THE ANALYSIS OF THE DIFFUSION OF PERSONAL TELE-COMMUNICATIONS IN SOUTH AFRICA

by

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The Analysis of the Diffusion of Personal Telecommunications in South Africa.

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ABSTRACT

The purpose of this study is to analyse the diffusion of personal telecommunications in South Africa.

The importance of this field of study lies in the fact that it illustrates how innovation, particularly in the field of personal telecommunications, can be diffused and managed. It highlights the way diffusion occurs particularly through networks and linkages in industry and by way of the different role players, i.e. suppliers, service providers and customers.

The method used was that of reading extensive literature in order to understand theories and design questionnaires/interviews, which were then administered to main players in the industry. This report contains the findings of these questionnaires and interviews.

The researcher considers the most important finding of this study to be that diffusion cannot occur without knowledge and communication, and collaboration between role players. The author also shows that diffusion of an innovation, if managed properly, can be a great economic booster in any country.

The author says that the interactions of the main leaders in the industry show that the cellular industry in South Africa is highly collaborative. All players in this industry, namely suppliers, service providers and retailers, work together to reach a common goal. There is space for the suppliers to compete at supplier level, leaving room for service providers to compete at their level and giving the retailers space to compete at retailer level.

According to the leaders in this industry, the most effective diffusion mechanisms are clusters, newspaper advertising, collaboration, price, corporate culture, industry structure, joint venture, partnership and radio advertising. Diffusion in this industry is achieved by working together, from the supplier through the service provider to the retailer, then from the retailer to the end-user. This diffusion process has to be managed. Management of this industry is both vertical and horizontal. The industry requires management that is knowledgeable at all levels and with strong links and interrelationships. In an industry of this nature, management is often challenged with risk. Risk management is important in this industry and this is usually achieved by spreading the risk across the players, so that everybody understands their stake and is willing to share responsibility.

The following conclusions about the South African cellular industry can be reached.

It is an industry that has shown rapid growth. The main driving force behind this rapid growth is the cost of airtime and the price of the handsets. The pre-paid scheme does not require subscribers to be creditworthy to be mobile. One does not have to enter into a contract with the service providers and earn a monthly salary in a certain bracket to be able to be connected.

Another contributing factor is the ease with which subscribers can get cellular phones and airtime vouchers. The accessibility of these facilities has contributed to the increase of the subscriber base, and the cash-and-carry phenomenon with no strings attached, has worked magic for the South African industry.

The author also concludes that the service providers are controlling the industry. The reason is that the service providers operate as a hub or central point in the industry. They control the link between the suppliers and the end users. The service providers have set up retailers to sell airtime and the hardware (cell phones) to the end users. The retailers have to work through the service providers to purchase the hardware from the suppliers. Competition in this industry is thus both horizontal and vertical and is bounded. The suppliers have a dedicated market of supplying equipment in which they compete at supplier level and through the retailers, at retail level. The service providers compete, at the level of service providers, with services they offer and again at the level of retailers.

This whole diffusion process is managed from the development of the product to the use of the product and service. The different levels of the industry all have to be managed: the suppliers, service providers, retailers and end users. At each level an integrative type of management has to be administered, ensuring that all the interrelationships of the industry are maintained and strengthened from time to time, both vertically and horizontally. SATRA is the regulatory body who regulates competition and administers regulation and legislation within the industry.

Since the industry is flourishing, one can conclude that the diffusion of personal telecommunications is well managed by the telecommunications industry in South Africa.

"Die Analise van die diffusieproses in persoonlike telekommunikasie in Suid-Afrika"

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OPSOMMING

Die doel van hierdie studie was die analise van die diffusieproses in persoonlike telekommunikasie in Suid-Afrika.

Die belangrikheid van hierdie navorsing lê in die feit dat dit illustreer hoedat innovasie, veral in die veld van persoonlike telekommunikasie, diffundeer en bestuur kan word. Dit beklemtoon hoedanig diffusie plaasvind deur middel van netwerke en industriekoppeling, deur middel van die verskillende rolspelers, naamlik toerustingverskaffers, diensverskaffers en gebruikers.

Die metode waarvolgens te werk gegaan is, was eerstens 'n uitgebreide literatuursoektog wat daarop gemik was om die teorieë te begryp en dit het aanleiding gegee tot die samestelling van vraelyste en onderhoude met die verskillende rolspelers in die industrie. Hierdie verslag bevat die bevindinge van die vraelyste en onderhoude.

Die navorser beskou die belangrikste bevinding van hierdie verslag dat diffusie nie kan plaasvind sonder kennis en kommunikasie, asook samewerking tussen die rolspelers nie. Verder dat diffusie van 'n innovasie 'n inspuiting in 'n land se ekonomie kan wees mits dit behoorlik bestuur word.

Die skrywer is van mening dat interaksies van die hoof rolspelers in die industrie wys dat die sellulêre industrie in Suid-Afrika hoogs samewerkend is. Al die rolspelers, naamlik toerustingverskaffers, diensverskaffers en handelaars werk saam ter bereiking van 'n gesamentlike doel. Hulle laat ruimte vir die toerustingverskaffers om op daardie vlak te werk en dieselfde geld vir diensverskaffers en handelaars.

Volgens leiers in die industrie is die effektiefste diffusie meganismes groeperinge, koerant advertensies, samewerking, prys, korporatiewe kultuur, industrie struktuur, vennootskappe en radio advertensies. Diffusie in hierdie industrie word bereik deur samewerking tussen toerustingverskaffer, deur die diensverskaffer tot by die handelaar en vandaar na die eindgebruiker.

Hierdie diffusie proses moet bestuur word beide vertikaal en horisontaal. Kundiges wat kennis dra van die industrie en ook vertroud is met die verskillende vlakke en daarby sterk bande en verhoudings het in die industrie is belangrik. Bestuur in 'n industrie van hierdie aard moet dikwels met risiko's rekening hou omrede daar meer as een rolspeler is. Risikobestuur is belangrik in hierdie industrie en dit word gewoonlik bereik deur die risiko te versprei onder die rolspelers sodat elkeen hulle aandeel besef en verstaan en daarom die verantwoordelikheid deel.

Die volgende gevolgtrekkings oor die Suid-Afrikaanse sellulêre industrie word gemaak: Dit is 'n industrie wat geweldige groei beleef het. Die dryfkrag agter die snelle groei is die koste van lugtyd en die prys van handstelle. Die voorafbetalingstelsel vereis nie dat gebruikers kredietwaardig moet wees om mobiel te wees nie. 'n Individu hoef nie 'n kontrak aan te gaan met die diensverskaffer nie en hoef ook nie 'n minimum maandelikse salaris te verdien om gekoppel te word nie.

'n Ander bydraende faktor is die gemak waarmee intekenare sellulêre fone kan bekom tesame met lugtyd koepons. Die toeganklikheid van hierdie fasiliteite het bygedra tot die toename in intekenare en omrede daar min rompslomp is het dit 'n bloeitydperk vir die industrie teweeg gebring.

Ten slotte meen die skrywe dat diensverskaffers die industrie beheer aangesien hulle die sentrale punt in die industrie beklee. Hulle beheer die skakel tussen toerustingverskaffers en eind-gebruikers. Die diensverskaffers het handelaars gevestig wat lugtyd en hardeware [selfone] verkoop aan die eind-gebruikers. Handelaars moet deur die diensverskaffers werk om sellulêre fone te bekom vanaf die toerusting-verskaffers. Kompetisie is dus beide horisontaal en vertikaal en is begrens. Die toerustingverskaffers het 'n toegewyde mark om toerusting te verskaf en ding mee op die vlak van diensverksaffers en deur die handelaars op hulle vlak. Die diensverskaffers ding mee op hulle valk, en deur die dienste wat hulle aanbied, ook op die handelaarsvlak.

Die totale diffusie proses word bestuur vanaf die ontwikkelings van die produk tot by die uiteindelike gebruik van die toerustingsproduk en die diens wat verskaf word. Al die vlakke van die industrie moet beheer en bestuur word; die toerustingverskaffers, diensverskaffers, handelaars en eindgebruikers. By elke vlak moet 'n geïntegreerde bestuursplan in werking gestel word om te verseker dat die interafhanklike verhouding tussen rolspelers in stand gehou word en beide horisontaal en vertikaal versterk word. SATRA is die regulerende organisasie wat kyk na kompetisie en wat wetgewing en regulasies in hierdie industrie administreer.

Aangesien die industrie tans floreer kan mens met tereg sê dat die diffusie van persoonlike telekommunikasie in die telekommunikasie industrie van Suid-Afrika goed bestuur word.

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1 Introduction

In September 1993 Mr. Alan Knott-Craig said, "Cell phones will change our lives as much as or more than television did".

In 1994 the new cellular industry in South Africa was born. Vodacom made projections of 250,000 subscribers in ten years, but a mere two years later Vodacom had passed the milestone of 300,000 subscribers.

With such a background, it is quite intriguing to try and find out why the projections were off the mark by such a great margin. One can assume that the projections were based on figures for an employed base of individuals earning above a certain salary range. This group of individuals would be able to afford a contract with a service provider. One of the criteria for qualifying for cellular service was that one had to be employed. In 1999 the Reserve Bank indicated that only 30% of South Africans had bank accounts. This means that 70% of South Africans deal strictly on a cash only basis. This in itself excluded much of the potential subscriber base from the market potential. The question that follows is, "What actually fuelled the growth of this industry to such high proportions"?

Any product/ service that is meant for consumption or use by a consumer base has to have certain structures that will ensure that the customer base is aware of it. And that customer base must be willing to adopt the product/service as an answer its needs. Diffusion mechanisms are used to achieve the goal of getting the product/service to spread across a broad customer base.

The main objective of this study is to analyse the diffusion of personal telecommunications in South Africa.

A brief overview of the content of each chapter follows.

Chapter One is a brief introduction, an overview of the chapters and the research methodology. Chapter Two describes the telecommunications industry in South Africa, as well as a description of relevant regulators in this industry. Chapter Three is a review of the literature and a description of the theories examined in the literature study. These

theories are used as the basic framework of the research. Chapter Four is an explanation of some of the known diffusion mechanisms used in the cellular industry. Chapter Five describes some of the technologies used in the cellular industry, and discusses data communications. Chapter Six is an overview of competing technologies and a discussion of the rural phone market. Chapter Seven describes an example of a technology cluster within the wireless industry in South Africa. Chapter Eight reports on consumer trends and forecasts and discusses the fuelling of the growth of the cellular industry in South Africa. Chapter Nine reports the results obtained from the questionnaire administered in the industry. Chapter Ten discusses diffusion and Chapter Eleven contains the conclusion and recommendations of the research.

Research Methodology

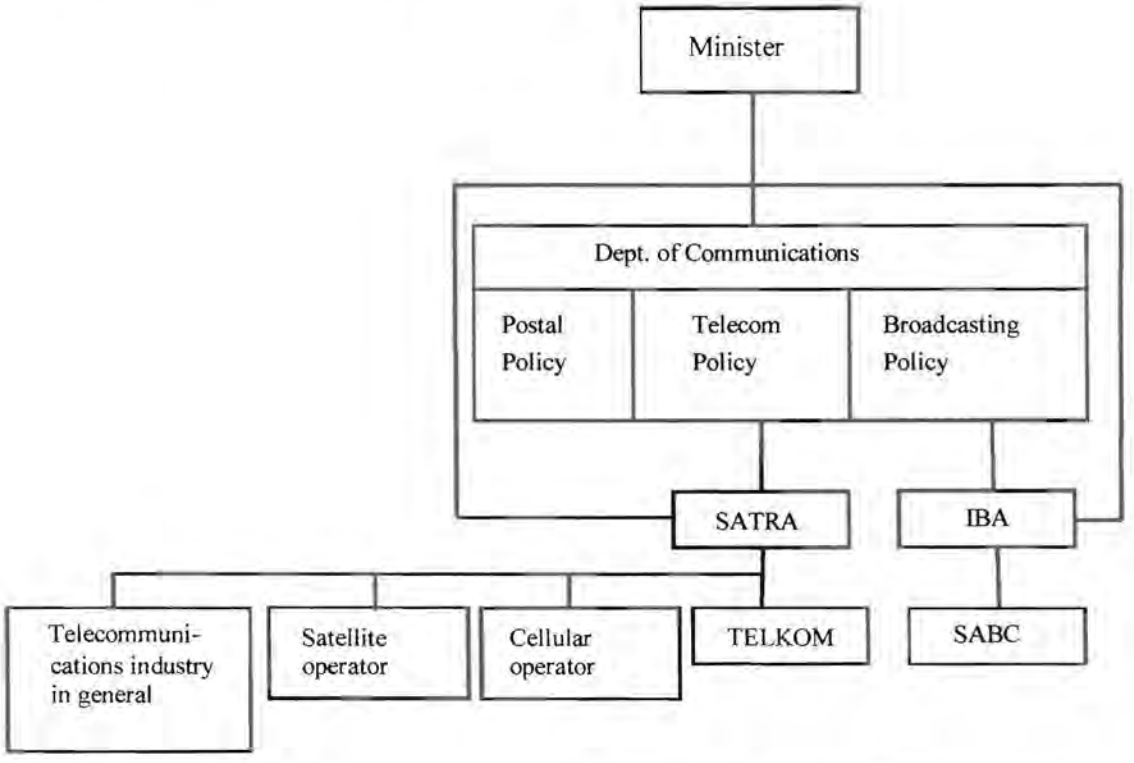
This research began with an extensive literature review to ensure clarity on the various theories of diffusion. Then a framework/proposal for the research project was established. Following that, a questionnaire was designed to try and link what the theories said to practice in the industry. Along with the questionnaires, interviews with the main players in the industry were undertaken, after which their results were combined in this report and published.

2 Telecommunications Industry Structure And Policy

2.1 Telecommunications Industry Structure

The cellular industry analysed here is part of a much bigger telecommunications industry in South Africa. The Minister of Communications, *Dr. Ivy Matsepe-Cassaburi* heads this industry. The minister's department is charged with policy-making for post, telecommunications and broadcasting services. It is further charged with the responsibility for SATRA and the IBA. SATRA is *the South African Telecommunications Regulatory Authority* and the IBA is the *Independent Broadcasting Authority*. These two bodies are important for the purposes of this research. SATRA is charged with regulating the telecommunications industry in general, including satellite operators, cellular operators and Telkom. The IBA, on the other hand, is primarily charged with manning the *South Africa Broadcasting Corporation (SABC)*. Figure 2.1 below illustrates the structure of telecommunications structure in South Africa.

Figure 2. 1 South African Telecommunications Industry [1]



Telecommunications is the order of the day around the world. It is one of the factors that influence economic success in most countries today. In South Africa a very serious view has been taken with respect to telecommunications, hence the theme: "Telecommunications and Development in South Africa" in the White Paper [2].

According to the White Paper [2], South Africa recognises the central importance of access to telecommunications in order to achieve economic and social goals. The goal of its policy and vision is that there should be affordable communications for all businesses and citizens alike. This vision has to strike a balance in providing services to the disadvantaged rural and urban areas in order to meet the need for a growing South African economy. In order for South Africa to grow economically, it has to be linked to the global village and to compete internationally. For this to happen, it has to have access to the international information highway and have its own integrated, high-quality network, which provides value-added services.

To ensure that this happens, the Ministry of Posts, Telecommunications and Broadcasting has set-up an agency called *The Universal Service Agency*. Its main purpose is to promote telecommunications in South Africa. Its target is members of historically disadvantaged communities, especially those in rural areas. This agency is there to redress the imbalances of the past, socially, economically and politically.

This agency and the regulator SATRA should never be in competition, because they are part of the same team and focused on the same overall objective, but with responsibility for closely linked but different activities.

One set of activities is rule-based and it involves the firm and transparent application and enforcement of the regulation, which embodies the principles of telecommunications policy. The regulator has sole power of enforcement. The agency should identify more creative and innovative methods of promoting a universal methods service within the broad framework of development planning.

2.1.1 Telecommunication Policies

SATRA (The South African Telecommunications Regulatory Authority) was established as an independent body to regulate the telecommunications industry. It was charged with objectives, functions, standard and quality, frequency spectrum, licensing, competition, ownership and investment, service provision and user needs. These are described in the White Paper [2].

SATRA's objectives:

- To regulate telecommunications in the Republic of South Africa in the public interest;
- To achieve progress towards the social goals of the telecommunications policy- the provision of universal service;
- To ensure the provision of a wide range of telecommunications services to stimulate and support economic growth;
- To regulate the activities of Telkom in conjunction with the Minister of Posts, Telecommunications and Broadcasting and to stimulate investment in the public telecommunications network;
- To ensure a 'level playing field' where competitive entry is permitted in terms of the telecommunications policy;
- To protect the interests of telecommunications users and consumers;
- To stimulate innovation in the telecommunication sector with a view to building an information superhighway in South Africa;
- To promote the development of human resources for the telecommunications sector;
- To promote a competitive and effective manufacturing and supply industry;
- To assure the technical pre-conditions for effective telecommunications operations; and
- To manage common national resources, such as the radio frequency spectrum, effectively.

SATRA's functions:

- Set goals for the achievement of universal services;
- Liase with Telkom with regard to universal service during the period of exclusivity;
- Set universal service obligations;
- Administer the universal service fund, which will be managed by the universal service agency and
- Ensure that the needs of disabled people are taken into account in the expansion of universal service.

Service provision and user needs:

- Promote the provision of efficient, effective and affordable telecommunications services for all sectors of society and the development of public and private services, which are responsive to the needs of users;
- Ensure that the provision of public services, the needs of the constituent regions of South Africa and local communities are duly taken into account;
- Ensure that telecommunications services, viewed collectively, develop and promote a sound business environment in the interest of healthy competition, efficient services and modern facilities;
- Protect the integrity and viability of public telecommunications services and
- Develop regulations supporting the achievement of policy objectives.

Ownership and investment:

- Encourage investment in, and promote the stability of, the industry; and
- Encourage ownership and control of telecommunications services in accordance with the requirements of anti-competitive legislation.

Competition:

- Promote fair competition between telecommunications service providers where such competition is permitted, in conjunction with the state's competition policy; and
- Allow service providers maximum freedom in the pursuit of their commercial objectives, while simultaneously taking into account the telecommunications needs of the public and the policy objectives of the Government.

Licensing:

- Undertake the licensing of all telecommunications service providers according to the policy guidelines set by the Minister;
- License radio spectrum users, except those that operate in terms of licences issued by the Independent Broadcasting Authority;
- Undertake the review of existing licences where applicable;
- Monitor and enforce compliance with the relevant legislation and regulations;
- Evaluate and prioritise tenders for new licences;
- Determine appropriate classes of licences; and
- Hear complaints from users and service providers.

Frequency spectrum:

- Ensure the most efficient use of the radio frequency spectrum allocation and institute the mechanisms necessary to achieve this;
- Control and rationalise radio frequency spectrum allocation and usage by means of appropriate measures; and
- Establish and implement a national radio frequency spectrum plan.

Standard and quality:

- Set national standards governing the provision of telecommunications services and ensure compliance therewith;

- Ensure that the needs of disabled people are taken into account, particularly with regard to type-approval for customer premises equipment (CPE);
- Set technical and quality standards applicable in consultation with the telecommunications industry; and
- Undertake type-approval of customer premise equipment (CPE) and the rules for their connection to the network.

Research:

- Promote and conduct research into developments in telecommunications regulation policy and technology.

Interconnection:

- Determine interconnection guidelines, facilitate interconnection negotiations and approve interconnection agreements (with modifications as necessary) in the public interest.

Tariff regulation:

- "Tariffs should be regulated, however, the nature and extent of such regulation will vary in accordance with the circumstances in evidence in different areas of the telecommunications sector".
- "In areas of the telecommunications sector in which a monopoly is in place or in which competition is not sufficient to ensure acceptable levels of affordability, tariffs should be regulated. The preferred mechanism is a price-capping regime, allowing for the freedom to set tariff levels at any reasonable point below the cap and for consumer price index-related increases on an annual basis" according to White Paper [2].
- Regulate tariffs if and when required, in the public interest.

Consumer protection:

- Take responsibility for consumer protection with regard to telecommunications.

Numbering:

- Administer South Africa's numbering plan.

Access to Intelsat:

- Regulate access of others to Intelsat services.

Liaison with Minister:

- Advise the Minister in the event of enquiries, complaints, objections or disputes.

Parliament:

- Report to Parliament on the performance of its functions;
- Annually submit a budget to Parliament for approval.

Consultation and international participation:

- Participate in international delegations, in consultation with the Ministry, on issues relating to telecommunications;
- Provide a forum for consultation with all interested parties.

Once the telecommunications industry had been restructured and this restructuring had taken effect, a new regulatory authority was established. Telkom was stripped of some of its responsibilities with regard to its duties in the industry. This new market structure was needed to accelerate development and take account of technological and international trends in the telecommunications industry. With this in mind, Telkom had to be protected after having been a monopoly for so long. Telkom was allowed a 25-year license to build and operate a public switched telecommunications service, facilitated by the Telecommunications Act of 1996. This operating licence was gazetted in May 1997. For five years, Telkom is protected from competition in certain markets, namely:

- Public switched telecommunications services (PSTS);
- Radio communications and

- Value added network services (VANS).

In addition Telkom will have exclusive rights and protection in the following markets:

- National long distance;
- International;
- Local access;
- Public pay phones;
- Infrastructure for value added network services;
- Fixed lines for use by mobile cellular network operators; and
- Infrastructure for private networks other than Transnet and Eskom.

Prices:

According to the White Paper [2]: "The minister will determine Telkom's price increase for the first three years following the issue of the licence to Telkom. Following this period, SATRA will set tariffs. Over time the effect of this should be to lower the real cost of communications. In turn this should make services more affordable to more people and improve capacity utilisation of the networks, thus improving the network operators' financial health".

"In terms of the Act, only suppliers registered with SATRA will be allowed to trade in communications products. Similarly, only those certified as competent by SATRA may install or maintain communications equipment".

Value added network services:

The value added network services are open to competition, subject to licence conditions. There is a ban on resale capacity and on carrying voice traffic. The licence fee is R 15 000 a year and the licence defines VANS as including, but not only,

- Electronic data;
- Electronic mail;
- Protocol conversation;
- Database access;

- Managed data network services;
- Voice mail;
- Store and forward fax;
- Video conferencing;
- Telecommunications related to publishing and advertising services, whether electronic or print;
- Electronic information services, including Internet service provision;

Radio licence:

Telkom's proposed radio licence is non-exclusive and aimed at permitting Telkom to provide public switched telecommunications services and value added network services via radio. License fees are set at R1540,00 per megahertz of frequency spectrum and R650, 000,00 per megahertz of duplex pair, wireless local loop and frequency spectrum.

According to the Department of Communications [12], restructuring of South Africa's telecommunications sector is different from that of the rest of the world. "South Africa is basically an expanding market where restructuring is aimed at achieving universal service. Trends in similar restructuring programmes in emerging economies show that, because the sector is expanding, prospects for job creation are enhanced. Even if, in the long term, one enterprise typically the former monopoly network operator, could shed jobs, there will be a net gain of jobs in the sector over the medium long-term".

South Africa is a member of the World Trade Organisation (WTO) group on telecommunications. South Africa's key offer is that Telkom's monopoly of public switched telecommunications services will end no later than December 2003. Thereafter another public network operator will be permitted. In addition, South Africa has offered to explore the feasibility of licensing more than two public network operators after 2003. However, all traffic, including radio based services, but excepting voice services on value added networks must pass through the duopoly's networks.

In doing this, lessons learnt overseas will be implemented locally. What is clear is that wireless technologies will play a much bigger role in Telkom's plans than previously. The

cost of a GSM (global system for mobile communications) base station is already the same as that of an equivalent fixed wire exchange and a GSM station can be installed more quickly and is not as susceptible to vandalism. The same is true for other, less sophisticated, wireless systems. Already suppliers Altech Alcatel Telecoms, Ericsson, Lucent and Siemens are involved in pilot phase studies in rural areas of the country.

Technologies which show promise include global mobile systems based on low-earth orbit satellites (a number will be in operation by the end of the century), Rurtel, CDMA, rural cellular and solar power.

Telkom will enjoy a period of exclusivity, after which various telecommunications market segments are to be liberalised in a phased process put into motion and overseen by SATRA. From the onset it must be realised that it will be difficult to define the boundaries of market segments or services. The reason is that telecommunications technologies are very flexible. SATRA as opposed to Telkom has been charged with legislation to the enforce rules of the industry. In order to implement the new market structure SATRA has to move with technology rather than against it.

The other regulatory body apart from SATRA is the IBA, which, in accordance with the White Paper [4], came into operation in April 1994 and has since made a major contribution in opening up the airwaves in South Africa. Amongst other things it has:

- Provided for the transformation of the state broadcaster into a public broadcasting service and the establishment of an entirely new community radio broadcasting sector;
- Expanded the private broadcasting industry, with the sale of six of the SABC's commercial radio stations and the granting of nine private radio licences, as well as the licensing of a new, private, free-to-air national television station; and
- Created a framework for further policy development for the South African broadcasting system.

The principal roles of the regulator include:

- Administration of the statutory scheme for granting and renewing broadcasting licenses;

- Management of the broadcasting services frequency bands and other parts of the radio frequency spectrum properly delegated by Parliament and the Minister for broadcasting purposes;

- Design and implementation of regulatory policies and licence conditions for different categories of broadcasting service, including conditions relating to:
  - Local content quotas and compliance with them and the strategies that evolve from them;
  - Service provision, including coverage obligations and language service provision;
  - Formulation of regulations for ownership and control compliance;
  - Code of Conduct compliance;
  - Empowerment; and
  - Monitoring the broadcasting industry to ensure compliance with broadcasting laws and regulations;

- Conducting research, including research into community standards to inform its regulator role;
- The enforcement, where appropriate and necessary of broadcasting laws and regulatory requirements; and
- An appropriate accountability to Parliament, the minister and the system of judicial review.

The functions of the regulator will include, but not be limited to:

- Planning, in accordance with the overall national plan, the availability of segments of the radio frequency spectrum on a national and area basis, including preparing a frequency allocation plan for South Africa. Efficiency and effectiveness should be the hallmarks of frequency allocation planning;
- The granting and renewal of broadcasting licences;
- Monitoring the operation of the IBA Act, technological developments and service trends in the broadcasting sector, and reporting to the Minister from time to time;

- Dealing with complaints about broadcasters' observance of community standards in programming and advertising;
- Dealing with and prescribing the appropriate radio frequency spectrum engineering characteristics of broadcasting services; and
- Making regulations necessary to give effect to broadcasting policy through due public processes.

