

38 Are there other technologies available that might be a better solution?

☐ Yes ☐ No

If yes, name them:

39 If so, why is Telkom not making use of them?

40 Are DECT and TDMA systems used in Sekhukhuneland?

☐ Yes ☐ No

41 With whom does Telkom have inter-firm R&D agreements?

42 How does Telkom go about determining the Needs, Capabilities, Problems, Aspirations, and Expectations of the rural community?

43 Once the needs for a new technology is determined/defined, how does Telkom go about generating a list of possible technologies that might fulfill these needs?

44 Have technology ever been transferred into rural areas of South Africa with limited advantages (or even disadvantages) to Telkom and(or) the rural citizen?

☐ Yes ☐ No

If yes, can you please give some examples (and explain why if possible):

45 Which people are involved in the decision-making process of technology transfer/diffusion into SA's rural areas ?

- ☐ Telkom Marketing segment
- ☐ Telkom's Public Relations Officer (PRO)
- ☐ Government
- ☐ International suppliers
- ☐ Local suppliers
- ☐ Police department in rural areas
- ☐ Social Workers working in rural areas
- ☐ Other Please specify:
- ☐ People living in rural communities
- ☐ Rural businesses
- ☐ Rural schools

46 Is Telkom involving the traditional (rural community) in new designs, technology choices, and implementation?

☐ Yes ☐ No

(If Yes) How do you do this?

47 Does Telkom have a database to store inputs from the rural community during the use of an existing technology proving useful information and feedback when designing new systems/processes?

☐ Yes ☐ No

If Yes, how do you do this & how do you get info on problems in rural areas?

48 How and how frequently does Telkom evaluate a transferred technology it uses?

49 How does Telkom identify the stakeholders to determine participants in the technology transfer decision-making process?

50 How does crime affect the way your company operates?

1	No impact at all
2	Noticeable but very little still
3	Crime does occur but it is endurable
4	High but a strategy is not currently followed to counteract crime
5	High and a strategy is currently followed to counteract crime
6	Extremely high and a strategy is followed to counteract crime

51 How is Telkom helping to make SA a safer place (reduce crime)?

1 To ease the problem of copper cable theft, Telkom is connecting large parts of South Africa using advanced radio-based telecommunications technology called DECT (Digital Enhanced Cordless Telecommunications).

2 Telkom offers free emergency number dialling to their customers

3

4

5

6

7

8

9

10

52 How much money does Telkom lose each year due to crime (including its devotion towards crime prevention)?

- ☐ less than R100 000
- ☐ R100 000 to R500 000
- ☐ R1million to R2million
- ☐ R2m to R5m
- ☐ R5m to R10m
- ☐ R10m to R50m
- ☐ R50m to R100m
- ☐ R100m to R 500m
- ☐ R500m to R1billion
- ☐ more than a billion rands

Because of:

- ☐ Theft
- ☐ Vandalism
- ☐ Internal Corruption
- ☐ Other. Please specify: _____

_____

_____

_____

_____

_____

_____

_____

_____

53 Penalties become payable should Telkom fail to achieve any of the 16 license targets spelt out in the license to Telkom in May 1997. In its first year of the exclusivity period Telkom achieved five of its 10 demanding service targets and had to pay R3, 3 million to SATRA (South African Telecommunications Regulatory Authority). What is Telkom's reaction on such penalties? Is it a good way to regulate the telecommunications industry in South Africa?

☐ Yes ☐ No

Please motivate:

_____

_____

_____

_____

_____

_____

54 Do you think the demands of the governments on Telkom are reasonable and wise?

- ☐ Yes
- ☐ No they are to strict
- ☐ No, they are to easy to satisfy
- ☐ No, they have a negative effect on the company's objectives

Comment (Please explain your answer briefly):

55 Which aspects of the governmental policy needs revising and why?

56 Is Telkom of the opinion that the educational system in South Africa is effective and able to follow the needs of the industry sufficiently?