The IBA and SATRA are already working hand in hand to prepare for the convergence of telecommunications and broadcasting in the year 2000. A single regulatory authority for broadcasting and telecommunications will be more than welcome, for the two regulatory bodies are charged with the same functions in industries where boundaries have long faded.

The IBA Act of 1993 and the SATRA Act of 1996 established two separate regulatory authorities for the broadcasting and telecommunications areas. These acts vested these two authorities with independent powers to regulate the two areas in the public interest. During 1996 the Telecommunications Act was promulgated after a wide-ranging consultative process.

The Telecommunications Act provided for the establishment of the telecommunications regulatory authority to regulate telecommunications and manage that part of the radio frequency spectrum appropriate for telecommunications services. The convergence of telecommunications, broadcasting and information technologies has forced government to focus on an appropriate regulatory structure.

The increasing difficulty of differentiating between that part of the radio frequency spectrum used for telecommunications and that part used for broadcasting and other services, has made it clear the need to merge the two regulatory authorities into a new authority responsible for regulating both the broadcasting and telecommunications areas.

According to the White Paper [5], the merging of the two regulatory authorities will also ensure that the high costs associated with maintaining separate regulatory structures, that require virtually the same technical skills and facilities will be minimised.

Once this has been achieved, it will be easier to execute government's vision. "This vision is in compliance with Government proposed industrial policies, which state that the long-term vision of South Africa's policy makers is to guide and expedite the country's process of industrial development up to the so called value added chain. And in so doing, to achieve the goal of creating substantial (high skill and high-income) employment opportunities on a sustainable basis in the long term" according to White Paper [2].

The local telecommunications supply industry may establish itself as a major player by niche marketing on the African continent. If the segments of the market are competitive and expandable, then the government will give financial support. This means that if the telecommunications industry finds itself in synergy with the rest of the world, it may reap tremendous benefits. These may come in the form of participation in the global economy, improved personal and business communication expanded trade and revitalised economic growth. These will only be achieved if South Africa is integrated into regional and international telecommunications systems.

The vital link of information flow for trade and social integration can only be realised through co-operation and co-ordination among the different parties involved in its development, as users, operators, manufacturers and policy makers.

According to White Paper [5]:"The government attaches great importance to effective regional integration and will actively support the activities of all South African players in these fields through policies. Which promote such regional co-operation in terms of cross-boarder communications, opening of markets for equipment and services. Adopting harmonised standards and technical specifications, efficient use of the radio spectrum, and formulation of common African positions for international negotiations in various world fora for telecommunications and information development".

2.2 International relations:

As a consequence of South Africa's readmission as a member of the Universal Postal Union (UPU) South Africa started participating fully in activities of the International Telecommunications Union (ITU) late in 1994. The full benefits of re-admission to these

communications agencies of the United Nations, whose fora adopt decisions and formulate strategies concerning the development of communications for the benefit of all its members, can now be reaped for South Africa and its peoples.

South Africa was elected as a member of the council of the ITU and the council of administration of the UPU in 1995. Both councils are responsible for the functioning of the unions in the four years between meetings of their highest decision-making organs, namely the *Plenipotentiary Conference* in the case of the ITU, and *Congress* in the case of the UPU. Consequently, their agendas include items on a wide variety of subjects and personnel matters, including the consideration and approval of the biennial budgets. This is a budgeting method generally followed by United Nations agencies. This is development assistance in the field of communications to the least developed and developing countries with special problems. They also deal with agendas and duration's of future conferences and meetings, progress measurements of strategic plans adopted by both unions and other aspects related to the smooth functioning of their respective Secretariats, which are situated in Born and Geneva (ITU).

The radio communications sector is one of the three sectors of the International Telecommunications Union (ITU) that hold regional seminars on frequency management annually. This is to assist administration in keeping abreast of regulatory issues associated with frequency management, and technological developments in radio communications. In co-operation with the ITU the department of Posts and Telecommunications decided to host such a seminar for some of the countries in the African Regions from 4 to 8 September 1995. The St. George's Hotel in Midrand, chosen as the venue for this seminar, was intended to mark the re-admission of this Administration to the organisation and to promote and consolidate regional co-operation.

The main objective of the seminar was to discuss amongst other things:

- Frequency management for both the telecommunication and broadcasting bands;
- Regulatory and procedural matters; and
- Preparations for the World Radio Communication Conference (WRC-95).

In addition, South Africa has joined two more bodies, which are INTELSAT and INMARSAT in an endeavour to join the global community by way of telecommunications. According to Government Documents [6].

2.3 International Telecommunications Satellite Organisation (INTELSAT)

A Telecommunications Department delegation attended the twentieth Assembly of members of INTELSAT, held in Copenhagen from 29 August to 1 September 1995. At this meeting the Assembly, the highest governing body of the organisation, decided among other things, to give the highest priority to the study of the new structure needed in order to adapt the organisation to a more competitive market environment. A working party was established to undertake the study, and the South African representative, in close collaboration with representatives from other African countries, has participated actively in the work of the working party.

2.4 International Mobile Satellite Organisation (INMARSAT):

The eleventh INMARSAT Assembly was held in London from 27 February to 1 March 1996 and was attended by delegation from the Department Of Telecommunications. One of the more important decisions taken at this meeting was that there is an urgent need to introduce changes to the structure of the organisation in order for it to remain commercially viable in a very competitive market. A special working group is undertaking a study and will make recommendations on a suitable new structure for the organisation, which was planned for implementation in 1997.

3 Literature Review and Diffusion Theories.

3.1 Overview

In this chapter some, but not all, of the literature will be reviewed. The main aim is to describe the theory needed for the analysis of the diffusion of personal telecommunications in South Africa. Rogers [7] says that Gabriel Tarde had an analytical eye on trends in his society. He was of French descent, a lawyer by profession and was the main European forefather of the field of diffusion. Tarde is said "to have observed certain generalisations about the diffusion of innovations which he called the law of imitation". The purpose of his scholarly observations, Tarde (1903) said, was to learn why, given one hundred different innovations conceived at the same time, - innovations in the form of words, in mythological ideas, in industrial processes, etc. - ten will spread abroad while ninety will be forgotten".

With this historical background, one can start reviewing some of the theories proposed in the literature.

3.2 Diffusion theory

Masters, like Rogers with regards to the diffusion of innovation [7], state that "diffusion is the process by which innovation is communicated through certain channels over time among the social system. Diffusion is a kind of social change, defined as the process by which alterations occur in the structure and function of the social system".

Rogers takes it further by pointing out that in order for diffusion to take place four elements must be present, namely an innovation, communication channels, time and a social system. He says that an innovation is an idea, practice or object, which is perceived as new by either an individual or a unit of adoption. In this study our innovation is the cellular phone or satellite phone.

The rate, at which the cellular phone is adopted, depends on its perceived newness to the individual. One has to look at the characteristics of the innovation itself to determine its rate of adoption in practice. The characteristics that play a role are relative advantage, compatibility, complexity, trialability and observability.

Rogers' explanation of these elements is as follows: relative advantage is the degree to which an innovation is perceived as better than the idea it supersedes, and this degree may be measured in economic terms, social prestige, convenience and satisfaction. The relative advantage of the cellular phone is that an end-user does not have to be at a fixed location to make a call. An end-user could be travelling and making a call at the same time. This is viewed as an added advantage, for it cuts down on time wasted travelling to fixed places to communicate. Another advantage is that it allows for timely decision-making and definitely improves time management.

Compatibility is the degree to which an innovation is perceived as being consistent with existing values, past experience and the needs of potential adopters. The compatibility of the cellular phone is related to the fact that consumer are already used to being able to communicate with anybody on a regular phone, and the cellular phone simply add the freedom of mobility.

Complexity is the degree to which an innovation is perceived as difficult to understand and use. Cellular telephones are similar in use to regular telephones.

Trialability is the degree to which an innovation may be experimented on. Access to cellular phones is quite easy today - everybody knows somebody who owns one or has access to one, which can be used for trial purposes.

Observability is the degree to which the results of an innovation are visible to others. Cellular phones are visible because people use them in public places. This makes them very visible to potential buyers.

Rogers [7] adds and highlights the fact that in order for the innovation (cellular phone) to be diffused, information about it must reach potential users. In order to achieve this, communication channels have to be used, which are a means by which messages go from one individual to another. In some cases the nature of the information-exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver, and the effect of the transfer. For example, communication channels could be billboard advertising, radio advertising, newspaper advertising, colleague to colleague conversation and magazines.

One must bear in mind that diffusion does not happen instantaneously. It happens over a period of time. This is, firstly, because before an end-user makes a decision to either adopt or reject an innovation, the adopter must have information that such an innovation exists. Secondly, the relative earliness or lateness of the adoption of the innovation by a certain individual or unit of adoption, in comparison to that of other individuals or members of a unit, depends on the type of individual or unit. Thirdly, the number of adopters influences the rate of adoption of an innovation in a certain system over a certain period.

In order for an innovation to diffuse, Rogers [7] says there must be a social system to which the innovation will be diffused. This system may consist of individuals, informal groups, organisations and subsystems. Within the social system, a social structure exists that affects the diffusion, the effects of norms on diffusion, the roles of opinion leaders and change agents, types of innovation-decisions, and the consequences of innovation. These issues involve relationships between the social system and the diffusion process that occurs within it.

Rogers [7] points out that once an innovation has been launched, there are two types of individuals within a social system, that influence others' attitudes towards the innovation. Firstly, there is the *opinion leader*, who has earned this position through his/her technical competence and social accessibility. Secondly, there is the *change agent,* who influences the clients' innovation-decisions in a direction deemed desirable by a change agency. Both of these individuals are a centre of interpersonal communications networks. A communications network consists of interconnected individuals who are linked by patterns of flows of information.

Mike *et al* [8], used transcutaneous oxygen monitoring as a case study to examine how new technologies are introduced into clinical practice. They identified certain major factors in the adoption of transcutaneous oxygen monitoring in their description of the diffusion of medical technology.

The social systems involved in this process were biomedical researchers, clinicians, hospital administrators, the health care industry, policy makers, the legal profession, educators, the news media and the general public. The aim was to share responsibility in

the spirit of the ethics of evidence, but the ultimate responsibility was seen to be that of the physician.

Mike *et al* [8] use the diffusion factors identified to analyse the diffusion of the monitoring system. These diffusion factors are prevailing theory, the innovation, environmental constraints and incentives, evaluation and methods, evaluation and communications channels.

What they discovered first, was that transcutaneous oxygen monitoring was the culmination of hailed achievements of the period, because of the prevailing theory and explanations for observed phenomena, which strongly influence the acceptance of new technologies. Innovations that reflect currently held beliefs tend to be readily adopted, whereas the introduction of new conceptual approaches may be delayed.

Second they realised that transcutaneous monitoring was rapidly adopted because it had, at that time, no competitors. Its disadvantage was that it was not easy to use and caused some frustration to the clinical staff, which made it vulnerable to competition. Because it was an innovation of that time and a new procedure it was more readily accepted, even though it was not easy to use. It required little change in practice style. It was highly remunerative, satisfying and had no worthy clinical competitors.

Thirdly, there were many incentives for adopting the technology for routine use in the neonatal intensive care unit and essentially there were no environmental constraints. The influence of the policy makers was thus seen, because the decisions of regulatory agencies, medical care insurers, institutional review boards, as well as the general climate of malpractice litigation determined its use.

The fourth factor was evaluation and methods of evaluation. Also sensitive to change by policy makers, this factor encompasses the role of technology assessment in affecting physician behaviour. Formal evaluation may have a direct influence on physicians, or it may influence experts who then influence physicians, who may in turn have an impact on medical practice.

The fifth discovery about channels of communication, was that there was a great deal of interest in studying the ways in which doctors learn about new procedures, in order to find

out which sources of information and channels of communication may be most influential. It is a complex scenario, including direct contact with sales representatives, the recommendations of colleagues, medical journals, conferences, continuing education and even the public news media. There are also different patterns particular to the type of innovation, the physician speciality group and the time elapsed since the initial announcement of the new procedure. In the transcutaneous monitoring study, for example, there was a strong effect from advocates, with extensive coverage in the medical literature, as well as aggressive detailing by the device manufacturers.

Mike *et al* [8] indicate that it is easier to introduce a new technology where it is needed. Transcutaneous oxygen monitoring was readily accepted within this medical community because it did not require medical staff to change the way in which they worked. This innovation turned out to be a highly remunerative. It was accepted more readily by medical personnel because they got recommendations about the innovation from colleagues and sources of information that were highly influential.

Girifalco [9] says there are two elements that are relevant when talking about technology diffusion: the extent of use and time. The extent of diffusion of a technology at any given time is defined by the degree to which it is in use at that time. So the process of diffusion is the gradual growth of the use of a technology as time passes.

He emphasises that the diffusion of technology should start with:

- A definition of the technology;
- A specification of the problem or its proxy within which the technology diffuses; and
- A choice of parameter which measures the extent of diffusion.

Once these definitions have been established, technology diffusion can be determined from the analysis of the time series for the diffusion parameter that measures the extent of the technology. The definitions affect the kinds of conclusions that can be drawn, as well as the framework of the analysis.

In addition, Girifalco [9] states that after a population and a diffusion parameter have been defined, there are still two major issues to be considered. The first of these is that a population may not be constant in time. We can expect most populations in which

technological diffusion takes place, change with time. The time series for the diffusion must then be supplemented with a time series for the size of the population.

Girifalco [9] continues by saying that the diffusion of technology is always preceded by the diffusion of information about that technology. Modern travel and communications have enormously increased the rate of information transfer, but even today information on new technologies is not available to everyone instantaneously. While advertising reaches large numbers of people very rapidly, it often takes more information about a new product than can be presented or absorbed from an advertisement before a decision to buy is made.

Girifalco [9] also points out that diffusion focuses on a particular technology and measures its spread independently of any other technology. However, a new technology often fulfils the same function in a better way than, one already in use. The new technology then grows at the expense of the old. This is the phenomenon of technological substitution. The particular nature of the technology and the circumstances in which it exists and grows are basic determinants of the causes, mechanisms and rates of its diffusion, however there are some obvious generalisations that can be made for a technology to diffuse:

- There must be some adopters who accept and implement technology.
- There must be some advocates of the technology who act as the primary agents of change.
- There must be reasons for both advocacy and acceptance.
- There must be a mechanism for communication between the advocates and the adopters.
- A certain quantity and quality of information must be attained before a decision to adopt can be made.
- For a given level of information, the probability of adoption may be different for different adopters.
- Technological diffusion takes place in a changing technical, economic, political, and social environment. The nature of this environment has a profound effect on the rates of diffusion and even on the types of technologies that will diffuse. While this is only a bare framework of the adoption process, it illustrates that technological diffusion is a complex technical, economic, and social phenomenon.

Girifalco, like Rogers, says that diffusion of an innovation will happen over the extent of use and time. He emphasises the fact that information must precede the innovation itself, so that people can make the decision to adopt or reject the innovation. He also mentions that an advocate for the innovation should exist and adopters should be present to use the innovation. In order for the information to flow to adopters from advocates of the innovation, some form of communication mechanisms must be in place. The environment must also be conducive for the diffusion to take place politically, environmentally and in a changing technical world and a social system.

Moore [10] looks at diffusion through what he calls "the technology adoption life cycle". He says our attitude toward technology adoption becomes significant, at least in a marketing sense, any time we are introduced to products that require us to change our current mode of behaviour or to modify other products and services we rely on. Such change sensitive products are called *discontinuous innovations*. The contrasting term, *continuous innovations*, refers to the normal upgrading of products that does not require us to change behaviour.

Moore [10] says classical industries introduce discontinuous innovations only occasionally and with trepidation, however high-tech enterprises do so routinely and confidently. From their inception, therefore, high-tech industries needed a marketing model that coped effectively with this type of product introduction. Thus the technological life cycle became central to the entire sector's approach to marketing.

Moore [10] presents us with a model that describes the market penetration of any new technology product in terms of a progression in the types of consumers it attracts throughout its useful life. The curve is bell shaped. Its divisions are equivalent to the standard deviation. That is the early majority and the late majority fall within one standard deviation from the mean, the early adopters and the laggards within two, and way out there, at the very onset of a new technology, about three standard deviations from the norm are the innovators.

The groups, Moore [10] says, are distinguished from each other by their characteristic response to a discontinuous innovation based on a new technology. Each group has a unique psychographic profile: a combination of psychology and demographics that makes

its marketing responses different to those of the other groups. Understanding each profile and its relationship to its neighbours is a critical component of high-tech marketing.

Moore [10] describes the behaviour of each group. Innovators pursue new technology products aggressively. Marketers seek innovators out even before a formal marketing program has been launched. This is because technology is a central interest in their lives, regardless of the function it performs. At root level, they are intrigued by any fundamental advance and often make technology purchases simply for the pleasure of exploring the new device's properties. There are not very many innovators in any given market segment, but winning them over at the outset of a marketing campaign is key nonetheless, because their endorsement reassures the other players in the market that the product does, in fact, work.

Early adopters, like innovators, buy into new product concepts very early in the life cycle, but unlike innovators they are not technologists. Rather, they are people who find it easy to imagine, understand and appreciate the benefits of a new technology and relate these potential benefits to their other concerns. Whenever they find a strong match, between these benefits and concerns, early adopters are willing to base their buying decisions upon it. Because early adopters do not rely on well-established references in making these buying decisions, preferring instead to rely on their own intuition and vision, they are key to opening up any high-tech market segment.

The early majority shares some of the early adopter's ability to relate to technology, but ultimately they are driven by a strong sense of practicability. They know that many new inventions end up as passing fads, so they are content to wait and see how other people make out with them before they buy in themselves. They want to see well-established references before investing substantially. Because there are so many people in this segment - roughly one third of the whole adoption life cycle - winning their business is key to any substantial profits and growth.

The late majority shares all the concerns of the early majority, plus one major additional one. Whereas, people in the early majority are comfortable with their ability to handle a technology product, the late majority will only buy such a product if it has become an established standard. Even then, the late majority wants to see lots of support and they tend to buy from large, well-established companies. Like the early majority, this group

comprises about one third of the total buying population in any given segment. Courting its favour is highly profitable indeed, for while profit margins decrease as the products mature so do the selling costs and virtually all research and development costs have been amortised by this stage.

The laggards simply do not want anything to do with new technology, for a variety of reasons, some personal and some economic. The only time they ever buy a technological product is when it is buried deep within another product.

Moore [10] takes us further by introducing us to what he calls the High Tech Marketing Model in his endeavour to clarify the diffusion of technology. What Moore is pointing out here is the unfolding, through all stages, of the Technological Adoption Life Cycle. What is dazzling about this concept, particularly for those who own equity in a high-tech venture, is its promise of virtual monopoly over a major new market development. If you can get there first, "catch the curve" and ride it through the early majority segment, thereby establishing the de facto standard, you can get rich very quickly and "own" a highly profitable market for a very long time.

Moore [10] points out some interesting facts about what may go wrong in the marketing ploy of the companies. He introduces a gap between any two psychographic groups. Each of these gaps represents an opportunity for marketing to lose momentum, to miss the transition to the next segment, thereby never to gain the Promised Land of profit-margin leadership in the middle of the bell curve.

Moore [10] states that the first crack gap is between the innovators and the early adopters. It is a gap that occurs when a new technology product cannot readily be translated into a major new benefit. Such a benefit is typically symbolised by a single compelling application, the one thing that best captures the power and value of the new product. If the marketing effort is unable to find this compelling application, then market development stalls at the innovators and the future of the product falls through the crack.

There is another crack between the early majority and late majority. By this point in the Technological Adoption Life Cycle, the market is already well developed and has absorbed the technology product into the mainstream. The key issue now is the transition from the

early to the late majority. It has to do with demands on the end user to be technologically competent.

The most important gap highlighted by Moore [10] is the deep and dividing chasm that separates the early adopters from the early majority. This is by far the most formidable and unforgiving transition in the Technological Adoption Life Cycle and it is all the more dangerous because it typically goes unrecognised. The notion that part of what defines a high-tech market is the tendency of its members to refer to each other when making a buying decision is the key to successful marketing.

Many marketing professionals break "the market" up into isolable "market segments". Market segments, in this vocabulary, meet our definition of markets, including the self-referencing aspects. When marketing consultants sell market segmentation studies, all they are actually doing is breaking out the natural market boundaries within the aggregate of current and potential sales.

According to Moore [10], marketing professionals insist on market segmentation because they know no meaningful marketing program can be implemented across a set of customers who do not refer to each other. Every program must rely on some ongoing chain-reaction effects - what is usually called word of mouth. The more self-referencing the market is, the more tightly-bounded its communication channels are and the greater the opportunity for such effects.

In the early markets stage, Moore [10] discusses different types of customers for high-tech marketing the initial customer set for a new technology product is made up primarily of innovators and early adopters. In the high-tech industry, the innovators are better known as technology enthusiasts or just *techies*, whereas the early adopters are visionaries. The visionaries are the ones who first appreciate the architecture of a product and why it has a competitive advantage over the current crop of products established in the marketplace. Visionaries make great critics for they truly care.

In business, technology enthusiasts are the gatekeepers for any new technology. They are the ones who have the interest to learn about it and the ones everyone else deems

competent to do the early evaluation. As such, they are the first key to any high-tech marketing effort.

As a buying population, or as key influences in corporate buying decisions, technology enthusiasts have fewer requirements than any other group in the adoption profile, but one must not ignore the issues that are important to them. Their primary need is the truth.

Secondly, whenever possible, when they have a technical problem, they want access to the most technically knowledgeable person to answer it.

Thirdly, they want to be the first people to get new products. By working with them under nondisclosure - a commitment to which they typically adhere scrupulously, one can get excellent feedback early in the design cycle and begin building supporters, who will influence buyers not only in their own companies but elsewhere in the marketplace as well.

To reach technology enthusiasts, Moore [10] says, one needs to place one's messages in one of the various channels - computer bulletin boards, retail stores that cater specifically for the technology expert, technical publications, technology conferences and the like.

Enthusiasts can be compared to the kindling that helps to start a fire. They need to be cherished for that reason and letting them in on the secret, allowing them to play with the product and give you feedback does this. Wherever appropriate, you should implement the improvements they suggest and let them know that you have according to Moore [10].

The early adopters or visionaries, are those rare breeds of people who have the insight to match an emerging technology to a strategic opportunity. They have the temperament to translate that insight into a high-visibility, high-risk project and the charisma to get the rest of their organisation to buy into the project, according to Moore [10].

The core of their dream is a business goal, not a technology goal and it involves taking a quantum leap forward in how business is conducted in industry or by their customers. It also involves a high degree of personal recognition and reward. Understanding their dream, one understands how to market to them. Visionaries are not looking for an improvement; they are looking for a fundamental breakthrough. Technology is important only inasmuch as it promises to deliver on this dream. The key point is that, in contrast

with the technology enthusiast, a visionary derives value not from a systems technology itself, but from the strategic leap forward it enables.

Visionaries drive the high-tech industry because they see the potential for an "order of magnitude" return on investment and are willing to take high risks to pursue their goal. They will work with vendors who have little or no funding, with products that start life as little more than a diagram on a white board and with technology gurus who bear a disconcerting resemblance to Rasputin. They know that they are going outside the mainstream and they accept that as part of the price they have to pay when trying to leapfrog over the competition.

This means they can usually provide up-front money to seed additional development that supports their project - hence their importance as a source of high-tech development capital. As a buying group, visionaries are easy to sell to but very hard to please. Visionaries see the future in terms of windows of opportunity and see those windows closing.

Furthermore, Moore [10] explains the dynamics of early markets by saying that to get an early market started requires an entrepreneurial company with a breakthrough technology product. That enables a compelling new application, a technology enthusiast who can evaluate and appreciate the superiority of the product over current alternatives and a well-healed visionary who can foresee an order of magnitude improvement from implementing the new application. When the market is unfolding as it should, the entrepreneurial company seeds the technology enthusiast community with early copies of its product while at the same time sharing its vision with visionary executives. It then invites the visionary executives to check with the technology enthusiasts of their choice, to verify that the vision is indeed achievable. Out of these interactions comes a series of negotiations in which, for what seems like a very large amount of money and time, but which will later be recognised as just the tip of the iceberg. The technology enthusiasts get to buy more toys than they ever dreamed of. The entrepreneurial company commits itself to product modifications and system integration services, it never intended to and the visionary has what, on paper, looks to be an achievable project, but which is, in fact, a highly improbable dream.

Moore [10] cautions that at this stage there might be a problem where marketing falls through the crack between the technology enthusiast and the visionary. By failing to discover what provides the order of magnitude leap in benefits.
Moore [10] says mainstream markets,are dominated by the early majority, who tend to be accepted as leaders by the late majority, which are best thought of as conservatives and rejected as leaders by the laggards or sceptics.

The members of this pragmatic group are best known to their closest colleagues, from whom they typically have earned the highest respect, by their peers within their industry, where they show up near the top of the leader board year after year. To market successfully to pragmatists, one has to understand their values and work to serve them. If the goal of visionaries is to take a quantum leap forward, the goal of pragmatists is to make a percentage improvement. They will take risks when required, but they put safety nets in place first and manage the risks very closely.

If pragmatists are hard to win over, they are loyal once won, often enforcing a company standard that requires the purchase of the product, for a given requirement.

When pragmatists buy, they care about the company they are buying from, the quality of the product they are buying, the infrastructure of supporting products and system interfaces and the reliability of the service they will get. They control the bulk of the money in the marketplace. The rewards for building relationships of trust with them are very much worth the effort. They communicate vertically within their industry. They will not buy from one unless one is established and one cannot be established until they buy from one. Pragmatists want to buy from proven market leaders because they know third parties will design support products around the market-leading product. They are price-sensitive. They are willing to pay a modest premium for top quality or special services but, in the absence of any special differentiation, they want the best deal.

According to Moore [10], the *late majority* or *conservatives* like to buy pre-assembled packages, with everything bundled, at a heavily discounted price. The last thing they want to hear is that the software they have just bought does not support the printer they have just installed.

Last, but not least, Moore [10] mentions the dynamics of downstream markets. Just as the visionary drive the development of the early market. Winning their support, is not only the point of entry, because they are the key to long-term dominance, but having done so, one cannot take a market for granted.

To maintain leadership in a mainstream market, one must at least keep pace with the competition. It is no longer necessary to be the technology leader, nor is it necessary to have the very best product, but the product must be good enough and should a competitor make a major breakthrough, one has to make at least catch-up response.

Moore takes the adoption of a new product further by saying that, there are different types of audience in a social system. There are those people who will adopt a product early like innovators, they are usually very few in number. Then there are the early adopters who are just people in the high-tech market. They too are still quite few in numbers. These two groups of people do not indicate that there is a market, for whatever product has been sold or is on the market. The emergence of an early majority starts to indicate that a market does exist for a product. A rise in profit is realised at this point, which occurs just before the emergence of the late majority, which is the mass market. Then the very last to adopt are those who will buy the innovation only because it is part of a product they want.

Jaakkola *et al* [11] use the Heuristic Diffusion Model to increase our understanding of the diffusion process. The authors look at adopter categories to try and understand diffusion. The first buyers are the innovators and who serve the role of technological innovation as differentiator and inspirator, (the emotional (e.g. category imagery and perceived need) and rational (e.g. costs and quality of offer), barriers are very high for further uptake after this class of people.

Then secondly, its the early adopters, innovation translates into having money to afford products and the ability to manage needs, often met in business. Thirdly there is the early majority, who want to follow development of technology, but also finds functional benefits as well as the means to satisfy personal needs. Just before the late majority the technological innovation reaches its growth peak. In this category very low emotional and rational barriers exist to accept technology. At different user group levels, end-user perception and usage needs dominate the various stages of the technology diffusion

process. Jaakkola *et al* [11] state that end user adoption of mobile technology can be influenced by various factors and drivers to describe market mechanisms.

Diffusion is divided into three main parts. First, what affects the triggering of diffusion, is regulation, end user category, services, substitutes, previous generations and distribution. Second, what impacts on the speed of diffusion are price, services, distribution, substitutes, previous penetration and GDP. Third, what determines the maximum level of diffusion is price, service, distribution, competition and GDP.

According to Jaakkola *et al* [11], drivers change as diffusion moves from one phase to the next, which means that those in the mobile industry have to be dynamic about changing conditions as the diffusion progresses. If the next generation of technology is positioned correctly, the existence of a previous generation of technology may, in fact, help enable the diffusion of the next generation.

What Jaakkalo *et al* [11], point, out furthermore, is that in the cellular industry, two diffusion processes take place concurrently: equipment diffusion and service diffusion. Diffusion of equipment leads diffusion of usage. Saturation in the usage increases continuously as services are developed. In this industry, diffusion can be categorised into usage groups, which in turn can have different drivers for triggering, speed and maximum level of diffusion. The utility of this approach stems from the fact that it helps target business activities in the direction where the most benefits can be expected.

In order to trigger diffusion, usage group with the most potential should first be identified. Then, with the help of an analysis of the drivers of diffusion, marketing activities should be carefully designed to fit the drivers of the targeted usage group's profile.

Main drivers identified for the diffusion of mobile phones are economic factors, substitutes, previous market generations, regulations, distribution, competition, user equipment, service and price. Once these have been identified their sensitivity with respect to diffusion can be examined.

Jaakkola *et al* like Rogers and Moore, look at different adopter categories. They use the Heuristic Diffusion Model to increase understanding of the diffusion process. The authors look at what triggers the diffusion process, which can be substitutes and services. In order

to trigger the diffusion process, they must identify a potential user group. The authors are also interested in the impact on the speed of diffusion of factors such as price, services, previous penetration and distribution and to determine the level of diffusion, they look at price, service, competition and GDP. In the industry of telecommunications two processes of diffusion take place, that of the equipment and that of the service. One cannot continue without the other.

Communication seems to be of paramount importance in the process of diffusion. In order for an innovation to diffuse, there must be a way of communicating the availability of that innovation. Some communications structures have to be in place for it to be possible to disseminate this information. According to Allen *et al* [12], technological gatekeepers are the most effective source of information. The authors illustrate how information flows through certain structures, and discussing first how information enters an organisation. It is clear that entry does occur, because without it, no research and development organisation could survive for long. No research and development organisation, no matter how large, can be fully self-sustaining. In order for the organisation to survive, its members must keep themselves abreast of current developments in those technologies, which are central to the mission of the organisation. It must, in other words, constantly import technical information. Not only were the organisations studied by Allen et al [12] surviving, they were, to all appearances, thriving. They were extremely successful and highly regarded technically. They must, therefore, have been successful, somehow, in acquiring information from outside and disseminating it within their borders. Allen *et al* [12] wished to find out how they did this.

They discovered that the process by which organisations most effectively import information is an indirect one. There exists, in the organisations that they studied a small number of key people upon whom others rely for information. These key people, or 'technological gatekeepers', differ from their colleagues in their orientation toward outside information sources. They read far more, particularly more difficult 'harder' literature. Their relationship with professional engineering and scientific journals is significantly greater than that of the average technologist. They also maintain broader-ranging and longer-term relationships with technologists outside of their organisations. The technological gatekeeper mediates between his colleagues and the world outside their

organisation and he effectively links the organisation to scientific and technological activity in the world at large.

Allen *et al* [12] point out that there is what is called the network of gatekeepers. This communications network (or portions thereof) can be characterised according to the degree of interconnectedness that exists among nodes. There are several degrees of interconnectedness or 'connectivity' that can exist in a network. In this, only that degree of connectivity, which Flammet in Allen et al [12] calls 'strong', will be considered. A strong connected component, or strong component in a network, is one in which all nodes are mutually reachable. In a communication network, a potential exists for the transmission of information between any two members of a strong component. Gatekeepers, therefore, maintain close communication among themselves, thus increasing substantially their effectiveness in linking the organisation to the outside world. In fact, if one were to attempt to design an optimal system for bringing in new technical information and disseminating it within the organisation, it would be difficult to better or improve this model.

New information is brought into the organisation through the gatekeeper. It can be communicated quite readily to other gatekeepers through the gatekeeper network and disseminated outward from one or more points to other members of the organisation.

In addition to formal organisation structure, there are available to management at least two other factors that can be used to promote (or discourage) communication. The first operates through the extension of informal friendship-type relationships within the organisation. Simply stated, people are more willing to ask questions of others whom they know, than of strangers.

The second factor is that transfers. The transferred individual will provide a communication path back to his old organisation. His influence lies far beyond the direct link, though. Probably the most important contribution of the transferred person lies in his ability to make referrals.

Allen *et al* [12] says that gatekeeping is still the most effective way of transmitting information, whether it is from company to company, or just within the ranks of a firm or

between colleagues. It is even more effective when the gatekeepers operate in a network. This makes them highly effective in the dissemination of information.

Banta [13], on the other hand, illustrates the diffusion of an innovation, by looking at the driving forces of the diffusion.

Since its introduction in the USA in the summer of 1973, the computed tomography (CT scanner as the Cat or EMI scanner) has come to exemplify the problems facing the USA in developing policies to deal with medical technology. Its diffusion has been extraordinarily rapid, and given a capital investment of about $500,000 per scanner, millions have been spent acquiring this highly visible technology. Controlling the diffusion of the CT scanner was an early test for the new Health Systems Agencies and State Health Planning Agencies developed under the 1974 health planning legislation. Despite rapid acceptance by the medical community, CT scanners have also often been cited as an example of a technology whose efficacy (or benefit) has not been clearly shown to explain its diffusion of CT scanners.

Why, then, did, CT scanning spread so rapidly? It is not because of its dramatic effects on patients' health, nor because it made possible diagnoses neither possible before, nor even because the medical literature indicated its great usefulness. In fact, up until June 1995, only 13 clinical papers had been published on CT head scanning. While almost 100 CT scanners were in use, allowing physicians to visualise conditions, such as tumours, that they had had difficulty seeing previously. In addition, reports at professional meetings preceded the published literature by more than a year. Nonetheless, the nature of the technology itself does not seem to fully explain the rapidity with which it spread.

Those who have written on the diffusion of medical technology have stressed the explanatory importance of organisational and economic variables.

CT scanning diffused most rapidly among large hospitals. Similar tendencies have been observed with other technologies. Early diffusion to those hospitals affiliated with medical schools was observed for intensive care units and nuclear medicine.

According to Banta [13], the type of descriptive analysis presented does not allow the inference of explanatory models of diffusion trends. It is striking, however, that health-planning agencies seem to have very little effect.

It seems as if there was no information strategy in place. Much of the problem with CT scanners is related to a lack of information about their efficiency and indications for appropriate use. Physicians did not know when CT scanners should be used and institutional purchasers had no reliable information indicating whether or not the CT scanner was an essential part of medical care. An information strategy would require the development of new mechanisms for ensuring that important technologies are evaluated in a timely way by competent investigators. Furthermore, such a strategy would require the periodic synthesis and dissemination of information on specific technologies to those who make decisions on medical technologies.

In addition the regulator strategy seemed to have flaws. The are two major regulatory programs related to medical technology such as the CT scanner. The medical devices regulatory program under the Food and Drug Administration; the Professional Standards Review Organisation (PSRO's) under the Health Care Financing Administration, which exist to ensure appropriate utilisation of technologies used under the Medicare and Medcaid programs.

Finally it seems that a reimbursement strategy seemed not to be enforced. In other countries, an approach often used to restrain diffusion is to limit the total available budget, thereby forcing physicians and institutions to choose among technologies or investments. This strategy has been little used in the USA, but seem to have great potential.

What Banta illustrates is the fact that under-developed policies sometimes interfere with the diffusion process. This is because it becomes unclear which guidelines to use to diffuse an innovation, which makes it difficult to draw boundaries or to determine how well the innovation actually does what it is supposed to do.

3.3 Competition Theory

Porter [14] says that, "in any industry, whether domestic or international, produces a product or a service. The rules of competition are embodied in the five competitive forces:

the entry of new competitors, the threat of substitutes, the bargaining power of buyers, the bargaining power of suppliers and the rivalry among existing competition". This is illustrated in Table 3.1 and Figure 3.1 below.

Table 3. 1 Elements Of Industry Structure [15]

Entry Barriers	Determinants of Supplier Power	Rivalry Determinants
Economies of Scale	Differentiation of inputs	Industry growth
Proprietary product differences	Switching costs of suppliers and firms in the industry	Fixed (or storage) costs/value added
Brand identity	Presence of substitute inputs	Intermittent over capacity
Switching costs	Supplier concentration	Brand identity
Capital requirements	Importance of volume to supplier	Switching costs
Access to distribution	Cost relative to total purchases in the industry	Concentration and balance
Absolute cost advantage	Impact of inputs on cost or differentiation	Information complexity
Propriety learning curve		Diversity of competitors
Access to necessary inputs		Corporate stakes
Proprietary low-cost product design		Exit barriers
Determinants of Substitution Threat	**Determinants of Buyer Power**	**Price Sensitivity**
Relative price performance of substitutes	Bargaining leverage	Price/total purchases
Switching costs	Buyer concentration versus firm concentration	Product differences
Buyer propensity to substitute	Buyer volume	Brand identity
	Buyer switching costs relative to firm switching costs	Impact on quality/performance
	Buyer information	Buyer profits
	Ability to backward integrate	Decision makers' incentives
	Substitute products	
	Pull-through	

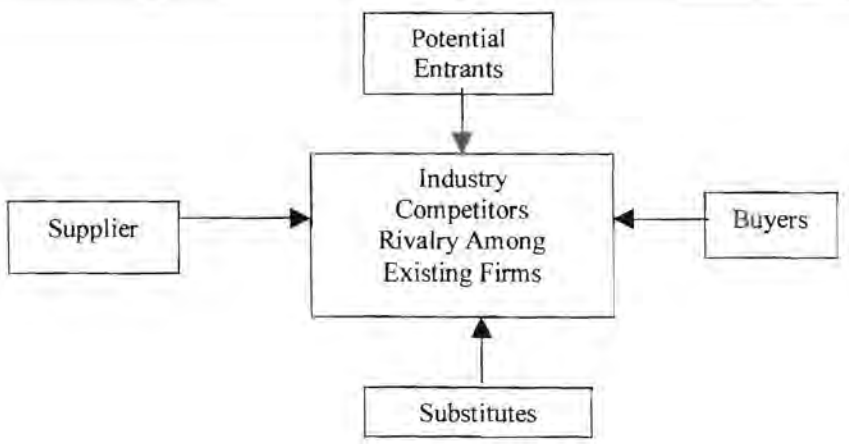


Figure 3. 1 The Five Competitive Forces That Determine Industry Profitability [15]

According to Porter [14], competitive strategy does not only respond to the environment, but also attempts to shape that environment in a firm's favour. The five competitive forces (See Figure 3.1) determine the industry's profitability because they influence price, cost and required investment of firms in an industry.

Buyer power influences the prices that firms can charge, as does the threat of substitution. The power of buyers influences cost and investment. This is because powerful buyers demand costly service. The bargaining power of suppliers determines the costs of raw materials and other inputs. The intensity of rivalry influences prices as well as the costs of competing in areas such as advertising and sales force. The threat of entry places a limit on prices and shapes the investment required to deter entrants.

The crucial question in determining profitability is whether firms can capture the value they create for buyers, or whether this value is competed away to others. Industry structure determines who captures the value (see Table 3.1).

The threat of entry determines the likelihood that new firms will enter an industry and compete away the value, either passing it on to buyers in the form of lower prices or dissipating it by raising the costs of competing. The power of buyers determines the extent to which they retain most of the value created for them, leaving firms in an industry only modest returns.

The threat of substitutes determines the extent to which some other product can meet the same buyer needs and thus places a ceiling on the amount a buyer is willing to pay for an industry's product.

The power of suppliers determines the extent to which value created for buyers will be appropriate by suppliers rather than the firms in industry. The intensity of rivalry acts similarly to the threat of entry. Determines the extent to which firms already in an industry

will compete away the value they create for buyers among themselves, passing it on to buyers in lower prices.

Porter [14] continues by saying the two basic types of competitive advantage combined with the scope of activities which a firm seeks to achieve, leads to three generic strategies for achieving the above, namely average performance in industry: cost leadership, differentiation and focus.

If a firm can achieve and sustain overall cost leadership, it can command prices at or near the industry average. At equivalent or lower prices than its rivals, a cost leader's low cost position translates into higher returns. A cost leader cannot, however, ignore the bases of differentiation. If its product is not perceived as comparable or acceptable to buyers, a cost leader will be forced to discount prices well below those of competitors to gain sales.

This means product differentiation is peculiar to each industry. Differentiation can be based on the product itself; the delivery system in which it is sold; the marketing approach and a broad range of other factors.

A firm that can achieve and sustain differentiation will perform above average in its industry if its price premium exceeds the extra costs incurred in being unique. A differentiator must always seek ways of differentiating that lead to a price premium greater than the cost of differentiating that lead to a price premium greater than the cost position.

Porter [14] says, furthermore, that the differentiation strategy requires that a firm choose attributes in which to differentiate itself that are different from those of its rivals'. A firm must truly be unique at something or be perceived as unique, if it is to expect a premium price.

The focus strategy has two variants. In cost focus, a firm seeks a cost advantage in its target segment, while in differentiation focus, a firm seeks differentiation in its target segments. Both variants of the focus strategy rest on differences between a focussed target segments and other segments in industry.

The target segments must either have buyers with unusual needs or else the production and delivery system that best serves the target segment must differ from that of other industry

segments. Cost focus exploits differences in cost behaviour in some segments, while differentiation focus exploits the special needs of buyers in certain segments. Such differences imply that the segments are poorly served by broadly targeted competitors who serve them at the same time as they serve others. The focuser can thus achieve competitive advantage by dedicating itself to the segments exclusively. Breadth of target is clearly a matter of degree, but the essence of focus is the exploitation of a narrow target difference from the balance of the industry. Narrow focus, in and of itself, is not sufficient for above-average performance.

According to Prahalad *et al* [16], competition occurs not just between individual product or service offerings, but between firms and coalition firms. Top management teams compete in the acquisition of foresight about a broad new opportunity arena, such as genetically engineered drugs.

Companies compete in building core competencies that transcend the resources of individual business units. Coalitions compete to create new competitive space. Economists, strategy researchers and management have too often assumed that competition is limited to the market for goods and services, yet competition for foresight, competition to build competencies and competition to shape industry evolution through a coalition, are all examples of extra-market or non-market competition.

The fact that this competition takes place outside the "market" does not make it any less real. Insensitivity to this broader scope of competition can prevent a company from preparing adequately for the future.

Prahalad *et al* [16] also say that understanding a business's competitive position gives some indication of its relative potential for profits. The theory is that different industries and industry segments have different average profitability levels and that these differences persist over time. Depending on the array of competitive forces at work, a particular industry segment may be, on average, inherently more or less profitable than another.

The industry structure analysis is well suited to describing the 'what' of competitiveness (i.e. what is it that makes one company or industry more profitable than another). As new 'what' have been uncovered, companies have been exhorted to "compete on time", become

"customer-led", strive for quality, simultaneous engineering and pursue a host of other desirable advantages. Yet, with all the attention given to understanding the particulars of cost, quality, customer service and time-to-market advantages, 'why' of competitiveness seems to have gone largely unanswered.

Why do some companies seem able to continually create new forms of competitive advantage, while others seem only to observe and follow? Why are some firms net advantage creators and others, net advantage imitators? There is a need not only to keep score of existing advantages -what they are and who has them -but to discover the "engine" that propels the process of advantage creation.

Argwal *et al* [17], as an illustration of competition in service industries say, some of the major potential sources of sustainable competitive advantage that seem relevant for telecommunications firms are:

- Economies of scale and scope;
- Brand equity;
- Long term relationships;
- Information technology; and
- Corporate culture and organisational expertise.

With the entry of larger competitors and firms with multiple service lines, economies of scale and scope will become extremely important. Once a corporate infrastructure is in place, the cost of providing additional services to customers is small.

The costs of providing call screening, voice mail and caller ID to a customer who has already bought basic Personal Communications Services (PCS) is minimal. Companies that can provide a full range of services, like local, long distance, wireless voice, data, television and internet access are likely to be more successful due to economies of scale and the ability to market a whole bundle of services. Wireless companies will be able to offer bundled local, long distance and wireless services. However, interchange carriers and others also have the capability to offer "service bundles" and may have larger existing customer bases to which they can offer this service. In addition, multi-product firms can

better bear the financial burden of marketing Personal Communications Services (PCS) products, as large amounts have already been invested in licence costs.

Argwal *et al* [17] say that bundling of services is preferred by many customers in proprietary studies that have been undertaken. Customers prefer bundles of local, long distance and wireless services from one company to buying separate services from two or three different firms. Having a single point of contact for customer service, billing and service activation provides utility for customers.

Large firms can achieve these economies of scope through acquisition and mergers, while other firms will obtain this advantage through partnering arrangements.

In the telecom market, brand equity is defined as a set of assets and liabilities linked to a brand. Some of these assets include brand awareness, brand loyalty and perceived quality. AT&T has a strong competitive edge in terms of its brand equity, which was built on the basis of extensive advertising over a long period of time. Since many firms are entering the wireless markets only now, the level of brand equity in the market can be judged by examining the strength of the brands in the local and long distance markets.

Long-term relationships will be extremely valuable to firms in the market. Retaining current customers is much less expensive than acquiring new ones. Churn is a major problem in the industry. Strategies have to be adopted to reduce churn by increasing the transaction cost for the customers and providing more value. One way to do this is to provide a bundle of services, including both wireless and land-line telecommunications and other related services. This will improve the relationship with customers and also increase the implicit cost of switching for the customer. This strategy will be effective, if the bundle of potential services, offered by one firm, is much wider than that of the other firms.

Having comprehensive databases of customers will be a major asset to players in the wireless market. Having a unified billing system provides a competitive advantage in the marketplace. Thus, having state-of-the-art information technology can provide tremendous competitive advantages to firms in this industry.

Argwal *et al* [17] continue by saying that in mobile telephony, some firms will have superior management skills. In recent years, cellular marketing departments have had difficulty processing large volumes of orders for service and have found it problematic to deal with high volumes of customer care inquiries. Since there have been more than enough customers coming to the carriers and seeking their services, little attention has been paid to innovate marketing and branding programs. This situation, will, however, have to change as competition for customers becomes more intense.

Other new Personal Communications Services (PCS) players may have smaller, more agile organisations and may be better able to take quick action. Agile firms can gain from the first mover advantage by rapidly bringing new services to the market. Constantly being in touch with the market will therefore be important. Innovation in packaging and marketing will need to be used to provide positional advantage.

Firms that leverage some of these bases of potential competitive advantage will, potentially, see results in terms of strong customer satisfaction, a high degree of loyalty, a large market share and profitability.

Some proprietary research shows that early adopters of Personal Communications Services (PCS) in the residential sector are likely to be buyers of high technology products such as pagers, compact disc players and video cameras. Those who are single, male, younger and with higher expenditures on telephone services are also more likely to acquire wireless services early. Early adopters in the business sector will likely be current users of cellular, paging, private mobile radio and voice mail services. In addition, they are likely to be drawn from larger establishments in business services.

In addition Argwal *et al* [17] identify four generic strategies for survival, which overlap with those suggested by Porter. They are:

- Lowest cost service, offering acceptable quality at the lowest competitive cost and thus being best able to meet commodity type price competition;
- Focused product superiority, providing superior value through product innovation and leadership;

- Horizontal service integration, being able to offer a broad range of bundled mobility and non-mobility types of services, e.g. local, long distance, wireless, video, internet, etc;
- Superior customer relationships, focusing on satisfying the customer, building long-term relationships and reducing churn.

The lowest cost provider does not need to focus as heavily on customers or innovative service, as on cost management. The firm's size, economies of scale and information resources can provide comparative advantage. The segments for this strategy will clearly be the price-sensitive ones. Acceptable customer service will have to be provided. Products offered will be limited.

The focused product superiority strategy involves continuous innovation in products and services. Strong brand equity will be needed to maintain a name in the marketplace. While relationship management is important, product innovation is key. Some firms for example, could offer single number offerings, allowing the subscriber to give one number on which callers can reach them anytime or any place. One can program the system to develop a calling protocol in case there is no answer. For example, it may first try the subscriber's home, the office, the car and finally, if there is no answer, then it can revert to voice mail. Providing call management features enhances user control. These will include call screening, call blocking and voice mail, all of which can be combined into an integrated package. On the hardware side, multi-mode terminals that are able to function with both cellular and (Personal communications Services) PCS networks could be marketed.

Horizontal integration requires strategic alliances with other service providers and in-depth understanding of the needs of customers. Economies of scale will be crucial here, as well as good information technology to integrate the various services into one bill, customer service, etc. Marketing personnel need to be well trained in diverse products and services. A key marketing challenge will be to decide which features and bundles are valuable for which segments, at what prices and to be able to provide them more efficiently than competitors.

As the competition intensifies, average airtime prices are bound to decline. Various pricing strategies may be relevant: lowest cost per minute, high fixed cost with low per minute cost, or no fixed cost with high per minute cost for emergency use. In addition, there are seeing "free" and bundle-in free minutes that are part of the basic monthly service charge. The challenge will be to provide value to the customer.

The superior customer relationship strategy requires an existing base of customers and strong marketing and customer care programs to maintain and grow the customer base. Superior training of personnel and delegation of authority to customer contact employees will be critical for delivering superior service. A strong corporate culture and a good information technology infrastructure will help provide superior customer relationships.

The marketing landscape for mobile telephony is changing rapidly. Cellular operators will have to upgrade their marketing personnel and skills quickly to be able to compete in this evolving environment. Old strategies that used to work in a relatively secure, duopoly market may no longer be profitable. New Personal Communications Services (PCS) competitors will have to determine their strategic postures and fashion a marketing strategy to meet their goals. Three major marketing challenges will be to develop a compelling buying position beyond low price; to identify and capture distribution channels, and to develop and maintain brand equities.

The main marketing challenge in the short term will be that of the defining the needs of different segments, differentiating offerings competitively and overcoming barriers associated with less-than-ideal services in the early years. Creating brand equity and providing bundled services to reduce churn in the market are going to be key ingredients in this new environment.

As the mobile telephony market becomes more broad-based, distribution will become the key to the fight for survival and prosperity. Retail re-sellers who can provide information to potential subscribers have to be recruited. Companies may not have the time or the resources to establish in-house direct sales forces. Existing telemarketers may be used, perhaps with strategic alliances and equity participation, to provide wide coverage of the markets. Franchising opportunities may also arise.

One key to success in the market will be brand equity. With similar technology available to all players, it will be difficult to differentiate the services being offered. Brand equity may therefore emerge as a key to this market. Players with existing brand-awareness will have to make much lower investments in entering mobile telephony. Newer firms with PCS licences will have the opportunity to create and establish their unique brand names.

Gorhing [18] illustrates that competition in the wireless industry clearly exists and has led to many successes, the most apparent of which may be the evidence that the wireless is beginning to replace wireline. Gorhing [18] says that Mauldin's research indicates that 25% of PCS customers in Louisiana use a wireless service as their primary telephone. Users may not rely on that phone as their only phone, but 15% of those users have actually disconnected their wireline phones.

Gorhing [18] says that Mauldin says the concept of disconnecting wireline phones primarily attracts two groups of customers: low -end users who are typically not interested in long-distance calls and upper-end customers who are heavy roamers and make high volumes of long distance calls. In between those segments is a large middle market, which does not have as great an interest in substitution.

Despite the high percentages of customers who are already substituting wireless for wireline. Mauldin does not see this becoming a more widespread occurrence for some time, because wireline will continue to offer a superior connection for data use, even though people express interest in replacing their wireline phones with wireless ones. Such people are especially likely to fall into the upper-income brackets and to be heavy business users. These users have fax lines and PCs in their homes and their Internet and faxing needs are best served by wireline offerings.

Driving the possibility of wireline replacement is the emergence of pricing plans that include large number of minutes at low prices. The proliferation of One Rate-type plans will fuel a wholesale market. AT&T uses an intelligent roaming database that instructs roaming phones on which network to log onto in a specific area. AT&T designates that network because it offers the lowest of prices. Operators are eager to carry AT&T's roaming traffic because they can earn significant profits from these minutes and they get wholesale airtime.

AT&T's Digital One Rate plan led to a perceived need by some operators and industry followers to operate a national network. Bell Atlantic's acquisition of Nynex and its pending acquisition of GTE, are about achieving scale. Scale allows for the purchasing economies, which in turn allows Bell Atlantic to invest in technology. While Seindeberg acknowledged that low rates are important and that Bell Atlantic matches competitors' low rates over the long term, value will be most important and continued investment in technology will yield valuable service.

Gorhing [18] states that pricing plans are now the name of the game. The technology battles are over for consumers who are now primarily interested in price. Throughout price plans will continue to evolve. Then they will stabilise and consumers will grow more interested in valuable features.