☐ Yes ☐ No

Please explain your answer briefly:

_____

_____

_____

_____

_____

_____

_____

_____

_____

57 Would you like to receive feedback on the outcome of this research project?

☐ Yes ☐ No

☐ Give me feedback via E-mail at the following address:

E-mail address: _____

58 Would you like to be invited to the final presentation of this project?

☐ Yes ☐ No

Let me know of the presentation date and time through:

Contact telephone no: | | | | | | | | | Work

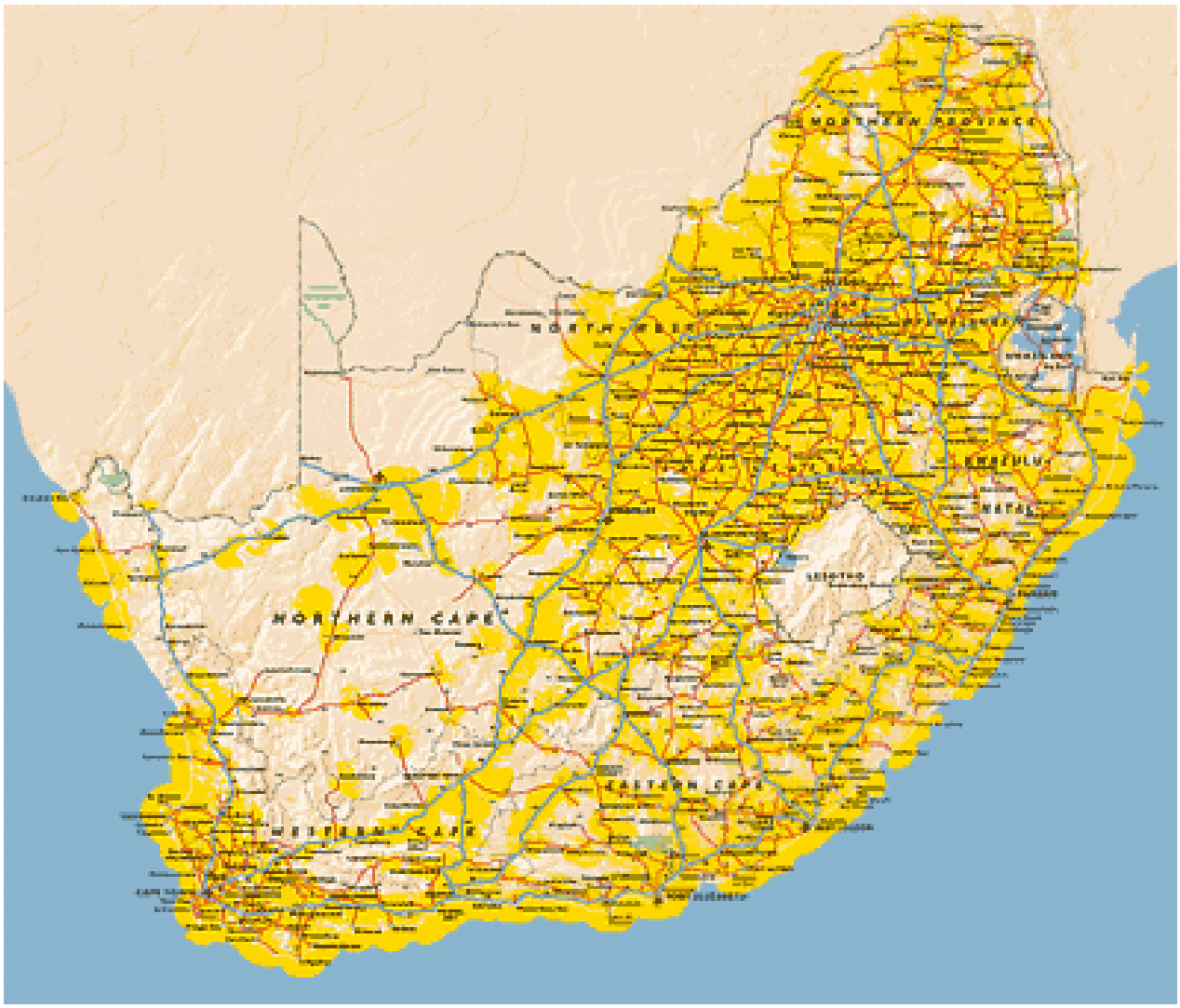
| | | | | | | | | Cellphone no

E-mail address: _____

Thank you for participating in this research project

Appendix H

MTN Coverage map



Appendix I

Vodacom Coverage map

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