The decisions operators are making today regarding the shape of their businesses, whether they are to pursue tiny towns or the whole globe, will likely determine the makeup of the wireless market that we see in the future.

3.4 Forecast Theory

Burgelman *et al* [19] say that forecasts are made possible by the established relationship between the rate of technological advance and time. These forecasts are used to follow the trends of technology at different phases of its lifecycle. Analysis of historical data from a considerable number of phenomena shows that progress is not random and discontinuous, but follows a regular pattern when a selected attribute, such as functional performance, a technical parameter, or economic performance, is plotted against time. One finds an S-curve pattern.

The S-curve is similar to a product life cycle, in that there is a slow initial growth, followed by a rapid rise to exponential growth, which slows down as it approaches, asymptotically, an upper limit.

According to Gaynor [20], all technologies are systems whose operations are controlled by many different variables and specifications. The appropriate performance measure for a technology is one, which relates technical progress directly to customer utility. The choice

of the technological performance with which to characterise the utility of technical progress is therefore a critical choice in forecasting technological change.

Twiss *et al,* in Gaynor [20], say that one can plot the rate of change of a performance parameter over time and one will likely see a kind of S-curve. This common pattern, which has occurred consistently in the past, has been called the "technology S-curve" and has been used as the basis for extrapolative forecasts of technology change. The curve has three periods: an early period of new invention, a middle period of technology improvement and a late period of technology maturity.

There are two kinds of rates of technical progress:

- Incremental progress along the S-curve, as improvements are made in a technology utilising one physical process; and
- Discontinuous progress, jumping from an old S-curve to a new S-curve as improvements in a technology use a new and different physical progress.

Gaynor [20] says that according to Smith, the substitution process is being considered explicitly in functional terms. It is viewed in terms of the technical and marketing capabilities associated with the existing product as well as the innovations. Also recognised are the high levels of uncertainty that surround young industry and the rivalry among those who seek to structure the framework of competition in ways that favour their interests. The dynamics of this rivalry and the rules of competition that are formed as the new industry develops can have a significant impact on long-term substitution patterns.

According to Gaynor [20] functional perspective is vital for analysing substitution dynamics and long-term substitution outcomes. This suggests that while the range of functions for which an existing product is used may be narrowed, its sales can be largely unaffected within principal markets even as a new product gains widespread acceptance. Thus it may not be necessary to stem adoption of the new product in order for the existing product to be able to survive and prosper.

Gaynor [20] also talks of the resource-based perspective, which says in itself it is important to look beyond the impact on a traditional product and view the threat of substitution in

terms of the firm's existing research and development, manufacturing and marketing capabilities. Such capabilities are the foundation of a firm's position in the given markets. The extent to which they prove to be valuable for the new product, is a key issue for continued viability where an existing product is displaced.

In addition, Gaynor [20] discusses competitive perspective, pointing out that how an industry evolves can affect substitution patterns. The strategies of various firms may reflect different competitive capabilities and/or economic interests. Competing designs may vary in the range of functions they perform the potential effectiveness with which they perform given functions, the technical capabilities on which they are based and their marketing requirements.

According to Tidd *et al* [21], the diffusion of innovation is typically described by an S-shaped curve. Initially the rate of adoption is low and adoption is confined to innovators'. Next to adopt are the early adopters and then the late majority and finally the curve tails off as only laggards remain.

Kwasncki *et al* [22] say that the word "to diffuse" was derived at the end of the fourteenth century from the Latin *diffundere*, which means, "to spread over". In science, the term "diffusion" refers to the phenomenon of the spreading over time, in space or acceptance in a social environment, of some specific term or pattern. Spatial diffusion is the object of interest mainly of sociologists and development planners. Diffusion in the human-social environment interests researchers in market development and planners of technological development at the firm, regional and national levels. Integration of these two approaches is however, possible and has in fact been done.

One aim is to develop a relatively simple and easy model of technological substitution (diffusion). Ryan *et al* in Kwasnicki et al [22], say that in their early investigations of diffusion, they noted two important features of that process: the very wide range of rates at which different innovations spread and the general S-shaped diffusion of most innovations. These two features have now become the key stylised facts of the diffusion process, but it is necessary to add that the S-shaped pattern of diffusion is recorded only in the case of two competing technologies, the new and the old. At any moment, more than two technologies compete, so that we have multi-technological diffusion (sometimes called substitution).

The diffusion of a single technology has the form of a bell shaped curve. Broadly speaking, the bell-shaped curve consists of an introductory phase, when the diffusion rate is not very high, followed by a phase of relatively quick diffusion. The third phase may be called the matured phase, in which the market share of the technology declines and the use and emergence of new and better technology (typically the new technology emerges during the second phase, of quick diffusion of the old technology).

3.5 Cluster Theory

In strategic management and industrial economics the formation of competitive high technological clusters is important to technological innovations. According to Sabourrin *et al* [23], they indicate that Shumpeter was the first to "indicate that technological innovations are not an isolated phenomenon, equally distributed in time in the economic system, but tend to appear in the form of bunching in specific industrial sectors. Since Shumpeter, several researchers have shown that the study of innovation should focus on the process underlying the formation of competitive high technological clusters".

It is generally agreed that technological clusters are formed and shaped by the collective and innovative behaviour of technological firms. In addition, Porter [14] is also quoted "as proposing a model for analysing the competitiveness of regions and countries and argued that this concept should include four strategic resources in the formation of high technology clusters: highly qualified manpower, technological infrastructure, knowledge resources and capital resources".

According to Sabourin *et al* [23]: "strategic resources are represented as a sequential path of causality where highly qualified human resources play a key role in initiating dynamics in the creation of a competitive cluster. Knowledge resources then assume the role of protecting the assets of the firms and technological infrastructures become the firm's leverage in its capacity to develop new technological products and processes. Then in the end the availability of capital is a factor of financial leverage with a multiplier effect on the technological and commercial capabilities of the firm".

In addition, Porter [14] says that economic, technological and competitive developments are increasing the competitive advantage to be gained by those who can identify and

exploit interrelationships among distinct but related businesses. He talks about horizontal strategy, which he says cuts across divisional boundaries. This horizontal strategy is a co-ordinated set of goals and policies across distinct but interrelated business units. It provides for explicit co-ordination among business units, that make corporate or group strategy more than the sum of the individual business strategies.

Porter [14] points out three types of interrelationships among business units, namely tangible interrelationships, intangible interrelationships and competitor relationships.

Tangible interrelationships arise from opportunities to share activities in the value chain among related business units, due to the presence of common buyers, channels, technologies and other factors. Tangible interrelationships lead to competitive advantage if they share costs or enhance differentiation enough, to exceed the cost of sharing.

Intangible interrelationships, transfers the management of *know-how* among separate value chains. Here the competitive advantage is shown by transference of know-how about how to manage a particular type of activity from one business unit to another.

Competitor relationships stem from the existence of rivals that actually or potentially compete with a firm in more than one industry. From what has been discussed above, one can conclude that business unit clusters are formed around intangible and tangible interrelationships.

3.6 Managing Innovation Theory

Gaynor [20] says that managers must understand both the importance of new-product innovation to business success and their own role in supporting the new innovation process.

New product innovation is a fundamental business process, whose purpose is to create and sustain growth in both revenues and profits. This process is the innovation engine. The innovation engine gathers information on topics such as new technology, market trends, and customer needs and new manufacturing techniques.

Information from the innovation engine enables the introduction of a steady stream of new products into the customer and user world. The value that these products provide

stimulates an ever-increasing customer base to make purchases that result in steadily-increasing revenues for the company.

Top-level business managers decide whether or not to invest in new-product innovation and how much money to spend this way. A key objective of managers of new-product innovation activities should be to make sure that high-level executives believe that their innovation engine is the best investment opportunity available.

A primary objective of the innovation engine must be to ensure that the cash-flow cycle for each new product makes a return on investment. This is because a new-product innovation activity addresses a new opportunity in the marketplace. An opportunity exists when congruence occurs between a customer need and the ability of technology to create a solution for that need.

A key management goal is to direct innovation activity in a way that maximises business success. If a manager wants to increase total project profitability, priority should be given to moving extinction time as far as possible and taking time to maximise gross profit.

Top-level executives are responsible for both achieving acceptable business performance today and steering their corporation to a successful future in a competitive world. To improve future revenue performance, executives must do their part in improving the selection of opportunities for investment. This means establishing strategic directions for new product innovation activity that guide the corporation towards markets that will support future growth. Gaynor [20] adds that management of these plans should be done in a way that will effectively guide the selection of individual project opportunities.

Executives must communicate that new products will provide a high rate of return, excellent competitive performance and superior value for the customer. They should also stress that all dealings with customers will reflect the high integrity of the corporation.

The innovation engine must anticipate and support the manufacturing infrastructure so that newly introduced products fit naturally within the effort.

To be competitive, leading companies must focus on the capabilities that they are best at, those core competencies that differentiate them from their competitors and that provide the

necessary competitive edge for the future. They must then find vendors and partners to fill in the rest of the capacity they need to provide products and services to their customers.

All managers of new-product innovation activity must strive to optimise cash flow for their projects. Given that an opportunity fits with corporate plans, the best opportunities will also have the following attributes:

- A population of potential customers;
- A substantial profit potential;
- Technical, market and manufacturing feasibility; and
- The potential for a sustainable competitive advantage.

Spending time and energy initially to describe the best possible product response for a given opportunity will help a great deal to ensure the desired financial return.

The size of project teams should allow efficient achievement of the best time to market. The goals of management should be to provide the team with what they need to meet commitments and to remove any obstacles that get in their way. The responsibility for ensuring that the output of innovation efforts fits with required manufacturing and regulatory constraints rests with the managers of the innovation activity.

Members of staff from almost every function in the business are involved in some way in new product innovation. The innovation engine must therefore be owned and managed by the top-level leadership team of the business unit.

The process of developing a product must involve expertise from both manufacturing and marketing, to ensure that the right product is designed into a market-competitive and manufacturable form. This will happen if the opportunity-scanning process crosses functionality. Inputs into this process include non-specific titbits of information from the technical, market and manufacturing arenas in which business enterprise is involved.

Potential opportunity with the division of business leadership provides the sense of alignment with strategies and core competencies needed to establish the right priorities.

Once an opportunity to define a product presents itself, information from the opportunity scanning process, that describes the business opportunity selected and includes information

about customer needs and new technologies. At the end of this process, a business proposal should emerge that will be presented to the business management team, to enable them to make a well-informed decision on whether or not to invest the necessary resources.

Once product development has been initiated, the information created in product development should be captured and managed by an effective product data management system that controls access to the information, manages revisions and provides systematic backup and safe storage of the information.

According to Gaynor [20], once a product has been developed it has to be introduced, sold and supported. To do this, support services have to be put together that will distribute the product, support its application and repair services. This marketing capacity can only be achieved through on going exchange of information between product development and manufacturing engineering efforts. After this exchange is achieved and information about the product is available, then awareness of the product among target customers is established. New distribution channels are initiated and the sales force gains initial experience with the product and the customer.

There are specific roles which managers' play in the innovation process. These roles include that of project management skills, engineering process and project staffing.

The project manager's role is to ensure a clear, stable product definition, a consistent and pervasive understanding of both customer and user needs, and a common understanding of priorities and decision criteria.

With the engineering process, engineers must understand the requirements of their tasks and the needs of the customer. They must understand how their work relates to the needs of the ultimate user of the product and how others will use the information that they produce in the innovation process.

In order for the project to be successful, the right type of staff has to be available. Meaning that the right people during start-up phase and the right level of resources during development phases.

Portfolio management is a key issue, so that when opportunities are scanned the range of project investments should also be scanned. The objective of this selection process is to create and maintain a relatively small portfolio of projects that has the highest possible future value.

Sometimes, in innovation, some projects stall for one reason or another. This creates a bottleneck. The project manager should be able to shift limited resources to alleviate this. If this is impossible portfolio management should be charged with dealing with the problem.

Gaynor [20] says that an innovative environment has to be created for a product to be developed. Product development is achieved by empowering a workforce that can depend entirely on the environment created by management. Leaders from project managers up through to executives must balance their behaviour across a range of roles to create such an environment. Managers need to wander around, stay in touch with what is happening and provide assistance when an individual gets off track.

Innovation is a process according to Tidd *et al* [21] and they claim that it should be managed as such. They add that, "successful innovation management is primarily about building and improving effective routines. Such learning comes from recognising and understanding effective routines (whether developed in-house or observed in another enterprise) and facilitating their emergence across the organisation". Innovation management is about putting on a good all round performance. Some of the routines it uses are successful, because innovation is strategy based, but it can only be achieved by learning from experience and being analytical.

Tidd *et al* [21] also say that successful innovation depends on effective internal and external linkages: Linkages offer opportunities for learning from tough customers, lead users, competitors, strategic alliances and alternative perspective.

Successful innovation requires enabling mechanisms for making change happen. This process involves systematic problem-solving and works best within a clear decision-making framework, which should help the organisation stop as well as progress

development if things are going wrong. It also requires skills in project management and control and parallel development of both the market and the technology streams.

Tidd *et al* [21] emphasise the fact that successful innovation only happens within a supportive organisational context, in which creative ideas can merge and be deployed effectively. Building and maintaining such organisational conditions is a critical part of innovation management. It involves working with structures, work organisation arrangements, training and development, reward and recognition systems and communication arrangements. Above all, the requirement is to create the conditions within which a learning organisation can begin to operate, with shared problem identification and solving and with the ability to capture and accumulate learning about technology and about management of the innovation process.

4 Diffusion Mechanisms.

4.1 Competitive Collaboration

In order for companies to survive nowadays they need each other. This is because there is not enough capital to sustain companies on their own from research and development through to distributing products to the end user. In order to overcome this, companies work together, even though they are competitive.

Hamel *et al* [24] say that collaboration between competitors is fashionable. France's Thomson and Japan's Sony manufacture videocassette recorders and Siemens and Phillips develop semiconductors. These companies do work together, even though they are in competition with each other, through infrastructures like co-operative research, outsourcing agreements and joint ventures. This is what is called "competitive collaboration". It seems to trigger unease about long-term consequences, but a strategic alliance can strengthen both companies against outsiders even as it weakens one partner *vis-à-vis* the other. Hamel *et al* [24] say that it takes so much money to develop new products and to penetrate new markets, that few companies can do this alone in every situation. Motorola needs Toshiba's capacity for distribution into the Japanese semiconductor market.

Companies that benefit the most from competitive collaboration adhere to a powerful set of principles. Hamel *et al* [24] say that collaboration is competition in a different form, so companies have to be strategic when they engage in collaboration. Successful companies never forget that their new partners may be out to disarm them. They enter alliances with clear strategic objectives and they also understand how their partners' objectives will affect their success.

Harmony is not the most important measure of success. Indeed, occasional conflict may be the best evidence of mutually beneficial collaboration. Few alliances remain win-win undertakings forever. A partner may feel content even as it unknowingly surrenders core skills.

According to Hamel *et al* [24] say *Cupertino* has limits. Companies must defend against competitive compromise. A strategic alliance is a constantly evolving bargain, whose real

terms go beyond the legal agreement or the aims of top management. What information is traded is determined from day to day, often by engineers and operating managers. Successful companies inform employees at all levels about which skills and technologies are off-limits to the partner and monitor what the partner requests and receive.

Hamel *et al* [24] emphasise that learning from partners is important. Successful companies view each alliance as a window on to their partners' broad capabilities. They use the alliance to build skills in areas outside the formal agreement and systematically diffuse new knowledge throughout their organisation.

Hamel *et al* [24] explain why it is important for companies to collaborate. Using an alliance to acquire new technologies or skills is not devious. It reflects the commitment and capacity of each partner to absorb the skills of each other.

They point out that strategic intent is an essential ingredient in the commitment to learning. The willingness of Asian companies to enter alliances represents a change in competitive tactics, not in competitive goals. NEC, for example, has used a series of collaborative ventures to enhance its technology and product competencies. It is the only company in the world with a leading position in telecommunications, computers and semiconductors - despite its investing less in research and development.

Hamel *et al* [24] also point out that a company's attitude towards collaboration is also of importance. A senior U.S. manager offered this analysis of his company's venture with a Japanese rival: "We complement each other well - our distribution capability and their manufacturing skill. I see no reason to invest upstream if we can find a secure source of product. This is a comfortable relationship for us".

An executive from this company's Japanese partner offered a different perspective; "When it is necessary to collaborate, I go to my employees and say this is bad, I wish we had these skills ourselves. Collaboration is second best. But I will feel worse, if after four years we do not know how to do what our partners know how to do. We must digest our skills".

Troubled laggards like Rover often strike alliances with surging latecomers like Honda. Having fallen behind in a key skill area (in this case that of manufacturing small cars), the laggard attempts to compensate for past failures. The latecomer uses the alliance to a close

specific skill gap, in this case, learning to build small cars for a regional market. But the laggard that forges a partnership for short term gain may find itself in a dependency spiral: as it contributes fewer and fewer distinctive skills, it must reveal more and more of its internal operations to keep the partner interested.

Hamel *et al* [24] say the point is for a company to emerge from an alliance more competitive than when it entered. There are certain conditions under which mutual gain is possible, at least for a time: when the partners' strategic goals converge, while their competitive goals diverge. That is, each partner allows for the other's continued prosperity in the shared business. Philips and Du Pont collaborate in developing and manufacturing compact discs, but neither side invades the other's market. There is a clear upstream/downstream division of effort.

The size and market power of both partners is modest compared with industry leaders. This, forces each side to accept that mutual dependence may have to continue for many years. Long-term collaboration may be so crucial to both partners that neither will risk antagonising the other by an overtly competitive bid to appropriate skills or competencies. Each partner believes it can learn from the other and, at the same time, limit it, to proprietary skills.

For collaboration to succeed, each partner must contribute something distinctive, basic research, product development skills, manufacturing capacity and access to distribution channels. The challenge is to share enough skills, to create skills, to create advantage vis-à-vis companies outside the alliance while preventing a wholesale transfer of core skills to the partner. This is a very fine line to walk. Companies must select which skills and technologies they pass on to their partners carefully. They must develop safeguards against unintended informal transfers of information. The goal is to limit the transparency of their operations.

The type of skill a company contributes is an important factor in determining how easily its partner can internalise its skill. The potential for transfer is greatest when a partner's contribution is easily transported (in engineering drawings, on computer tapes, or in the heads of a few technical experts), easily interpreted (able to be reduced to commonly

understood equations or symbols). And easily absorbed (the skill or competence is independent of any particular cultural context).

Many of the skills that migrate between companies are not covered in the formal terms of the collaboration. Top management puts together strategic alliances and sets the legal parameters for exchange, but what is actually traded, is determined by the day-to-day interactions of engineers, marketers and product developers. In other words, by who says what to whom, who gets access to what facilities and who sits on which joint committees. The most important deals ("I'll share this with you if you share that with me") may be struck four or five organisational levels below the point the deal was signed. Here lurks the greatest risk of unintended transfers of important skills.

Hamel *et al* [24] points out that limiting unintended transfers at the operating level requires careful attention to the role of gatekeepers, the people who control what information flows to a partner. A gatekeeper can be effective only if there are a limited number of gateways through which a partner can access people and facilities. Fujitsu's many partners all go through a single office, the "collaboration section", to request information and assistance from different divisions. Collegiality is a prerequisite for collaboration success, but too much collegiality should set off warning bells to senior managers. Limiting unintended transfers ultimately depends on employee loyalty and self-discipline.

Learning begins at the top. Senior management must be committed to enhancing their companies' skills, as well as to avoiding financial risk. But most learning takes place at the lower levels of an alliance.

Competitive collaboration also provides a way of getting close enough to rivals to predict how they will behave when an alliance unravels or runs its course. Knowledge acquired from a competitor-partner is only valuable after it is diffused through the organisation.

Whether a company controls 51% or 49% of a joint venture may be much less important than the rate at which each partner learns from the other. Companies that are confident of their ability to learn may even prefer some ambiguity in the alliance's legal structure. Ambiguity creates more potential to acquire skills and technologies. The challenge for Western companies is not to write tighter legal agreements, but to become better learners.

Collaboration has become the way to work in industry of late. Companies do not have enough capital to sustain all the business functions on their own and to become really profitable. Companies' get together to share skills and learn as much as they can from their partners, without having to compromise their business capabilities.

In essence, my research suggests that the cellular industry in South Africa is all about competitive collaboration. The suppliers need the service providers to add value to their handsets by providing airtime. On the other hand, the service providers need equipment in order to have airtime services. By the same token, it is imperative to have the cell phones distributed to the customer and the supplier depends on the service provider to distribute the cellular phones through their wholesalers, which are their cell shops etc.

4.2 Administrative Innovation

Venkatraman *et al* [25] says that diffusion mechanisms are viewed as institutional arrangements that serve to influence the exchange process. They include external mechanisms, such as long-term contracts, licensing agreements and partnership, as well as internal mechanisms, such as executive compensation, board composition and corporate culture.

They illustrate their point by discussing the adoption of one external-governance mechanism (joint venture) and one internal-governance mechanism (M-form, i.e. multidivisional organisation structure).

The conceptual model is rooted in the notions of "imperfect imitability" with emerging resource -based theory of the firm (Barney 1991). A comparison is made of the relative explanatory powers of the internal-influence diffusion models while also examining the adequacy of a more fully specified mixed-influence model.

The empirical analysis is based on the following: The adoption of the joint venture in one specific industry sector. Namely the information technology (I.T.) sector, with generalizability assessed through a multisector dataset; and the adoption of M-form structure by extending the work of (Mahajan *et al* 1988), through significant analytical refinements that are more powerful and that overcome certain econometric limitations.

On the basis of the differential degree of immitability, internal and external influences are conceptualised as appropriate process determinants of diffusion for the two governance mechanisms.

Venkatraman *et al* [25] say that their perspective on the diffusion of innovation is as follows. The diffusion of an innovation is defined as the process by which the innovation "is communicated through certain channels over time among the members of a social system" according to Rogers [7]. Empirical studies have been concerned with developing analytical models to predict the patterns of adoption and the speed of the diffusion. It has been found that cumulative adoption be represented by an S-curve with four important elements, namely innovation, channels of communication, time and the social system. The underlying behaviour theory is that, as more firms that have adopted the innovation come into contact with non-adopting firms, their superior performances, resulting from the earlier adoption of the particular innovation, will encourage non-adopters to adopt the innovation.

A definition of administrative innovation is "involving significant changes in the routines used by the organisation to deal with its tasks of internal arrangements and external alignments" according to Ventraman *et al* [25].

This definition captures the following elements:

- The critical notion of first-time adoption by the organisation unit;
- Changes in the routines and procedures of organisation and management, that are associated with substantial "set-up" costs and organisational disruption; and
- A broader view of administrative tasks as organisation-environment co-alignment reflecting both internal arrangements as well as external alignments.

Venkatraman *et al* [25] talk of joint venture as an administrative innovation. The point of departure in this research is the argument that the first-time adoption of joint venture by an organisation is an administrative innovation.

This is because an organisation's first adoption of a joint venture represents a fundamental shift away from the established mode of conducting an economic activity, namely hierarchy versus market. It requires substantially modified business processes or

organisational repertoires to deliver products and services in the marketplace, as well as to deal with other firms and the general environment. These may involve liaison roles, joint decision-making for allocation of resources, structuring of tasks, redistribution of authority and specification of criteria for performance assessment that span across organisation boundaries.

4.3 Technology Transfer

Bessant *et al* [26] call the process through which technology moves from outside sources to the organisation "technological transfer". An interactive examination of the process reviews some of the policy mechanisms, which enable it to proceed effectively and, in particular, looks at the role, which can be played by consultants as an integral part of policies aimed at stimulating the diffusion of industrial practice.

An emerging, interactive model, for technology transfer. What is transferred may take many forms. It could be a tangible form of a new piece of process equipment or embodied in a prototype product. It could, equally, be in the form of knowledge, codified via a patent licence or a set of design specifications. It may be transferred embodied in physical form or it may be carried over in the knowledge and experience of a particular individual recruited to a firm. Technological knowledge may be coded in explicit form or held in a tacit mode, part of the information and knowledge derived from experience in particular activities.

A second point made about technological transfer is that it is not an instantaneous event, but a time-based process involving several stages. These range from initial recognition of an opportunity or need, through search, comparison, selection, acquisition, implementation and long-term use (involving learning and development). This is a complex activity involving multiple actors and elements and various patterns of interrelationship. Each stage in the process may be influenced a different set of issues.

Transactions in the transfer of technology are not always made on a one-to-one basis, but may also be made on a many-to-one or one-to-many or many-to-many basis. In addition, they may not always proceed directly, but may operate through various forms of intermediary.

Technology is a multi-dimensional commodity and a particular package might not be available from a single supplier but from a combination of sources. Technology does not remain static over time, but is constantly being modified. Thus each transaction in technology transfer is, to some extent, unique and company-specific, i.e. involving a particular configuration of technology.

Bessant *et al* [26] add that empirical evidence on innovation adoption suggests that a much wider set of influences and motives are at work and that it is the perceived, rather than the objective, characteristics of innovations, which affect the adoption decision. Thus policy mechanisms need to be flexible enough to raise awareness and to permit potential users to explore and evaluate technologies against their own particular and subjective criteria prior to adoption.

Diffusion studies have highlighted the importance of 'opinion leaders' in industrial communities. If such leaders can be identified and technology can successfully be transferred to them, there is a greater likelihood of other firms following suit.

Where a particular pattern of innovation (technological trajectory) becomes established, it helps define the track along which organisations in a given sector will tend to move in order to remain competitive. This bandwagon effect has both positive and negative implications. In a positive sense, it has an accelerator effect on policy makers, encouraging transfer of particular technologies across the population of firms.

There is always an awareness gap amongst smaller enterprises, which do not make use of the traditional channels of communication. Policy measures thus need to include an information and diffusion component which makes extensive use of a wide range of channels. Traditional interactive models often underestimate the extent of user/producer integration in the process of innovation and re-innovation.

Bessant *et al* [26] point out that the implicit assumption often exists that the point at which adoption takes place is the end of the innovation process, yet experience suggests that simply possessing a technological resource is no guarantee of its effective use. Building technological competence requires a learning process, to absorb and optimise the

technology. The implication for policy support is that, it should cover the post-adoption period as well as promote or facilitate adoption.

There is often a strong cultural dimension embedded within a particular technology that, when such technology is transferred to a different location, implementation may fail because of an underlying cultural mismatch.

Bessant *et al* [26] say that the diversity of the consultant's role and the flexibility of modes of operation and interaction mean that there is considerable scope for consultants to act as key bridging intermediaries across a wide range of users.

Experience suggests that there are a number of ways in which consultants can improve the operation of the innovation process. Firstly, there is the direct transfer of specialised knowledge, which has already been obtained and assimilated by the consultants. Secondly there is either implicit or explicit experience sharing. Here the consultants act like bees, cross-pollinating between firms and carrying experiences and ideas from one location or context into another. The third role is that of a "marriage broker", who provides users with a single point of contact through which to access a wide range of specialist services. These might be available from the consultants in question or they might be provided by other organisations known to the consultant. In this role, the consultant acts as a channel to and selection aid for the user.

The fourth role is a diagnostic one, in which consultants' help users articulate and define their particular innovation needs. Many users or firms lack the resources or experience to understand and prioritise their problems in such a way that external resources and opportunities can be utilised effectively. Consultants can provide a valuable input to this first stage of innovation, by creating a strategic framework for change. They can also move from identifying needs in this fashion, to suggesting means whereby the problems identified can be solved.

Technology transfer is the process by which technology moves from an outside source into an organisation. It is a process that takes a lot of time and involves interactions with a lot of players with different levels of skill and technical know-how. Movement of personnel from company to company, design specifications and prototypes can achieve technology

transfer. Because of the complexity of technology transfer it is sometimes important to use consultants as a bridge. They can use their vast knowledge and experience to transfer technology and implement it in different environments, with different cultures.

5 Technologies

5.1 Introduction

In this chapter the author gives an in-depth description of technologies that are being diffused in the cellular industry. This is to illustrate the functionality and capability of the technologies. Having appreciated the functionality and capability of the technologies then it may perhaps clarify why these technologies are being assimilated and diffused at such a high rate.

Burgelman *et al* [19] say, "technology refers to the theoretical and practical knowledge, skills and artifacts that can be used to develop products and services as well as their production and delivery systems. Technology can be embodied in people, materials, cognitive and physical processes, plant, equipment and tools. Key elements of technology may be implicit, existing only in embedded form (e.g. trade secrets based on know-how). Craftsmanship and experience usually have a large tacit component, so that important parts of technology may not be expressed or codified in manuals, routines and procedures, recipes, rules of thumb, or other explicit articulations.

The criteria for success regarding technology include technical expertise (can it do the job?) as well as commercial aspects (can it do the job profitably?). Technologies are usually the outcome of development activities to put inventions and discoveries to practical use".

5.2 Cellular Telephone Technology

For the purposes of this research into cellular telephone technology, the focus will be on Ericsson and Nokia. Nokia has produced the Nokia 9110 Communicator as a new product in the communicator product segment. The communicator is a product which combines digital voice, data communications applications (e.g. fax, e-mail, SMS) and other functions (e.g. calendar, notes, contacts) into a single unit.

The Nokia 9110 Communicator provides easy and efficient communications in one product. It could be described as an efficient mobile office and some of its features include:

- Send and receive faxes;
- Send and read e-mail with your communicator;
- Send and receive messages in a user-friendly way;
- A full-featured GSM phone;
- Excellent operation times.
- Hands- free phone;
- Easy use for conference calls;
- Easy to learn to use; and
- Calendar and contacts -compatible with popular PIM applications (e.g. Microsoft Outlook 97/98).

According to Nokia [27], Nokia telephones are now moving from being simple tools for passing messages to new communicators. They are now geared to be able to phone, fax, e-mail, and save files, including spreadsheets. They have memory cards, which are thumbnail sized diskettes with a capacity of 4MB. They even give one direct access to the Internet. An application protocol is needed for the phones to function in this manner, and Nokia has developed a new protocol called, which stands for Wireless Application Protocol (WAP).

Technically speaking, mobile phones are no longer just telephones. They are now communications devices capable of running applications and communicating with other devices and applications over a wireless network.

WAP specifies two essential elements of wireless communication, namely an end-to-end application protocol and an application environment based on a browser. The application protocol is a layered communication protocol that is embedded in each WAP-enabled user agent. The network side includes a server component, implementing the other end of the protocol, which is capable of communicating with any WAP user agents.

The second supplier that will be discussed, is ***Ericsson***.

Ericsson is a world-leading supplier of equipment for the telecommunications systems and related terminals. It produces advanced systems and products for wired and mobile communications in public and private networks.

Ericsson's [28] strategy states: "Ericsson's mission is to understand our customer's opportunities and needs and to provide communications solutions better than any competitor". In doing this, Ericsson can offer its shareholders a competitive return on their investments.

Ericsson has launched a cell phone called the T28. It is the smallest dual band mobile phone for GSM 900. Based on new technology and design platforms this is the most innovative phone developed by Ericsson. The T28 has up-to-date technology including the new frequencies specified by the Radio communications Committee, e-GSM or extended GSM.

It boasts full graphic display for easy readability and features an active flip, which lets the user start and end a call. The interior of the phone contains new functions, which will simplify communications efficiently for consumers. One of the many new features is voice dialling, which lets you contact someone simply by saying their name.

The T28 is loaded with advanced software that has been developed and utilised to ensure the user interface is faster and easier to navigate. Navigation is made simple by the use of icons, intuitive help texts and shortcuts to certain functions. Among the new features are the profiles, which let one adjust the phone to different situations. For instance, one can restrict certain calls or allow certain calls to get through during a meeting, or choose different ring signals and volumes, including the vibrating alert, for different incoming calls. The phone handles 37 languages. It is based on a new 3-volt platform, which draws less current, thereby ensuring longer talk and standby times, an overall improvement in smaller phones. Talk time is estimated at up to four and half-hours and the standby time is up to 200 hrs.

T28 also has intelligent accessories. For instance, if the phone is simply placed in vehicle-hands free set. The profile feature can automatically activate " vehicle mode", turning on the display and turning up the ring signal, so that it can be heard above the noise of traffic.

Furthermore, when one puts the phone on the desktop charger, it will automatically divert incoming calls to another telephone number, e.g. one's fixed line.

Other features include:

- Phone book with over 250 names;
- Conference Calls;
- Call/hold /Call wait;
- Alternative line service;
- Automatic world clock (Nitz);
- Two games Tetris and Solitaire;
- Easy access to the 20 most recent numbers dialled, calls received and calls missed;
- Advice on charging;
- Fixed dialling numbers;
- Call barring;
- Call line identification; and
- SIM Application Toolkit.

Ericsson advertises the T28 as a dual band phone for GSM 900 and 1800 bands, with intelligent network selection between the bands making roaming much easier and more flexible. It has been designed to satisfy the needs of an increasingly sophisticated market and thus includes vibrating alert, an important feature for any upmarket phone today. It even has a voice recognition feature that can be used not only to initiate calls but also to reject incoming calls.

Globalstar uses Ericsson, Qualcomm and Telltal telephones, but for the purpose of this research the focus will remain on Ericsson.

For a long-time, the dream of mobile phone users was to have total global coverage. With the current cellular systems this is not possible, because the land-based network cannot cover all areas economically and it is virtually impossible to cover the oceans with fixed cellular networks. Satellite technology will, however, offer-near total coverage to mobile phone users on specific satellite systems, mainly Iridium and Globalstar.

For this research, the area of interest in satellite telephones is Kyocera and Motorola. These two companies have developed technology to be used on satellite infrastructure.

5.3 Kyocera and Motorola pagers:

The Kyocera and Motorola pagers deliver a worldwide messaging tool that fits in the palm of the hand. It offers a flexible, cost-effective global communications package that receives all your messages, wherever your travels take you.

Its features are:

- Battery life of 30 days (1.5v AA alkaline battery); and
- Memory of 128 KB RAM.

5.4 Kyocera Satellite-Only Telephone

This telephone is dedicated to Iridium World Satellite Services. Its features are:

- Graphic LCD display;
- Multiple language display;
- World alarm timer;
- Choice of ringer alerts;
- Voice memo recording;
- Phone book memory;
- Continuous talk time is 100 min;
- Continuos Standby time is 24 hrs;
- Data speed of 2,400bps (available 1999).

5.5 Kyocera Multi-Mode Telephone

The Kyocera multi-mode phone gives one the versatility of terrestrial wireless services and access to the global coverage of the Iridium satellite network. Within cellular coverage areas, one can use one's Kyocera Iridium telephone on the local network. Outside the coverage areas, one snaps it the Iridium satellite attachment unit and one is instantly

connected to the largest, most comprehensive satellite network in the world. The telephone's features are:

- Iridium-ready satellite;
- GSM cellular attachment;
- Phone unit;
- Continuous talk time of up to two hours / 100 minutes up to four to five and a half hours with optional battery;
- Continuous standby time of 70-160 hours up to 24 hours (48 hours with optional battery); and
- Data speed of 9600 bps to 2400 bps (available from 1999).

5.6 Satellite Telephone Technologies

There must be an infrastructure to cater for satellite telephones. The facilitators in this case are satellites that orbit above a certain distance from the earth. These satellites are different in orbit.

Forrester [29] discusses the orbital differences between geosynchronous, medium and low earth orbit satellites.

5.7 Geosynchronous Earth Orbit Satellite (GEOs):

GEO's orbit exactly 22,300 miles above the Equator, and take exactly 24 hours to complete an orbit, thereby holding themselves steady above a fixed spot.

A constellation of three GEOs could provide coverage to the entire planet, hence their popular use as lofty broadcast antennas while eminently suitable for broadcast applications, however, the 0,25 signal delay each way, plus further delay in ground-based switching, makes GEO use for mobile telecommunications awkward. In-orbit life is now tending towards 15 years and recent Proton launches give some GEOs a theoretical life approaching 25 years.

5.8 Medium Earth Orbit Satellites (MEOs):

A MEO's orbit is significantly closer to earth than that of a GEO satellite, at 1,500 to 6,500 miles. Although this proximity reduces signal delays, it also means a MEO's signal area is smaller than that of a GEO. In other words, more MEOs are needed to cover the same area as a GEO. And because the nearer to earth a satellite is, the shorter its orbital life; MEOs' life expectancies are approximately six to 12 years. Thus, a MEO-based satellite system requires more launches to maintain a system than a GEO-based one and users must redirect antennas as satellite enter and leave orbit. Since MEOs are not geostationary, they require more complex tracking and co-ordination than GEOs.

5.9 Low Earth Orbit Satellite (LEO's)

There are three generally accepted types of LEOs, namely little LEOs, big LEOs and broadband or super LEOs. They all operate some 400 to 1,600 miles above the earth. As a consequence there are negligible transmission delays between end users and satellites. The advantage of LEO technology is that its power requirements for signal transmission are relatively low, meaning that small handheld cellular type units can transmit signals to and from LEOs.

Forrester [29] says that low earth orbit satellites present valuable savings to the satellite-builder. Cell size on earth is determined by the size of the satellite antenna and the orbital height. The higher the altitude, the larger the antenna needed to achieve the same cell size. Thus a GEO would need a 17 -meter antenna, a LEO needs an antenna of only half a metre to service the same cell size.

Satellite battery-life also plays a major part in LEO, MEO and GEO mission planning. The Globalstar and Iridium LEOs, for example, orbit the earth in about 100 minutes consequently requiring 5,000 charge/discharge cycles each year for the onboard batteries. In GEO orbit the batteries could be expected to last around 15 years easily, but this figure drops markedly in low earth orbit, with life expectancies of only about eight years.

5.10 Iridium

Iridium is one of the satellite companies that South Africa uses for its satellite infrastructure.

Iridium [30] says that it has 66 satellites forming a cross-linked grid above the earth. The Iridium system is the first low earth orbiting system for wireless telephone service. Only 780 km (485 miles) high these satellites work differently from those in higher orbit (36,000 km) in two major ways. Firstly they are close enough to receive the signals of a handheld device and secondly they act like cellular towers in the sky, where wireless signals move overhead instead of through ground based cells.

Iridium [30] says that it has gateways that are located in key regions around the world. Iridium gateways interconnect the Iridium constellation with Public Switched Telephone Networks, making communications possible between Iridium phones and any other telephone in the world. Gateways are owned and operated by Iridium LCC investors.

5.10.1 Iridium Services

Iridium provides telephony and paging coverage virtually anywhere in the world. Iridium world satellite services provide a direct satellite link for both incoming and outgoing communications in remote areas, poorly covered regions and location outside terrestrial networks.

Iridium world roaming service facilitates roaming across multiple wireless protocols, allowing a subscriber to keep one telephone number and receive one telephone bill for calls made anywhere on earth.

5.10.2 Communications Frequencies

The Iridium system employs a combination of Frequency Division Multiple Access and Time Division Multiple Access (FDMA/TDMA) signals, multiplexing to make the most efficient use of a limited spectrum.

The L-band (1616-1616.5 MHz) serves as the link between the satellite and iridium subscriber equipment.

The Ka-Band (19.419.6 GHz for downlinks; 29.1-29.3 GHz for uplinks) serves as the link between the satellite and the gateways and earth terminals.

5.10.3 Iridium Offerings:

- Voicemail
- Call forwarding
- Call waiting (planned for 1999)
- Call barring
- Complete calling party pays
- Global notification services
- Emergency calling
- Enhanced call completion
- Short message system (pending)
- Conference calling (planned for 1999).

Iridium will use this technology in conjunction with MTN and Vodacom to ensure that South Africans have access to mobile telecommunications no matter where in the world they are.

MTN [31] says that the Iridium network is a wireless personal communications network designed to permit any type of telephone transmission - voice, data, fax, or paging - to reach its destination anywhere in the world.

The Iridium system is unique in that it carries a 'cross-link' feature that allows the satellites to communicate directly with one another, rather than having to reflect signals off strategically placed ground or earth stations. The Iridium 'cross link' feature reduces the number of earth satellite telephony networks. There are 12 terrestrial gateways stationed around the world and four control centres from which billing will be handled.

Another unique feature of Iridium is that it can 'talk' to any terrestrial network in the world. The user will have only one global telephone number, no matter what network system he/she is roaming on at that time. As a mobile cellular phone, it seeks out available service from existing land-based networks. In this way it operates the same as cellular systems now in existence.

5.10.4 Iridium World Satellite Mode and Inter-Satellite Links

When a cellular service is not available, the Iridium user can switch the phone to satellite operation. The network consists of 66 Iridium satellites, ensuring that there will always be one available to receive the transmission. The call is then relayed from satellite, until it reaches its destination, either through a local Iridium gateway and the public switched network or directly to a receiving Iridium phone.

5.10.5 Relaying Calls to Ground Based Networks

Iridium satellites keep track of the location of the user's telephone location anywhere on the globe. A signal bearing the telephones' unique identification number is relayed back to the user's home gateway operator. This provides the data necessary to process customer accounts as well as to interconnect with conventional phone systems.

S.A. Wireless Communications [32] reports that Iridium has been unable to obtain a licence from SATRA for the past three years, which makes it impossible for it to break into the South African satellite market. SATRA has submitted a proposed satellite service licence conditions document to the ministry of communications. SATRA stated in April 1999 that it was in the process of completing regulations for global mobile personal communication by satellite operators. A document is, reportedly, complete, but there is no confirmation of its date of publication.

Iridium believes there is a potential market in South Africa of about 100,000 subscribers, but as the company spokesman explained, "we can't undertake commercial activities here without a licence. We don't sell Iridium SIM cards in South Africa because we can't".

S.A. Wireless Communications [32] says that everything is in place for Iridium to start operating and working with MTN and Vodacom, making sure that users with dual-mode handsets roaming outside of cellular coverage can switch to satellite. This remains illegal, however, until the service is licensed.

It costs more to link up via MTN and Vodacom than to use the Iridium SIM cards. As soon as South Africans are able to take advantage of cheap satellite prices, the cost reductions will position Iridium as a competitive telecommunications service. If Iridium does not get a licence it is going to close shop in South Africa.

5.11 Globalstar

Globalstar is Iridium's competition as far as satellite services are concerned. Globalstar [33] says that while targeting the "international business person" with its big LEO designed for cellular/satellite telephony services, it is of the opinion that this market is smaller than is suggested by Iridium. Consequently, Globalstar also has a strategy for aggressively pursuing users who have no telephone service at all.

Globalstar is a satellite based, wireless telecommunications system designed to provide voice, data, fax, and messaging and other telecommunications services to users worldwide. Users of Globalstar will make or receive calls using hand-held or vehicle mounted terminals similar to today's cellular phones. Calls will be relayed through Globalstar's 48-satellite constellation, in a 1,414 kilometre (approximately 900 mile) orbit above the earth, to a ground station, and then through local terrestrial wireline and wireless systems to their end destinations.

5.11.1 Satellite Description

Globalstar [33] says that it uses simple low-cost satellites designed to minimise both construction and launch costs. Globalstar's satellites do not connect one Globalstar user directly to another. Rather, they relay communications between the user and a gateway. The party being called is connected with the gateway through the Public Switch Telephone Network (thus maximising the use of existing, low-cost communications services) or back through a satellite if the party is another Globalstar user.

Communications:

The heart of a Globalstar satellite is its communication system, which is mounted on the earth deck. The earth deck is the larger of the two rectangular faces on the satellite's body. There are C-band antennas for communications with gateways and L- and S-band antennas for communications with user terminals. These antennas are of a phased array design that projects a pattern of 16 spot beams onto earth's surface, covering a service area, or "footprint", of several thousand kilometres in diameter.

L-and S-band user links: 1610-1626.5 MHz (user to satellite)

2483.5-2500 MHz (satellite to user)

C-band feeder links: 5091-5250 MHz (gateway to satellite)

6875-7055 MHz (satellite to gateway)

Globalstar [33] says that the gateway is an integral part of the ground segment, which includes the gateways, Ground Operations Control Centres (GOCCs), Satellite Operations Control Centres (SOCCs) and the Globalstar Data Network.

The gateway interconnects the Globalstar satellite based wireless network and the Public Land Mobile Network (PLMN), such as global system for mobile communications (GSM), or directly with the local telephone office's -Public Switched Telephone Network (PSTN).

The gateway can be connected to the existing PSTN using standard E1/T1 trunk supporting a variety of signalling protocols. To GSM networks, the gateway appears as a GSM-based station subsystem. To those mobile switches in the EIA/TIA environment, it appears as another mobile switch supporting the IS-41 Intersystem Operation Standard. In all cases, inter-operability between Globalstar and telephone/cellular companies is assured, and the subscribers maintain a single convenient point for billing.

Globalstar [33] reports that it has designed its fixed station products to allow local content and subscriber flexibility. A Globalstar antenna radio unit and optional digital telephone is provided by Globalstar. This digital phone includes a display for call progress indicators and icons for voice mail memory of frequently called numbers. The in-country service provider can provide the subscriber equipment locally.

The Globalstar single fixed line pay phone unit connects a single pay phone into the Public Telephone Switching Networks (PSTN) and standard pay telephone service. Access to the Globalstar constellation is given by an antenna mounted outside the booth with a clear view of the sky. This antenna will be cabled into the booth and connected into the Code Division Multiple Access (CDMA) radio unit.

Globalstar [33] reports that for mobile subscribers a vehicle mounted car kit is available. The Globalstar handheld unit can be mounted in a cradle that provides power to extend battery life and a hands-free operation for convenience and driving safety.

Personal:

The Globalstar/GSM Dual-Mode User terminal offers a global roaming solution for GSM cellular phone users. Globalstar enhances wireless service options by providing worldwide GSM cellular-like services in areas outside traditional cellular coverage, inside the GSM cellular networks or by switching to the Globalstar network.

Globalstar [33] says its system is designed to complement and extend, not to replace, existing Public Switched Telephone Network (PSTN) and Public Land Mobile Network (PLMN) infrastructures.

A call made via a Globalstar User Terminal will first attempt to make a connection through existing local cellular infrastructure and failing that, via the Globalstar satellite system. The call is then relayed via satellite down to a gateway, which then routes it through the existing national PSTN/PLMN system to its destination.

Globalstar takes advantage of the worldwide expansion of fibre optics networks, which has allowed for significant advancements in call quality, capacity and efficiency. As a result it is expected that Globalstar's worldwide network of gateways and service providers, will be positioned to leverage off these improvements in the world's wireline/fibre optic networks. And at the same time, take advantage of the competitive pricing of the international tariffs as provided by exchange carriers to reduce costs for Globalstar users and service providers.

Globalstar and Vodacom have formed a partnership, which will enable Vodacom's subscribers to have access to telecommunications anywhere in the world.

Globalstar [34] says that Vodacom subscribers will enjoy blanket mobile telephone coverage by September 1999 through Vodacom&rsquo's service provider agreement with Globalstar Southern Africa (Pty.) Ltd. This is a result of the successful launch of a Globalstar satellite. It will now be easy for subscribers to use dual-mode phones capable of switching from conventional cellular telephony to satellite telephony automatically or by choice. Globalstar expects its satellite tariffs to be significantly cheaper than current available tariffs.

Mr Higson, Head of the Globalstar project office in South Africa said, "The phones will communicate through a Globalstar satellite to a ground station currently being constructed in Delareyville, Northwest Province. The ground station will connect calls to the existing terrestrial telecommunications network and should be completed before March 1999". Thirty-two satellites will be launched by Globalstar to enable commercial service by September 1999. By December 1999, a total of 52 satellites will be in orbit.

Vodacom and Globalstar go into business together with the stumbling block of South Africa's not having GMPSC licenses ready.

5.12 Trends of technologies and forecasts

5.12.1 Data Communications

Fitzgerald [35] says that data communications is the movement of encoded information from one point to another by means of electrical or optical transmission systems. Such systems are often called data communications networks. In general, these networks are established to collect data from remote points (usually terminals or microcomputers) and transmit data to a central point equipped with a computer or another terminal, or to perform the reverse process or some combination of the two. Data communication networks facilitate more efficient use of central computers and improve the day-to-day control of a business by providing faster information flow. They provide message-switching services to allow terminals to talk to one another. In general, they offer a better and more timely interchange of data among their users and bring the power of computers closer to more users. The objective of most data communication networks is to reduce the time and effort required performing various business tasks.

Their main functions are to:

- Capture business data at its source;
- Centralise control over business data;
- Effect rapid dissemination of information;
- Reduce current and future costs of doing business;
- Support business expansion at reasonable incremental cost as the organisation grows;

- Support organisation objectives in centralising or decentralising computer systems; and
- Support improved management control of the organisation.

Data communications can be used to tackle the following items in business settings:

- Widespread use of microcomputers;
- Decentralised operations;
- A high volume of mail;
- Messenger service usage;
- Numerous telephone calls between various sites (voice communications corridors, that is, telephone calls, may be replaced by data transfer corridors);
- Repetitive paperwork operations, such as re-creating or copying information;
- Inefficient and time-consuming retrieval of current business information;
- Slow and untimely handling of the organisation's business functions;
- Inadequate control of the organisation 's assets; and
- Inadequate planning and forecasting

The general public is increasingly using the Internet for data services and browsing. Corporate users are installing their own Intranets for information and staff is accessing all sorts of information. A lot of functionality is being developed for the public using data services. This will definitely spill over to mobile networks. It is evident that the Internet will be an important platform for delivering mobile data services.

Silver [36] says that data communications is a major domain of telecommunications. Data communications is the timely movement of alphabetic or numeric data in a system. That uses two discrete signal states, to transmit characters. This domain transmits words, phrases, textual matter or digital information between two or more points.

Silver [36] says that distinctions are not clear-cut and domains often overlap. Digital data (letters and numbers) can be transmitted over television and displayed on a screen. It can also be sent over voice-grade telephone lines. Today there are still businesses that specialises in selected areas of communications, such as the transmission of voice (telephone), pictures (television) and numbers and characters (computer terminals). It is

still useful, however, to conceptualise information transferred into this area, because major facets of industry are built around it. Included in this industry is voice communication, which is telephone or radio. There is also video information. Pictures, images and diagrams sent over television or cable-access television system involves video transmission.

Rysavy [37] says that increasingly available and affordable wireless technologies like, cellular digital packet data (CDPD) and data-over personal communications services (PCS) do a fine job scuttling Internet Protocol (IP) packets, but real-world applications are more than the sum of their packets. Corporate networkers who want to put wireless Internet Protocol to work, need to clear certain hurdles, starting with limited coverage, low throughput and high latency.

Whether or not IP is worth it depends. The untethered technology can make a lot of sense in many business situations. Giving mobile workers access to corporate information and the Internet from anywhere can make them far more productive, but wireless Internet Protocol is not just another type of WAN connection. It has its own unique characteristics, ones that were not necessarily considered by developers of communications applications and networking protocols.

CCPD is the next option a digital packet overlay to the analogue cellular system that transmits Internet Protocol at an effective throughput of about 10kbit/s. Each mobile end-station has a fixed Internet Protocol address and is a true Internet host.

Rysavy [37] says one must consider the personal touch when discussing data. The technology that could tap wireless IP's true potential is data-over-digital personal communications services. Today's offerings are quite limited, restricted to circuit-switched connections to global system for mobile communications networks.

Personal communications services should increase in popularity as new services are rolled out. This year should see 14.4KBit/s Internet access for both global system for mobile communications and code division multiple access nets. Though still circuit switched these offerings will feel like packet thanks to the faster connections enabled by completely eliminating analogue modems. Beginning late 1999 CDMA, GSM and Interim Standard

136 (IS - 136) networks will all start offering high-speed packet data ranging from 64 to 384Kbit/s.

Rasavy [37] says faster wireless IP offerings are on the way. So-called 3G (third-generation) cellular systems will deliver throughput as high as 2Mbit/s in the local area and 144 kbit/s for mobile, but the earliest these systems will arrive in is 1999 and that's on a very limited basis. Most corporate networkers who want wireless Internet Protocol now are going to have to learn to live with 9.6 to 14.4 Kbit/s - a big consideration given that even 56-Kbit/s transfers can seem agonisingly slow on today's Internet.

They also have to deal with latency and its potentially crippling effect on client-server applications. With latencies (and round-trip times) ranging from half a second to more that five seconds, a new screen of information that takes a few seconds to update over a LAN could take half a minute or more over a wireless IP link.
Rasavy [37] says that wireless networks are linked to the rest of the world in three basic ways namely over private connections, over the Internet and over the public switched telephone network (PSTN). The third avenue of access, the switched public network is the least problematic for companies, since they already have dial-up systems in place for the remote users. If calls come in over a circuit, switched data service on a cellular network (via either an analogue or digital link) will be switched into the public switched telephone network and appear identical to other modem connections.

Many of today's cellular data services are, in fact, circuit switched. This will continue to be the case for the next few years, until wireless packet switched services start rolling out in Ernest. Network architects, who start getting ready now, are going to be in the right place to exploit new services and technologies.

Lippis [38] comments on moving mobile
Mobile Internet Protocol carriers on the wide area network (WAN) are already readying services, with good reason. The technology promises to deliver a lower cost of ownership and better quality than cellular. The interface is not whether the enterprise will be a standard leased line, with the carriers providing the infrastructure to support mobile users with IP routing.

The same goes for mobile Internet Protocol equipment. Vendors are rushing to implement the technology on all sorts of handheld, notably pagers, cell phones and palmtops.

Lippis [38] says that considering that plenty of net managers are going to build their own wireless infrastructure to support mobile IP on the campus or across the enterprise, it is an effective way to keep e-mail and data from competing with the general wireless population for limited bandwidth.

5.12.2 Asynchronous Transfer Mode

Dillion [39] says that Asynchronous Transfer Mode (ATM) is supposed to be all about scalability, i.e. from the departmental LAN (Local Area Network) to the global backbone. It is simply a matter of adding switches, but network architects run into many problems when they try to scale Asynchronous Transfer Mode to enterprise, because static routing, or setting up circuits by adding entries manually to the routing table of each Asynchronous Transfer Mode switch on the net.

The ATM Forum has a simple solution private network-to-network interface (PNNI), which dynamically updates switches on moves, additions and changes. Besides putting an end to repetitive-stress syndrome, the spec also enhances Asynchronous Transfer Mode's vaunted ability to deliver quality of service (QOS). Private network-to-network interface (PNNI) lets switches consider the bandwidth and delay of alternative paths, when deciding how best to meet the needs of any application. It also makes these judgements almost instantly, establishing the potential path or re-routing around problems far faster than frame-based protocols.

Dillion [39] says that peer group dynamics gives an explanation for networks. Private network-to-network interface (PNNI) simplifies the configuration of large networks, because it allows ATM switches to learn about their neighbour automatically and to distribute call routing information dynamically. Since asynchronous transfer mode is a connection-oriented service, there's a call set-up phase before data transfer begins.

Golick [40] says that the mention of multimedia to digital-age visionaries causes them to sing of data, graphics, audio and video coming together in a virtual reality whirligig of sight and sound.

Finding the storage capacity and bandwidth for a user' s transmitting a couple dozen 90-Mbyte video messages a week is however, a problem, and it will become worse with widening access to full duplex videoconferencing. Add to that intolerance to delay and jitters and multimedia looms not as the next big thing but as the next great challenge.

Gollick [40] says that, "data in various forms such as text, sound, still images, motion pictures and animation" is the innocuous-sounding definition of multimedia. Laid out in the Academic Press Dictionary of Science Technology, but that it means a lot more to net managers, who are forced to define it in terms of network traffic and new standards to support.

Golick [40] says that multimedia refers to data assembled prior to transmission, such as a pre-recorded speech. It is normally downloaded to the user's desktop before use, which makes it relatively insensitive to network delays. Raw throughput is the primary performance metric since the user cannot access the information until the entire file is received. The majority of multimedia traffic today, including strategic images, complex documents and recorded video, is pre-generated.

Real-time streaming, in contrast, refers to information created during transmission on the spot, such as a telephone call or live video feed. It is processed as a constant "stream" of incoming information and is highly sensitive to network latency. If the stream is delayed or interrupted, the end-user perceives a loss of quality or content.

E-mail storage requirements can be expected to increase by at least one order of magnitude in the near future and with more complex document types waiting to be created, storage requirements will grow at an exponential rate.

Gollick [40] says that asynchronous transmission mode allows two end-points to negotiate session parameters and specify such metrics as acceptable cell-loss rate, minimum throughput and maximum jitters and latency. The network, within the constraints of overall capacity, can adapt to the precise needs of different traffic types, but applications that take advantage of the services offered by asynchronous transmission mode are exceedingly rare. Although IBM and Microsoft are committed to building asynchronous transmission mode support into their operating systems, developments have been slow in

coming (although asynchronous transmission mode interfaces are now available in Windows NT). For this reason it is difficult to consider asynchronous transmission mode a viable near-future solution for multimedia support.

GSMDATA [41] says there are barriers to growth in the mobile data industry. Mobile data has been slow to take off because of the limitations of available communications technologies. Many existing mobile standards are not designed with mobile data as a primary focus. Data functionality has been added belatedly to analogue cellular and private and public access mobile radio (PMR/PAMR). In some cases, core aspects of the technologies themselves - such as analogue transmission and cell-hand over in early cellular networks - have made them less than ideal medium for data transmission.

Even where technologies have been improved or specifically designed for data, some operators made the initial mistake of believing that the battle would easily be won. Early on in the field of dedicated mobile data, operators seemed to think that users would flock to new services. They did not. The lesson is that most users require applications, and not just at the platform. Only a very limited number of applications, generally with identifiable niches, have specific requirements which justify the time and cost of the development of the application-specific packages.

GSMDATA [41] says that the last factor is simply timing. When dedicated mobile operators launched their technology platforms, they were handicapped by the fact that appropriate software had not been developed. When manufacturers looked to communications to provide the "killer applications" for products in the early 1990s, they found that cellular manufacturers were simply not ready to support the push of mobile data. Mobile data applications will thus develop at the pace of the slow elements that comprise complete solutions.

One of the driving factors for mobiles is the short messaging service (SMS), which is increasingly being used for advanced features such as Internet-driven e-mail delivery. While wider support for mobile - originated SMS is bound to attract many users. GSMDATA [41] also points out that user trends and usage models will comprise of a new generation of mobile phones with data functionality built in, is currently being released, and positioned as direct terminals in their own right, but complementary to mobile PCs.

They are attracting enormous interest, with demand exceeding supply in the early weeks of sale.

GSMDATA [41] says that future developments include the positive acceptance of the concept by business, the explosion of e-mail and Internet services, the low penetration of mobile data into the fast-growing installation of portable computing devices. And the enormous importance of data in fixed business communications and a genuine need for such services.

GSMDATA [41] says that if we look around at the penetration of digital cellular technologies that are capable of supporting support services. It is clear that the conditions for the mobile data revolution to finally take hold exist in Europe, they will develop elsewhere as the GSM community grows across the globe.

According to GSMDATA [41], there are factors, which could limit growth. Mobile data communications must be perceived to be reasonably priced. It is tempting for operators to position data as a premium service by setting tariffs too high, which may delay take-up in the short term, while increased competition leaves those who adopt this policy with fewer customers. One difficulty which operators have to overcome is the fact that while subsidies have made street prices for handsets very low, there is little scope for subsidising data-cards, often making them appear more expensive than the phones themselves. GSMDATA [41] believes that promoting faster uptake through lower tariffs will help to bring down the price of data cards naturally.

Infrastructure vendors like Ericsson, Nokia and Motorola, are keen to sell packet data upgrades, but also to ensure that there will be end-to-end connectivity to the Internet. They are doing their utmost in putting together standard forums, which will help the movement towards packet data packages as wireless access protocol (WAP). Bluetooth technology is another example of vendor-driven technology. Again, it has been driven by the likes of Ericsson and Nokia, to simplify the whole process of users and operators.

In terms of operators, a lot of cultural elements will have to be looked at. Mobile operators are not familiar with IP and the Internet. With mobile data, the network will host a pipeline to move the actual data. It will be advantageous for operators, and mobile

operators to embrace full partnership in order to do justice to this service, using simple bundled packages, with all software integrated onto, the terminal with the PC card integrated into the terminal.

5.13 Future Developments in the Mobile Industry

Observing the trends and future developments in the mobile industry, experts have something to say about what will happen in the future. Corpteros [42] says that the mutation of IT and telecommunications infrastructure into one intertwined data transfer methodology, is embodied in a new buzzword, "convergence". At the heart of convergence lies multi-functionality and the ability to sustain various protocols, including voice, Internet traffic, digital file transfer, fax and video-conferencing, on the same communications signal.

This necessitates high data-rate communication services, support for packet and circuit switched services, large volume capacity and sustenance of numerous simultaneous connections.

Multi-functionality allows users to browse the Internet, make a phone call and receive a fax at the same time. Without the required bandwidth this would all be impossible. Bandwidth, very simply, is the volume and speed capacity of the telecommunications connection. The optimal use of available bandwidth appeared in the way computers transfer data between each other: what it means, is that one is always online with the host application, without occupying a dedicated channel. Bursts of information are thus transferred when the required capacity is available. If we view voice as just another form of digital data, then packet switching in a converged environment becomes a reality.

Land-based telecommunications technology, such as integrated services digital network (ISDN), is tackling the issue of convergence and the required bandwidth with great energy, but it is the need for absolute mobility that it drives the development of wireless multimedia capabilities, which are currently being pioneered by Ericsson.

Market research has shown an indispensable parallel growth between the use of the Internet and mobile phones. Remote access now begins to mean exactly that, regardless of the availability of physical telephone lines.

Ericsson's ability to meet the demand of wireless multimedia services was demonstrated with by the development of High Speed Circuit Switched Data (HSCSD) and General Packet Radio Service (GPRS) capabilities. GPRS is packet switched mobile data service that has been widely accepted as the next step in the development of GSM technology. By the year 2000, GSM will have evolved with GPRS multi-slot capability and 14.4Kbps per timeslot, facilitating effective data rates of up to 115Kpbs.

The secret behind general packet radio service (GPRS) is that it optimises use of the available bandwidth, especially for intermittent bursts of Internet and Intranet traffic, by using radio resources only when actually receiving or transmitting data, thus allowing for many users to share the same channel. Efficient and effective use of various end-user applications, such as e-mail and Internet browsing is ensured.

The Wireless Application Protocol has become the world standard to which wireless information and telephony services on digital mobile phones must subscribe. Handset manufacturers, representing over 75% of the market across all technologies, have a user group to develop agreed protocols for uniform interfaces.

All WAP applications will function across a variety of networks. They will include various services and be compatible with a host of devices, from mobile phones and palmtops, to laptops and Personal Digital Assistants (PDA). Current practices dictate that if mobile phone users want access to online services, they have to connect their computers to the mobile phones. With WAP-enabled terminals, the terminal itself has a built-in browser. Internet access from small screen mobile phones will finally put the world in your pocket.

Corpteros [42] says Ericsson WAP Gateway is a network node providing a direct connection between the communication network and the Internet application servers. It acts as a client of these servers, accessing them via circuit or packet-switched systems and should be available from mid-1999.

Corpteros [42] says that by 2002, the third generation will be upon us. Currently under development, this system will be compatible with second generation systems, such as GSM, and will offer new breakthrough user benefits such as advanced Multimedia service,

and next generation mobile Internet. Today there is worldwide support to base the third-generation system on a technology that Ericsson has called as Wideband Code Division Multiple Access (WCDMA). It offers a full suite of multimedia applications at minimal cost. Apart from the enhanced ability of current multimedia applications, such as video conferencing, WCDMA opens the door to specialised mobile multimedia, including remote security monitoring, vehicle navigation systems and interactive health applications.

Quinley [43] says that for network operators in developing regions, buying into GSM could prove to be a smart investment decision, given recent developments in the technology's upgrade path. Several major enhancements that could effectively future proof services for customers are starting to receive much attention, most notably General Packet Radio Services and Enhanced Data Rate for GSM Evolution (EDGE). The International Telecommunications Union knows the ultimate leap to wideband wireless in the form of Universal Mobile Telecommunications System (UMTS) or IMT-2000 as it is.

Access to telecommunications has been and will remain at the core of economic development in the emerging markets. In order to reach out into the future and expand upon the significant progress that has been made over a short timeframe, third generation wireless access in these economies is especially vital.

Quinley [43] says that rolling out third generation wireless networks and services is a tradition, which is equally salient for swift introduction into the developing economy. It can facilitate not only economic growth, but also valuable societal integration. New regions, of the developing world as diverse as sub-Sahara Africa, Latin America and the Middle East are all set to become net beneficiaries of the late second-generation wireless. Furthermore, a major incentive for developing regions and remote locations is the role of the global satellite mobile networks now in the throes of commercial launch.

Third generation wireless will be able to harness the power of new access technologies and bearers, such as the Internet, for education and information purposes in the schools, and access centres in more remote areas, such as Australia's outback, the Himalayas, or half-way up the Amazon river.

According to Quinley [43], commercially, implementing third generation wireless in developing regions makes good business sense too. Opening up a retail market for e-commerce to remote regions can augment over-populated and fiercely contested mature markets. In marketing there will always be tiers of demand for low cost stretching across to high-spec goods and services.

One of the things that this industry has been striving for has been universality of the wireless family of technologies. It is time to grasp the opportunity of plummeting producer-prices and branch out into the whole world. Convergence of not only fixed and mobile telecommunications, telecommunications and information, but also economies and mindset, makes for systems that need to be transparent and open to equal access in time honoured tradition. No information 'haves' and 'have-nots' should not be allowed to develop in this new age of wireless access, irrespective of location, politics, or social status. On the road to integration there are countries in different states of deregulated telecom markets, which, to a greater or lesser extent, can be facilitate the opening up of domestic markets. By promoting competition and allowing access to third generation wireless operators, may enter some markets for the first time.

Quinley [43] says that regional economies around the world are ever more inextricably linked. Financially, commodity and retail markets prosper through cohesive and pragmatic approaches to system networking - of all kinds. It is generally recognised that telecommunications of all forms, is the nervous system of economic activity the world over. Leaving out any one part surely defeats the object and threatens to undermine the rest of the hard work. Far be it for the wireless industry to be the conscience of a new world order, but if the remit of the industry then it has to be this, get the world rewired wirelessly.

One key goal for third generation mobile services is the establishment of global roaming capabilities. This will bring significant societal benefits to increasingly mobile and itinerant people in the next century. For government institutions in emerging markets, the radio spectrum available for global societal growth and integration, will be a key issue over the coming years. A family of systems for the third - generation wireless called IMT-2000 will require access to appropriate and adequate radio spectrum to meet expected demand.

Haller [44] says that technology now moves at space-shuttle speed. The cellular industry is one of the most exciting industries today, but at the same time one of the most daunting. We got used to holding cell phones to our ears to communicate, but now we are being told to hold our cell phones in our hand in order to communicate visually. Nokia says that we are moving from a hear phone to a view phone and the last time something similar occurred, was during the move from radio to television.

Communications today is looks at building blocks being developed on which the future of cellular communications will rest. From WEB to wireless application protocol - the platform for a new generation of cellular phones. Phones are becoming personal multimedia tools.

According to Haller [44], WAP will bring the Internet to the palm of your hand and Nokia has captured the initial market with the development of the world's first WAP phone, the 7110. WAP is a universal open standard for bringing Internet content and advanced Value Added Services to cell phones and other wireless devices. New media telephones will make this promise a reality with expertly developed user interfaces, larger screens, more memory and easier input allowing better connectivity.

The main reasons why this technology will succeed is the popularity of the Internet and the fact that Internet companies are just as eager to get into the cell phone market. This is essential, because Web pages have to be modified before wireless customers can download them onto their much smaller phone screens.

Services, which are most obviously WAP-compatible, are banking, weather reports, flight information, ticket sales, traffic reports and CNN headlines. Their problem is that media phones cannot support full-colour visuals and large graphics yet.

"Seamless Connectivity Bluetooth" is a short-range radio based technology developed by the Bluetooth Special Interest Group (SIG) consisting of Ericsson, IBM, Nokia, and Toshiba. It is designed to link portable devices such as cell phones, portable PCs, personal digital assistants (PDA's), printers and digital cameras so that they can exchange data without the use of cable, which hampers ease-of use.

Bluetooth is a technology-enabling advanced interconnectivity between different electronic devices through a short-range radio link (Low Power Radio Frequency or LPRF). Imagine taking a business trip and instead of carrying along a laptop, taking a Bluetooth-enabled portable hard drive. Haller [44] says that this device is small enough to fit into one's pocket and whenever one is in the range of a computer with Bluetooth capability, one can access all one's files and save new files onto one's drive, from that computer.

Other Bluetooth developments include "Bluetooth Info-Wear", which is a personal digital assistant (PDA) in the form of a wristwatch! This device can access information contained within the user's Bluetooth enabled computer, such as the address-book, calendar, tasks and e-mail. The watch has four operations, which enable the functions to read e-mails, accept reject meetings, mark tasks completed and pre-set automatic replies to e-mails. The info-wear watch automatically synchronises and updates the PC as soon as it comes into range.

Another accessory is the "wireless wallet", which provides an easy and efficient way to access any Smartcard-based services. Only 17mm thick when closed, it is an ordinary looking leather wallet, yet it contains the magic of Bluetooth connectivity.

Haller [44] says furthermore, that some cell phone developers are looking at the option to integrating a large proportion of the Bluetooth silicon chip into the existing chipset, which is the technical heart of the cell phone.

Third Generation (3G) mobile devices and services will transform wireless communications into, real-time on-line connectivity, regardless of time and place. We can constantly be linked to several location-based services that offer us the particular kinds of information that we need. Third Generation (3G) systems is the umbrella term given to the new range of infrastructure and handsets being developed to provide much enhanced data communication services within cellular networks.

Haller [44] says that these services, which will provide data rates from 384 KBps up to 2 MBps, are scheduled to begin in the year 2000, with the high-speed Universal Mobile Telecommunications System (UMTS), becoming available during 2002. Human needs evolve and the need for instant information at any time and any place is becoming stronger. There are a few concepts, which are steering future communications technology. There is

the convergence of Internet and cellular, followed by the development of technologies to support it. The result will be a plethora of new concepts.

In conclusion, this chapter gives us a feel of the present technologies and new technologies to come into play in the cellular industry. It even gives us an insight into which direction the cellular industry will be taken in the future, e.g. moving us away from the hear phone to the view phone and also moving us away from cable connectivity to Bluetooth technology.

6 Competing Technologies.

6.1 Competition between technologies

In this chapter the author talks of competing technologies. These competing technologies are a result of markets that have not being tapped. For example the rural areas in South Africa are under-serviced where telecommunications is concerned. Because the rural areas are sparsely populated and in most cases very far from metropolitan areas, it has been very expensive to layout the infrastructure needed for telecommunications. The introduction of the cellular technologies may be one of the solutions to putting up telecommunications infrastructure in the rural areas.

Burgelman *et al* [19] says, that technologies can compete passively and unconsciously. When this happens, one technology may displace adoption of its rivals. Competition can be strategic, such as when products are priced and manipulated. They further point out that, as a result of technology competition, technologies become attractive and customers adopt them readily. This is caused by the following:

- Learning by using;
- Network externalities;
- Scale of economies in production;
- Informational increasing returns; and
- Technological inter-relatedness.

The above mentioned factors determine the character of the competition.

Fry [45] says that the changes in driving forces in the wireless infrastructure are numerous. Any one of these forces is sufficient to cause wireless equipment vendors to adapt their product offerings. In combination, they have a multiple effect resulting in an imperative for new developments in the field. The following section explores the various forces driving the development of the next generation of wireless infrastructure products.

6.1.1 Deregulation and the competitive climate

The emergence of standards and persistent market growth will continue to diminish the barriers to entry into the market and to raise the level of competition among equipment providers. We have already witnessed the emergence of new entrants who have made great progress in establishing themselves in the market. Some have done so by providing solutions consistent with emerging standards, (e.g. stand-alone home location register databases, authentication centres, intelligent antennas and cellular digital packet data [CDPD] systems).

Successive generations of products and the competition facilitated by open systems, which are defined by the American National Standards Institute (ANSI) and the European Telecommunications Standards Institute (ETSI), have resulted in the introduction of wireless solutions at extremely competitive price points.

The result is that today's advanced base stations and switching equipment (hardware) will become tomorrow's commodity products and manufacturers must therefore innovate new products to maintain or enhance their market positions. Success in the marketplace depends on the delivery of complete solutions, especially software that enhances carriers. On international level governments are quickening the pace of deregulation as they recognise the obvious benefits of competitive forces driving service costs down and enhancing local telecommunications infrastructures. Increased competition leads carriers to seek new ways to differentiate or focus their service offerings and to reduce costs.

Fry [45] says that with competition increasing for basic voice services and minute-of-use prices falling, carriers are seeking to differentiate themselves in two notable ways. First, they are attempting to develop branded identities through the use of logos and signature sounds/tones (e.g. pre-call announcements and voice mail notification tones) and focused marketing campaigns. These attempts aim to develop markets. In this situation, interoperability and feature transparency are crucial to a campaign's success. Network-based features and services must be flexible in the ways in which they are administered and presented to an end customer.

Secondly, carriers are trying to segment their subscriber base and offer more targeted features and services. Initially these features and services took the form of simple multi-

rate and use-sensitive billing plans. More recent approaches are more complex, bundling wireless and wireline services, adding geographic or time-of-day/day-of-week restrictions and supporting custom-calling plans or private networks. The trend is toward more sophisticated horizontal (messaging, paging and data) and vertical (cellular dispatch, power company meter reading) applications. Ideally carriers would like to see a continuous stream of new applications and features becoming available to their subscribers. Such a strategy is the key to their differentiated and share growth in the marketplace.

According to Fry [45] in order to increase competition among equipment vendors, carriers demand solutions that are based on industry standards, with the ultimate goal of achieving interoperability among network nodes. Not only will standards allow carriers to secure solutions to lower price points; standard-based solutions will also enable carriers to obtain a complete solution by purchasing partial solutions from a multitude of equipment providers. Such an environment will put equipment vendors under pressure to become competitive in areas that have been bundled with the total network offering.

Ochtel [46] endorses this by saying that "The World Trade Organisation's new agreement on basic telecommunications, endorsed by 69 countries, has opened new markets and increased competition as we move to the 21st century. Service providers need to shift their rural telephony strategies to take advantage of newly opened markets".

6.1.2 The Rural Phone Market

Geographically dispersed and sparsely populated areas pose a significant challenge. It is often unfeasible to fulfil the service required using traditional terrestrial technologies such as wireline, cellular or wireless local loop, because of high installation costs. As a result many service providers look to very small aperture terminal (VSAT) satellite technology to provide telephony to the rural market. Most providers understand the advantages of VSAT's, including distance independence, quick installation and greater reliability than the local terrestrial systems.

These remote VSAT sites, or "village phones", include stand alone, privately owned phones, public pay phones and public calling centres. The breadth of services required for remote villages is also quite limited. Typically only voice service is required, though some sites may need limited fax and data services.

As Ochtel [46] points out, since rural areas generally have a smaller economic base than urban areas and the geographic dispersion of lines makes maintenance, marketing and revenue collection expensive, telecom operators have until recently not been viewing rural service as a profitable business. Rural service is generally seen as an obligation, which is met by the development of the absolute minimum quality and quantity of service necessary to satisfy that obligation. For this "village phone" market, typical VSAT remote terminals focus on low cost and offer limited non-toll quality services.

Ochtel [46] also states that as communication services spread so does economic development and prosperity. The sizeable rural business market in developing nations is of utmost macroeconomic importance, even when it is not immediately self-sustaining.

A single customer may require from one to several hundred remote lines at farms, mining camps, petroleum exploration and other remote business entities. The demand for remote business calling is anticipated to be greater than for village phones and higher value services are also expected to be in demand. Toll-quality voice, fax and data services are also required for remote businesses. There are also opportunities for value-added services such as voice mail or call forwarding. In addition, Internet Protocol data services (for Internet access or corporate file transfers) may be required on the same platform.

The typical rural business user requires a single platform that supports advanced features to meet business needs. To match the toll-quality services offered in urban areas, VSAT products for rural business need to focus on quality and breadth of services and on satellite bandwidth efficiency.

For heavy rural mining camps, that sort of efficiency in satellite bandwidth will significantly reduce the service provider's total cost of ownership.

Deregulation in the worldwide telecommunications market provides incredible opportunities and new dimensions in rural telephony. The emerging rural business market promises to be a fast growing new addition to satellite services. "Village Phone" solutions are not appropriate for the business market, where much higher levels of daily communication are the norm and quality voice and fax services are required as well as advanced data services.

This wider range of services influences systems economics. A VSAT solution that minimises satellite bandwidth usage will offer rural business service providers a long-term solution. Ochtel [46] says that the ideal approach is to provide a single platform that can support the wide range of voice and data services required by the business market while minimising the total cost of ownership.

6.1.3 Rural Business Phone Market Characteristics:

- Remote businesses: Single business entity (farms, mines, other)
- Terminal sites: Single platform for private applications
- Low call activity: One to multiple hours per day per telephony line.
- Broad services: Toll-quality voice, fax, data, Internet access and video conferencing

Talmor [47] says VSAT allows for reliable data, voice and video communication using small satellite antennas. As a result of the search for new markets, VSAT vendors have succeeded in steadily lowering the price of the terminals while increasing their features and functionality.

When VSAT technology was first introduced into rural areas as a means of providing "last mile" telephony services, most takers were large corporations or international organisations that needed to ensure reliable telecommunications at any price. Tenders for government-initiated rural telephony projects usually specified microwave radio, since that was the familiar technology. Copper wire was not even considered since the cost would have been much too high. But microwave radio also had its limits. It does not adapt easily to mountainous terrain or terrain that requires widespread coverage, for example islands. Microwave towers transmit signals from control centres using a line of sight from one centre to the next. If a mountain is in the way the signal disappears.

Talmor [47] furthermore says that satellite solutions have a distinct advantage. The idea is to give rural subscribers what they need and to avoid making them pay for what they don't need. Smaller rural populations may be happy to have one or two telephone lines in their village. People use the telephone more as they become accustomed to it and increased use means increased value for the service provider. In some rural areas users are requesting not only private telephone lines, but also Internet access.

Talmor [47] adds that a new network in these locations can improve communications not only in terms of the number of lines, but also in terms of their quality and in the overall reliability of the network. Private users, government offices, military outposts, post offices and hospitals want to be able to connect within minutes and they want to be sure that they will be able to hear the person on the other end of the line.

The VSAT system can support private mailboxes at the public call office. Incoming calls can be addressed to a particular individual, even from a payphone. VSAT can be integrated with a virtual phone service and supply a message notification to users. Subscribers can access their mailboxes to verify whether they have a message. Data services, including fax, electronic mail and Internet access, are also supportable on the same VSAT system.

On a national level, governments are often anxious to provide improved access to education in areas outside the main city. Distance learning over a VSAT network enables an instructor, located in a fully equipped studio, to interact with students over a distance of hundreds of kilometres. The instructor's voice and image are transmitted from the studio by satellite to all the remote classrooms. Students watch the lecture on a television or computer screen and actively participate in the lessons using a standard touch-tone telephone. The teacher may call on a specific student and activate his/her telephone set so that all the students can hear.

According to Talmor [47] Global Mobile Personal Communications by Satellite (GMPCS) systems involve voice or data transmission to and from hand-held, portable and vehicle-mounted terminals. Two markets will be profoundly affected by these services: rural telephony and business travellers. The most important aspect is that the cost of completing a phone call over a satellite is independent of distance.

In conclusion cellular technology may be a solution for the rural area telecommunications dilemma. The cellular technology as a solution to telecommunications, has an advantage in the sense that, the solution can be tailor made to respond to the telecommunications needs of the individuals in a particular area.

7 Clusters.

7.1 Technology Clusters

In this chapter the author gives an example on how the cellular technology is being exploited in the vehicle tracking industry. This is a solution that is responding to crime prevention needs of the country. It illustrates how different industries come together and put their capabilities together and come up with a solution across a cluster.

Rogers [7] states that, "a technology cluster consists of one or more distinguishable elements of technology that are perceived as being interrelated. The boundaries around any given innovation are often not clear-cut or distinct. In the minds of potential adopters, one innovation may be perceived as closely related to another new idea. If this is the case, a change agency may find it useful to promote a cluster or package of innovations to clients, rather than treat each new idea separately". As an example of a technology cluster is the vehicle tracking industry.

BMI [48] says that the vehicle tracking, communication and recovery industry has been in existence for more than 15 years, yet the South African transport industry continues to be plagued by numerous factors, which, have slowed down the growth of the industry.

The main reasons for the current volatility is that, insufficient capital has been invested to maintain the infrastructure necessary for a good after-sales service and that resources have been poorly managed.

The industry structure consists of the service provider, installation company reaction unit and network provider. The service provider provides the customer with tracking and fleet management services. The customer deals only with the service provider and has no direct contact with other key players. Examples of service providers companies are Altrac, Tracker, Ressco, G-Track, Tamlock-V, Trans RSA, Paytrack, Matrix and Trakbak.

The service provider enters into a contract or agreement with an installation company, who installs the tracking system in the customer's vehicle. The service provider may also sub-contract a reaction unit to recover the vehicle if it is stolen. Once the distress signal is activated, the network through the service provider's base station picks it up. The location

and status of the vehicle is identified and a report is forwarded to the reaction unit who then recovers the stolen vehicle.

A Network Provider supplies the service provider with a communications infrastructure through its communications network. The communications network technologies used in the tracking device are GSM cellular networks; Global Positioning System (GPS) satellite networks; radio networks (VHF) and radio trunking. The network providers are Vodacom, MTN, Netstar, Fleetcall, Inmarsat, and Telkom's SPACETREAM VSAT service.

According to BMI [48], market segmentation is made up of large fleets consisting of commercial vehicles and car hire fleets, which are regarded as the upper end of the market.

A small fleet consists of sedans, LVD's and luxury cars weighing less than three tons. Normally there is no cargo at risk. Insurance companies are playing an active role in improving the existing operations in this fast growing segment of the market.

Parastatals such as Eskom need vehicle tracking and fleet management to monitor their fleet and also fleet management services such as performance analysis and trip planning.

7.1.1 Communications Networks and Coverage Areas

Communications networks are:

- Voice;
- Fixed wire;
- Cellular;
- Radio trucking;
- Paging.
- Data;
- Satellite;
- Mobile packet data network;
- Wireless; and
- Paging.

7.1.2 Mobility versus. Coverage Areas

According to BMI [48], most of the tracking systems mobile, stationary or fixed, cover the regional and national areas, but the main focus is on large conurbations such as Gauteng and Durban, and on the N1, N2 and N3.

7.1.3 Short and Long Range Tracking Systems

Short range tracking systems make use of radio repeater networks between the vehicle and the service provider base station. The base station sends out cyclic polling commands to each vehicle using one of the short-range networks. The polling command reaches the vehicle and triggers the on-board computer to transmit a status report to the base station. The on-board computer collects sensor outputs such as vehicle position derived from Global Positioning System (GPS) receiver. Long range tracking systems are similar to short range tracking systems, but instead of terrestrial radio they use geostationary Inmarsat satellite transmission.

7.2 Future technologies

BMI [48] identifies vehicle identification as a future development. This system consists of a device that is installed in the vehicle, which can transmit a secret signal with certain information about the vehicle, such as the make and registration number. The responders at the service provider's base station can pick up these signals. The vehicle can be identified even if its exterior has been tampered with.

7.2.1 Vehicle Immobiliser and Anti-Hijack Systems

Anti-hijack systems that use fibre optics as their main component are being installed in companies. Only trained personnel using sophisticated equipment can install these systems.

7.2.2 Satellite versus Radio and Cellular Networks

Vehicle tracking systems are increasingly becoming GPS and GSM based. The satellite network can enhance the operations of existing radio networks so efficiently that operators would rather collaborate than have their systems working independently.

In conclusion it can be appreciated how companies can come together as a cluster to respond to a market need.

8 Subscriber Trends

8.1 Overview

In South Africa the cellular industry has grown by more than a hundred percent in the first two years, with a gradual decrease in the subsequent years. This is illustrated in the figures and tables in this chapter. In this chapter S-curves are used to illustrate the growth trends of the market, with the subscribers/consumers as main focus. An explanation for the growth trends is also given.

8.2 Consumers

S-curve for Vodacom subscribers using cellular phones and S-curve of data communications services subscribers.

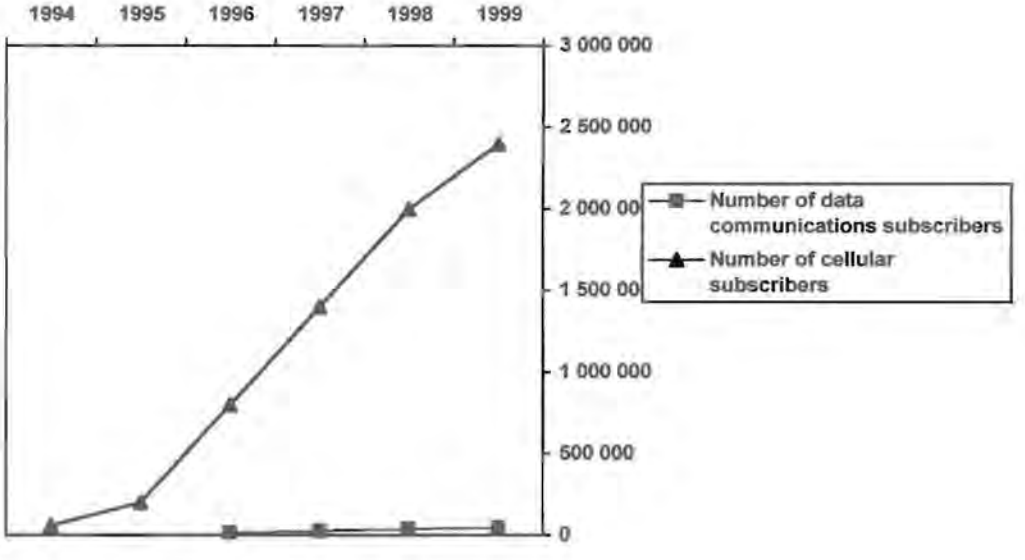


Figure 8. 1 Vodacom Subscribers [49]

According to a Vodacom representative [49] Vodacom has only 20000 data communications subscribers. Vodacom had 2.4 million subscribers in 1999. 60% of these subscribers were prepaid subscribers.

Table 8. 1 Number of Vodacom Subscriber [49]

Year	Number of subscriber	Annual Growth Rate
1994	60,000	
1995	200,000	107 %
1996	800,000	120 %
1997	1,400,000	55 %
1998	2,000,000	35 %
1999	2,400,000	18 %

The number of data communications subscribers at Vodacom is very low. The reason why the number of data communications subscribers is so low is that the community has not been fully educated on data communications and cellular phone users have up to now been more interested in making telephone calls as opposed to using data communications. Subscribers have to be taught to be data users.

The perception of the subscriber is important. Once subscribers have become used to using the Internet and e-commerce, they will want to transfer these transactions to mobiles. Service providers are not used to using Internet Protocol and the Internet. Once service providers get exposure on the Internet Protocol and become familiar with the Internet, they will be energised and the sales channels will become interested in selling data packages. The distribution channels will have to be integrated into this solution because they are still geared to selling voice only. The solution is simple bundle packages, with software integrated with the telephone and the PC card integrated with the terminal.

MTN, on the other hand had 1,200,000 subscribers up to 1999, of which 40% are prepaid according to Chard [50]. By the year 2002 projections by Vodacom are that the total cellular market consist of 10 million subscribers being serviced by MTN, Vodacom and the third service provider, and that satellite telephone technology will have 2000 subscribers. The target market for satellite telephone technology is corporate management and travellers. Bearing in mind that it is a very expensive service. Vodacom predicted that mobile satellite services would commence on the second half of 1999.

The figures in table 8.1 are used to analyse trends in the cellular telephones industry in South Africa.

Please note that for doing calculations for data communications that 60% prepaid do not use data communications. Therefore 60% of the total number of subscribers was subtracted to get the number of subscribers who can actually opt for the service. The author of this report calculated 5% of the subscribers to actually get the number of subscribers who are using data communications.

Figure 8. 2 MTN Cumulatives Figure For Cellular Phone Subscribers And Satellite Telephone Subscribers [51]

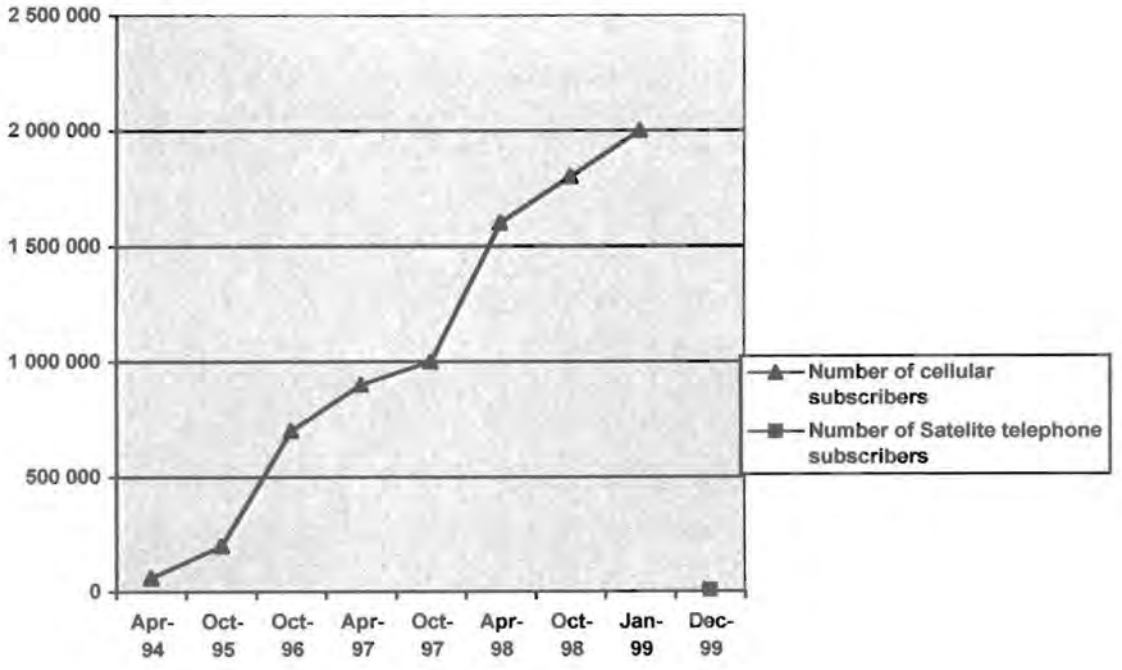


Table 8. 2 MTN Subscriber Levels [51]

YEAR	Subscriber Levels	Annual Growth Rate
1994	60,000	
1995	200,000	107%
1996	700,000	111%
1997	1,000,000	35%
1998	1,800,000	57%
1999	2,000,000	10%

These figures were provided by an MTN marketing representative [51]. The figures illustrate how MTN was competing in the cellular phone market. The author decided to start MTN and Vodacom off at the same level of subscribers because MTN was not forthcoming with its figures for the years 1994 and 1995.

An MTN representative [52] gave an estimation of the MTN's satellite telephone subscriber level. He estimated that there would be 5000 subscribers by the end of 1999. The reason is that satellite telephones were considered to be too expensive and out of reach in terms of price. He added that in the future there would be an increase in subscriber level when prices come down and volumes go up.

Another source from MTN [53] said that between 5000-8000 cell phones per month are stolen in South Africa. He estimated that there are 100 000 stolen cell phones on the South African market. He gave the subscriber numbers in South Africa up to 1999 as 1,1 million MTN subscribers and 1,4 million Vodacom subscribers. He thus claimed that there were 2,5 million cell phones on the market.

These figures furnished to the author of this report do not tally with marketing figures from the marketing offices of both Vodacom and MTN.

Figure 8.2 indicates an initial growth in MTN's number of subscribers during the years 1994 to 1997. After these years the growth had become is less rapid. This could mean that the market was becoming saturated with contract subscribers. In figure 8.2 a second rapid growth period is indicated during 1997-98 after the introduction of the prepaid service. Here a second phenomenon is observed of substitution of prepaid for contracts. Another observation is that market expansion took place as a result of the introduction of the prepaid service, which is more affordable than the contract service. The rapid market growth in 1996, is the result of the introduction of prepaid service at MTN, and also illustrates that substitution of one service for another had started to take place.

In the next section reasons are given to explain the growth rate of the MTN subscriber level illustrated in figure 8.3 below

Chard [50] says that prepaid customer, now account for more than half of the subscribers of many of the region's cellular network operators. In countries like Uganda and Zimbabwe this figure has risen to 90% or more. Statistics such as these provide a clear indication of how the cellular market is evolving and diversifying.

In South Africa MTN is phasing out the Pay-as-you-go option as it presently stands. The new, all encompassing Pay-As-You-Go 'One Card', brings MTN prepaid offering in line with prepaid systems widely used by most European operators. With around 80-90% of its subscribers using prepaid option, this operator has tailored its package to cater for two types of users, by introducing the, receive a lot card and call-a-lot card.

Both cards give access and airtime, but the user's choice depends on card value and the type of subscriber one is. On the corporate side, MTN has a card costing R720, that provides a year's access to the network and allows the user outgoing calls up to the value of the card. MTN to MTN calls are R2.50 per minute and MTN calls to other services is R2-75 a minute. Subscribers can load up to 24 months access time.

Chard [50] says that prepaid service is a regional solution where many of the people are unable to produce financial credentials necessary for a conventional airtime contract agreement. Prepaid service has opened a whole new market to access. There was a quote from the Reserve Bank stating that 30% of South Africans have bank accounts, which

means that 70% of the population operate with cash, and many of them want to be on the cellular network. This is why the prepaid market has grown so rapidly (Vodacom launched its Vodago service in 1995, and now has 1,2 million users).

A further reason why the prepaid is attractive to the South African users is that it is an off-the-shelf product, which is readily available through a wide variety of retail outlets. It is, in most cases, virtually ready for use the moment it is taken out of the box and a simple card to the operator is all that it takes to activate the service. Another reason for the popularity of the prepaid option is the freedom it gives the user. Airtime access can be purchased as and when it is required. For users who are on a tight budget, this provides them with the ability to control expenditure, which is an important advantage of prepaid services.

A cellular network operator can exploit other opportunities, for example by increasing the number of distribution channels to widen market opportunity (and hopefully sales volume). Greater market segmentation and therefore an opportunity to target a specific user sector. The market for used handsets can also be expanded (thus encouraging greater sales of prepaid SIM's). Another result is greater product differentiation from the competition.

Since most cellular contracts in the Southern African region result in the user owning a handset when the contract expires, transferring to prepaid becomes a viable option, as is selling the handset and starting a new contract (in order to upgrade the handset). The market for used handsets is flourishing, an individual can purchase a handset between R200-R400 in South Africa. Redeployment of the handset can be directly linked to an increase in the number of subscribers for the network operator.

Another advantage of prepaid services is that the number of distribution channels can be increased. The network operator can distribute its prepaid packages through virtually any channel, such as traditional service provider routes, supermarkets or petrol stations, etc.

Chard [50] points out that the same applies to airtime vouchers. One of the biggest challenges facing network operators is getting vouchers distributed as widely as possible and this has created a whole new industry. The voucher seems to appeal to the market since it is a "cash-and-carry" transaction. One party hands over cash and the voucher is

given in exchange. Vouchers are now sold virtually everywhere. Dealers are encouraged to stock vouchers through discount incentives and there are now even roadside vendors selling vouchers to motorists who stop at traffic lights.

Service providers and independent dealers can also create their own prepaid packages. MTN supplies its standard prepaid SIM packs to dealers, who can in turn buy their own handsets and bundle these together with the SIM and badge the product as their own. While the risk of internal fraud is very limited, given the high security measures implemented throughout manufacture and distribution, prepaid vouchers/scratch cards still pose a problem. Once they are printed, active and ready to use they could be stolen. MTN has a stringent system and its prepaid platform can blacklist all stolen cards and make them unavailable for loading.

Another threat to the network operator's prepaid system is the fact that SIM-only packages encourage the black market for stolen handsets.

The consensus from network operators is that the future for prepaid is bright. Its challenge is tailoring packages that meet the demand for different market segments. The prepaid option itself will diversify further. The whole intelligent network concept has great growth potential. There will be more flexibility in services with the possibility of two different accounts for the same customer. In corporate applications, for instance, certain numbers could be specified and when dialled could be charged to a corporate account, while personal calls could be charged to a private account.

Industry insiders are certain that the corporate business can turn the prepaid option to their advantage by changing from contract to prepaid, since it enables them to work according to a set budget. This ensures that employees of corporate do not exceed their cell phone allowances. The barriers to such a conversion are the initial monetary outlay, the cost-benefits off-peak calls with conventional airtime agreements and the cost and inconvenience of changing cell phone numbers.

Some cellular providers do not see migrating from contract to prepaid as a problem, since contracts are still more attractive to customers than the prepaid option when tariffs are compared, and have advantages like eventual ownership of the cell phone, more value-

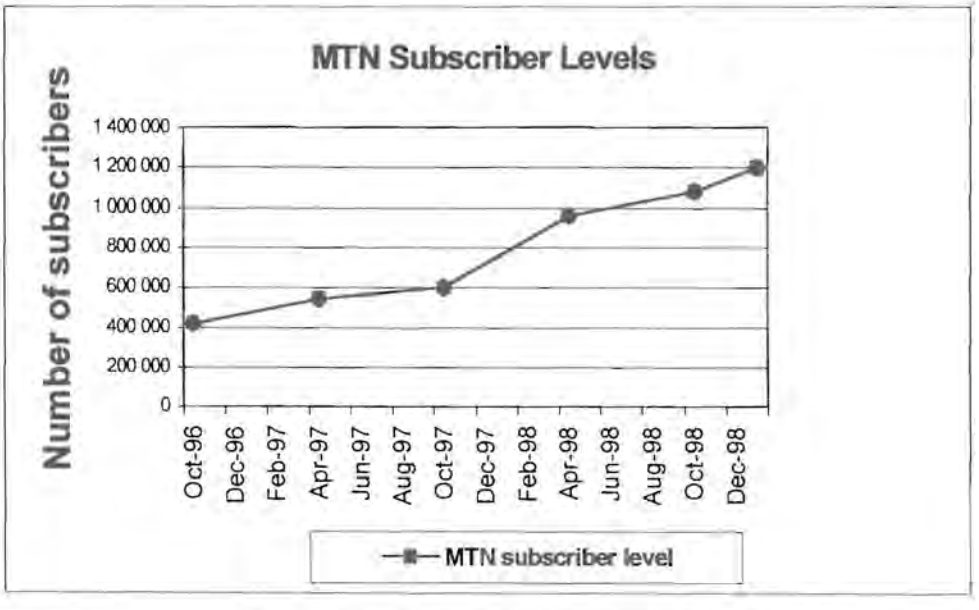
added services and international roaming. Prepaid actually reduces the risk of client bad debt as those who cannot afford to purchase an airtime agreement can simply buy-as-they-go.

When the third operator comes into business a drop in tariffs is anticipated. Price wars and prepaid packages will be a big contributing factor to the positioning of the networks in terms of subscriber base. Chard [50] says that the importance of prepaid for the network operator is beyond question. The main challenge will be to prevent customer churn through quality of service and to limit the amount of migration from contract to prepaid.

BMI [48] says the growth of the SA cellular market has been spectacular, up to ten times the expected take-off. Both Vodacom and MTN regularly claimed world records for the installation of base stations and subscriber growth. Churn, or the rate at which people swop networks, is relatively low at less than 20%. This suggests that people are reasonably happy with the service they get from their operators, but no one tracks down people who use the services then quit completely or who perhaps prefer the prepaid route.

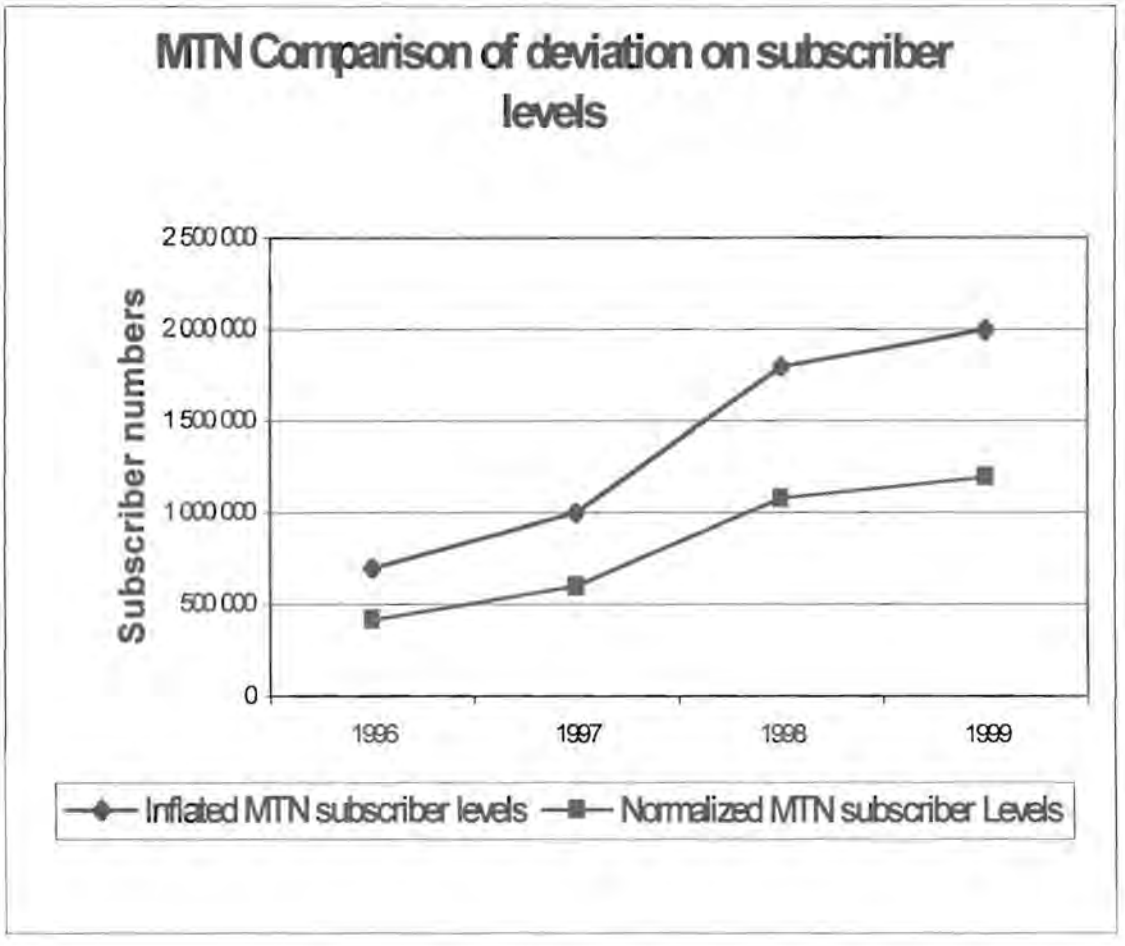
Both network operators have introduced value-added and premium rate services such as short message sending, fax mail, phone-in enquires, paging, vehicle tracking, sports results and stock market prices.

Figure 8. 3 MTN Subscriber Levels [53]



According to an MTN representative [53] the correct figures for MTN's subscriber base are the above in figure 8.3 as opposed to the ones received from MTN's marketing department in figure 8.2. In 1996 MTN introduced the prepaid packages for its subscribers, which, fuelled the growth of the subscriber levels. This package needs no contracts, no credit checks and the client gets instant access. While examining figure 8.3 one can observe that the S-curve is still in the growth phase. Here growth is driven by investment in terms of the fact that MTN had increased its distribution capacity and perhaps had solved some of its problems, for example by expanding its coverage in South Africa. At the same time MTN substituted its existing services (the ordinary prepaid package) with new and improved services that has benefits, such as free voicemail and unlimited incoming calls for a prepaid amount of money.

Figure 8. 4 MTN Comparison Of Deviation On Subscriber Levels



The subscriber base shown in figure 8.2 is much larger than that shown in figure 8.3. As a result it shows the MTN subscriber base to be much larger that it really is. When looking at the above figure 8.4 it shows the inflation of MTN's subscriber levels. These figures make up almost the total figure of the then given subscriber levels in South Africa in 1999 which was, 2,5 million subscribers.

MTN [54] says it conducts constant market research to determine the rapidly evolving changes in customer demand to enable them to tailor packages accordingly. In 1999 their marketing department introduced some customer friendly packages. These packages were for example *Carryover minutes*: which permits subscribers to transfer unused free airtime from one month to the next, and *share-time* an new package for couples, partners and children or any other twosome). Further developments include the elimination of a two card system and the introduction of a much more convenient one-card system for the prepaid options.

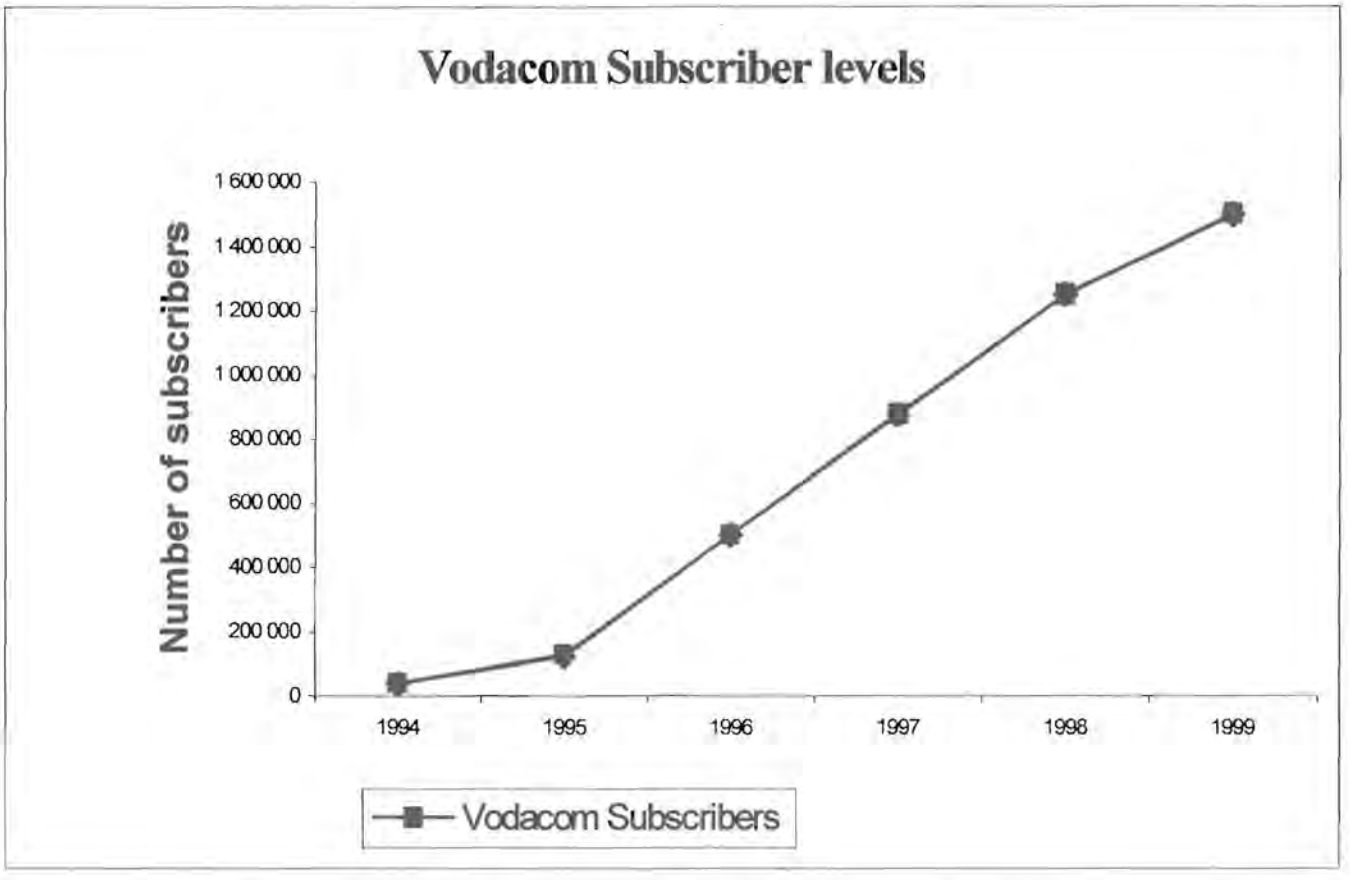
MTN [54] says among the unique services are "CallQuest" and "CallAudit". These software packages, which utilise the Internet are comprehensive on-line bill analysis tools, suited to both individuals and corporations, which provide access to valuable information about individual and group cellular usage.

In keeping MTN's young-at-heart spirit and dynamism of attractive promotions throughout the year, which are geared for subscribers of all ages and at every level of society, MTN's strategy is focused on developing regional hubs around which clusters of business will be developed. MTN has become an integral part of the challenging new developments taking place in technology. Convergence is one of the latest phenomena palms at the merging of technologies including cellular, Internet and even satellite.

MTN [54] says the future promises technology, which will enable mobile phones to roam seamlessly on desktop extensions, while synchronising transparently with desktop PCs and corporate local area networks (LAN's). The clear definition between PCs, mobile handsets, PDA's and television sets is already starting to disappear. Voice over the Internet will make PCs and mobile handsets almost indistinguishable. In other words, technology is converging around consumer and the consumer is mobile.

In the next section, Vodacom (the other service provider) is discussed.

Figure 8. 5 Vodacom Subscriber Levels [53]



From figure 8.5 it is clear that the introduction of the prepaid service in 1995 increased the growth of the subscriber base. This increase continues steadily along the growth phase of the S-curve as Vodacom introduced new bundled packages that replaced the ordinary prepaid packages. And the no credit no contract service is really gaining market share. The difference between figure 8.1 and figure 8.5 is that the subscriber bases are different in number. The subscriber base used in figure 8.1 were from figures given by the marketing department which seemed to be of the mark.

Figure 8. 6 Vodacom Subscriber Level deviation Comparison

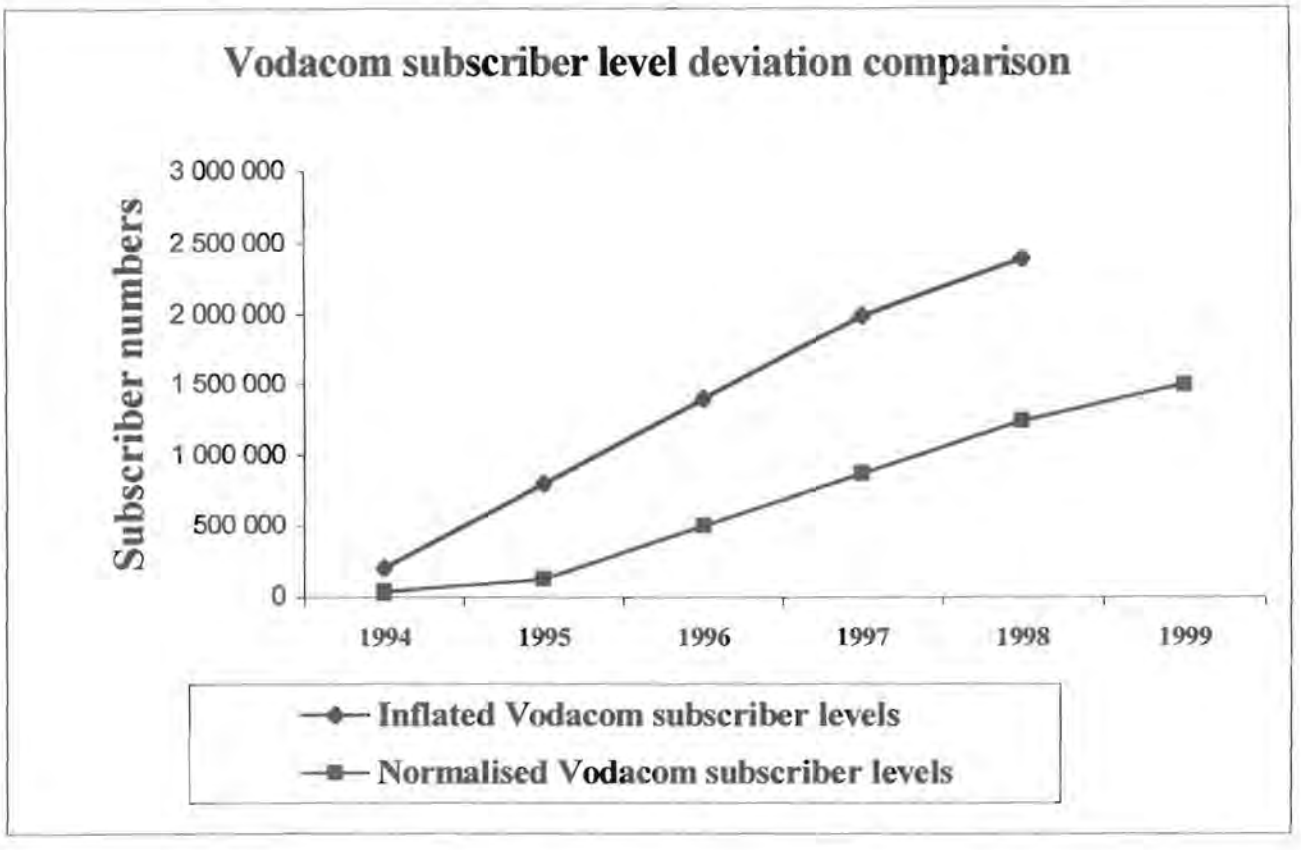


Figure 8.6 shows the difference between the two given logically, the inflated levels are inaccurate because they represent the total subscriber base of South Africa in 1999. Some other factors that are influencing the growth phase of Vodacom's subscriber base are mentioned below.

On 1 March 1994 the first 2,000 phones were connected, just before the elections, as a test phase. The following month another 10 000 were installed. As soon as this happened done election officers and journalists wanted cell phones. When the floodgates opened on 1 June 1994, in the first month Vodacom had 50, 000 subscribers. In order for Vodacom to gain and maintain its lead it had to ensure that an effective retail structure was in place. That helped attract subscribers through fierce competition at retail level. At the same time Vodacom was rolling out its network along 3000 kilometers of national highway.

In 1995, Vodacom used personal safety as their advertising ploy to increase subscriber levels. Value added services were also introduced such as voice-mail platform to increase the number of subscribers. In 1996, Vodacom introduced a fresh growth strategy, by building its Intelligent Network (IN) platform. The IN paved the way to a number of new products, which attracted new groups of consumers to cell phones. Vodacom introduced four new bundled tariff packages. The "Weekender" (free calls over the weekends) was aimed at the growing informal and casual market. Significantly, service providers qualified for a full connection bonus on Weekender connections, thereby discounting the price of cell phones and making it more accessible to this market.

The "Talk100", "Talk200" and "Talk500" tariffs indicated the number of free minutes included in a fixed monthly fee and were aimed at existing users who had a good idea of their cell phone usage. Vodacom did not charge for migration between its various tariff plans, thereby boosting usage of the new packages.

The most spectacular new growth came from the introduction of "Vodago", a prepaid, no contract, no-credit product. In fact the introduction of the prepaid propelled the cellular industry into a fast-moving consumer goods market. In 1997, a new service called "Shareline" was launched jointly with Business Report and Dow Jones, giving investors instant access to JSE share price information. In 1998 Vodacom entered the Internet market with the launch of Vodacom's Internet company, its new Internet Service Provider, a Yebo! Net which prepaid access to the Internet at local Telkom rates.

In 1999 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 cards in the handsets.

A Communications Consultant [55] says that, in the past four and a half years, cellular telephony has put some two million cell phones in the hands of South Africans across the spectrum and it has given millions more meaningful access to telephony for the first time. Effective marketing driven by people with an understanding of the importance of timing has been the key force in the explosive growth of the R10 billion South African cellular industry. The key to success in a competitive marketplace is to associate one's brand with a product category so that when customers think "cell phones", for example, the brand

name "Vodacom" springs to mind first. An example of a brand name, which has successfully achieved this, is Hoover. Not only do millions of consumers think "Hoover" when they think, "vacuum machine", but they actually refer to "Hoovering" when they mean "vacuuming". A marketer has really cracked it when it can claim this kind of association in the minds of consumers.

A communications Consultant [55] claims that Vodacom has achieved this in some respects. Vodacom's hugely popular television advertising largely revolves around two central characters, the antics of which are followed with great interest. One catchy phrase in the script - "Yebo gogo", is meant as a greeting and is difficult to translate. However, many people now refer to cell phones as "Yebo gogo's" and the "Yebo" part of the phrase (which means "Yes" or "hello"), is often found in newspaper headlines referring to Vodacom and cellular in general.

A communications consultant [55] points out that being proactive, as Vodacom was when it began advertising its brand seven months ahead of commercial operations, has the advantage of enabling a company to establish its brand as the generic term for its product category, as described above. However, there is the disadvantage of having to carry substantial marketing costs as one takes on the responsibility of guiding the consumer through the process of learning about a totally new product. Once a marketer has spent millions on this education process there is nothing to stop a competitor from entering the market and embarking on straight brand advertising once all the groundwork has been laid.

According to Communications Consultant [55] it is relatively easy to create an awareness of a need, but more difficult to take a product to those places where customers can be found. Vodacom had a vision of turning airtime into a fast moving consumer good and therefore cellular needed to be available where consumers bought their groceries. Vodacom took cellular out of the exclusive realm of the specialist retailer. Today there are more or less 6 000 distribution outlets where one can buy cellular-related goods, including hundreds of corner cafes, garage shops and takeaways.

A communications consultant [55] add that marketers often talk of the importance that retailers attach to the parking lots next to their supermarkets. It is not that parking lots attract customers, but they have become a "given" and the customer views them as an

essential element of the shopping experience. They do not per se generate revenue and seem to make extremely unproductive use of space; but without a parking lot the supermarket is doomed. South Africa's network of national roads is the "parking lot" of the cellular industry. Vodacom will certainly not generate much revenue from a base station erected alongside a highway in the middle of nowhere; however, the cellular customer expects to be able to use a cell phone all the way from Cape Town to Johannesburg.

The South African cellular industry is organised in such a way that customers have little contact cellular network operators. There is a number of service providers who are responsible for the retailing of airtime contracts and who have more day-to-day contact with customers than service providers do. As a result, the customer could feel more loyal towards the service provider than towards the network operator.

Many service providers are dual service providers and confused loyalties do not go a long way towards reducing churn, an important objective of any cellular network operator. Therefore, Vodacom developed the first cellular retail centre in the world, "Vodaworld", to generate loyalty towards Vodacom by satisfying every customer who visits the centre while keeping the service provider structure in place.

Marketing is best done within a competitive environment and therefore Vodacom welcomes South African Telecommunications Regulatory Authority's (SATRA) decision to award an additional two cellular network licences. The introduction of new networks is an excellent development in an industry with the capacity of growing to 10 million users in the medium term. However, Vodacom is concerned about the conditions that SATRA would apply to the new licences, particularly that they might be more favourable than those under which Vodacom began operations.

A communications consultant [55] says that if Vodacom has to absorb the costs of these conditions and new entrants do not, then that will be against the spirit of free competition, which, Vodacom is trying to foster. New entrants are already fortunate enough not to have had to build awareness of cell phones and their applications. As mentioned above, Vodacom has carried substantial marketing costs in its quest to educate consumers about cell phones.

Burgelman *et al* [19] say the following, "corporate management of technology requires careful planning of the relationships among a company's technologies, its markets and its development activities and it requires systematic linkages between a company's product and process technologies, the products developed must also be produced efficiently". They say that in marketing many critical questions remain unanswered. Some of them are:

- What problems are involved in selling a technology?
- Is a company that sells a technology giving away its "seed" and thus prejudicing its future?
- How, to whom and when should a technology be sold?
- What is the relationship between the sale of a technology and the sale of a product based on that technology?

They say that a complete marketing of a technology requires the development of a coherent strategy for a full portfolio of technologies.

8.3 Development of a Coherent Strategy for a Full Portfolio of Technologies

The decisions on acquisition or divestment of individual technologies are the result of an awareness of the value of developing technology primarily for direct sale without incorporation into products. The clear understanding of the relationship between the sale of a technology through license and the sale of products based on that technology is a recognition that a technology buyer often has a better idea of its needs and opportunities than a technology seller; reliance on technology marketers.

Vodacom addresses some of these issues in its marketing strategy. Vodacom's marketing profile has the following characteristics.

Vodacom's positioning:

A communications consultant [55] talks, of Vodacom's advertising he says that Vodacom's Yebo Gogo advertising campaign has given the brand a 100% awareness level and that it has won numerous awards for effective and popular advertising. A series of commercials with the Yebo Gogo theme and characters have been developed which has become an

integral part of the South African culture. The characters are in demand and consumers anticipate the next chapter in the ongoing story.

The tone of the advertising is warm, likeable, friendly, humorous, and relays the message that Vodacom is South Africa's favourite and most reliable network. Vodacom continues to concentrate its advertising on the medium of television, especially as cellular services and products have developed into a mass-market product.

Vodacom's advertising strategy communicates Vodacom's leadership strategy and shows subscribers the benefits of leadership.

According to Communications Consultant [55] relationship marketing at Vodacom focuses to retain preferred clients and build loyalty. This is achieved through database evaluation, data enhancement, analysis, research, marketing and sales. One of the most effective vehicles used is Vodacom's subscriber magazine, *Vodaworld,* with a print order of 160,000.

Vodacom's regional marketing department is acutely aware of the different requirements in the regions of operation. Local tactical communication opportunities are used advantageously by regional marketing teams who understand that market.

Sports marketing at Vodacom has achieved massive brand awareness through its sport sponsorships, especially as official network of the Rugby World Cup, sponsorship of Vodacom Cup rugby and, more recently, its multi-million sponsorship of the PGA Golf Tournament.

In addition Communications Consultant [55] says retail market research at Vodacom's thousands of outlets retailing airtime and cell phones, point-of-sale material has to be innovative, eye-catching and has to communicate the brand-character of Vodacom. Literature has been developed that is flexible, interchangeable and durable. The characters from Vodacom's 'Yebo Gogo' campaign have been used extensively in point-of-sale material to communicate the brand qualities and distinguish Vodacom from its competitor.

Figure 8. 7 Total Cellular Subscriber Base In South Africa [56]

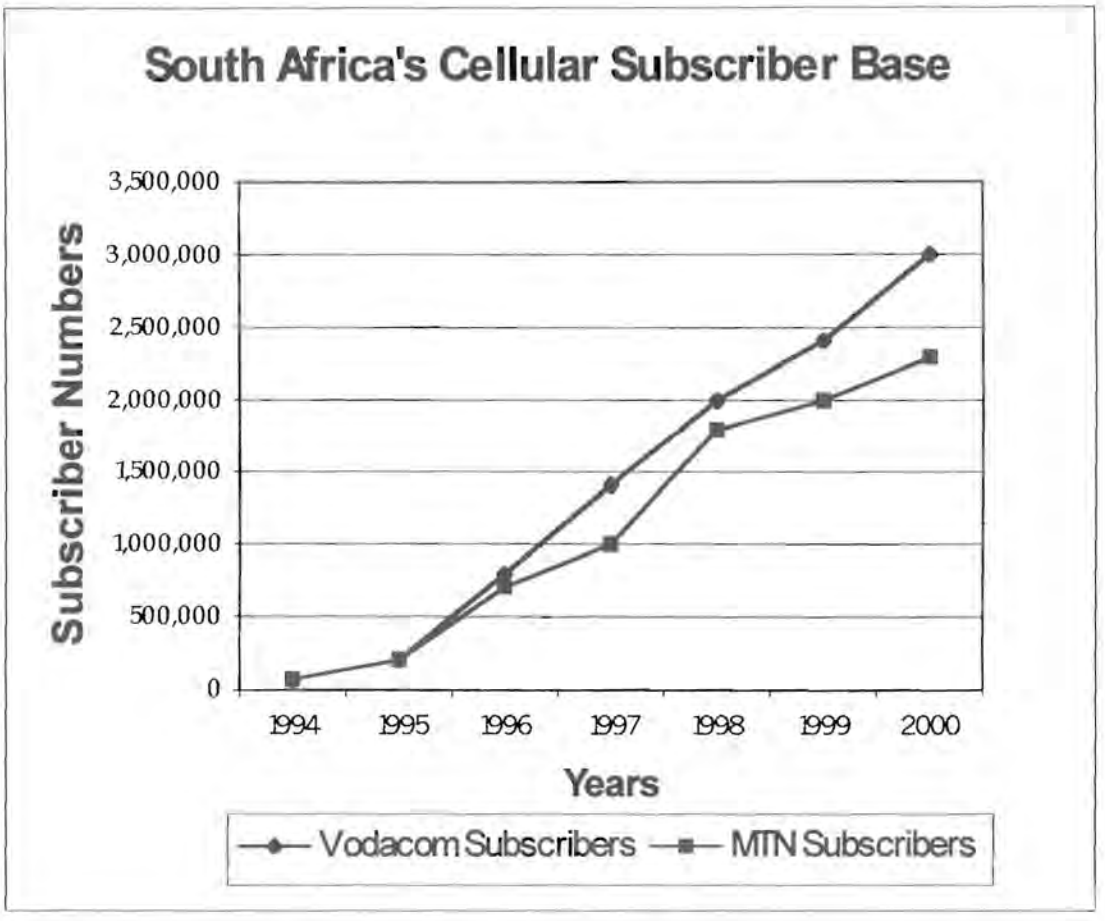


Figure 8.7 illustrates a few things about the cellular industry in South Africa. First of all it gives us a clear indication that Vodacom is leading in terms of subscriber base. Secondly it shows us that the growth rate that Vodacom is experiencing is much higher than that of MTN. This could be attributed to the fact that Vodacom is always ahead in introducing services. MTN seems to have taken the "follower approach" in this market. The reason could be that MTN does not want to invest too much into breaking ground in services; all it does is to come up with a product/service that will substitute a product/service that Vodacom has already introduced.

9 Industry Interviews.

9.1 Overview

In 1994 South Africa's leading service provider, Vodacom, published its projections for growth in the cellular market. Vodacom had projected 250,000 subscribers in ten years starting from 1994. Within a month of operation, starting from the 1st of June 1994, Vodacom had 50,000 subscribers. By the year 1996 Vodacom had passed its 300,000-subscriber milestone. In 1995 Vodacom introduced the "Vodago" package and its introduction caused rapid growth in the cellular industry. This is clearly illustrated on the S-curve of cellular subscribers with Vodacom, (see figure 8.7). In 1996 MTN introduced the prepaid package for its customers. By the same token examining MTN's S-curve (see figure 8.7) this was the beginning of growth of MTN's subscriber base.

It is important to establish what facilitated the growth of the cellular industry in South Africa. A questionnaire was put together to establish what propelled the diffusion of cellular phones and the ever-increasing customer base of the service providers. The questions asked were inline with diffusion mechanisms used in the industry. The author wanted to establish how mechanisms actually influenced the growth of the industry. The questions were important, because they enabled the author to establish what type of industry of South African cell phone industry is and which mechanisms are used to diffuse product and service.

A questionnaire/Interview was administered to help address the below mentioned questions:

- How did the industry manage to attract a subscriber base that far exceeds the projections?
- What type of industry is the cellular industry in South Africa?
- What types of mechanisms were used to promote the technology and the service?
- What sort of social factors are involved in the desire to have access to airtime plus owning a cell phone?
- Is a cellular phone a status symbol, convenience or necessity?

- Is it necessary to be able to communicate while one is on the move?

To address the issues mentioned above a questionnaire was put together in order to provide insight into the cellular phone industry. The method of administering the questionnaires was to interview top level officials in the respective companies, namely Ericsson and Nokia, (the leading suppliers of cell phones in South Africa). Vodacom and MTN (the service providers) and Iridium as the new satellite service in South Africa.

Representatives from the following companies were interviewed:

- Nokia;
- Ericsson;
- Iridium;
- MTN; and
- FCB, on behalf of Vodacom.

The questionnaire used in the interviews is included in the appendix, as well as definitions of the various diffusion methods.

9.2 Interviews about Diffusion Mechanisms

9.2.1 Nokia Interview

The Nokia representative indicated that Nokia diffuses cell phones by working through the service providers. The service providers buy cell phones from the suppliers in bulk, e.g. 50,000 units. Then the service provider in turn distributes these cell phones through retail outlets. The retail outlets vary: MTN uses Saleshouse, MTN cellshops, Incredible Connections outlets, grocery stores (such as Checkers) and garages (such as Engen).

Vodacom, on the other hand, uses Jet, Vodac, Radiospoor, Nashua, Plessey cellular, Nedtel Cellular, Dion, Jet, GSM, Vodac, Smartcall, Teljoy Cellular services, Edgars, Global Telematics, grocery stores (such as Pick n' Pay) and garages such as Engen).

In terms of brand names Nokia is number one in South Africa; this is because of their aggressive advertising strategy. They fund the retail outlets to advertise for them in conjunction with service providers. Nokia owns 51 % of the market share in South Africa

because of their brand name awareness. It is the eleventh strongest brand name in the world, worth 11 billion Rand.

Nokia is always pushing for functionality improvement to ensure that their customers remain loyal. A new direction that Nokia is taking is providing business solutions for corporations; this is done by selling their equipment, in such a way that, the technology can be used for problem solving. Nokia recently provided a business solution for Askafrica, which is a research company that does market research across the country. In order for Askafrica to get its results quickly and to enable them to timeously update their database in Pretoria. They use a network technology business solution, which allows researchers in the field to dial directly from their cell phones into the network to update their database. It is an efficient way of using sophisticated equipment to do research at low cost and a different mindset. This in turn is translated to competitive advantage in the marketplace for this company, since the results they get from the field are reported on time and analysed quickly to be first to market.

The Nokia representative added that he saw a new market penetration at the lower end of the market, which includes school children up to the age of five. This is because of the new packages "call a lot" and "receive a lot" which both service providers have introduced. Running costs of these packages is about R10-00 a month.

The prepaid option has made it possible for a new market of second hand cell phones and stolen cell phones. Stolen cell phones are becoming a problem because countries like Zimbabwe, Mozambique and Malawi are not part of the International Trust Corporation (ITC), which is the body that keeps a blacklist of stolen cell phones. Since these countries do not belong to the ITC, they provide a market for stolen cell phones from South Africa.

In response to the questionnaire the Nokia representative rated the effectiveness of diffusion mechanisms in this order:

Rate 1: Excellent / Very Good

- Collaboration
- Corporate Research
- Joint Ventures
- Corporate Culture

- Newspaper Advertising

Rate 2: Medium

- Outsourcing Agreements
- Long-term-contracts
- Partnership
- Technology Transfer
- Billboard Advertising
- Radio Advertising
- Convenience versus price ratio

Rate 3: Low

- Board Participation

Rate 4: Poor

- Technology Conferences
- Technical Expertise
- Expeditions(Expo's)
- Regulation and Legislation

Rate 5: I do not know

- Gatekeepers
- Competing Technologies

In other words, according to the Nokia representative collaboration, corporate research, joint ventures, corporate culture and newspaper advertising are the best ways of diffusing cellular phones.

9.2.2 Ericsson Interview

The Ericsson representative said that South Africa has a potential market of 17 million subscribers of which the market has only just captured 2.5-million subscriber base. He says that Ericsson, as a supplier, does not have direct contact with the end-users, since they use the service providers to distribute their handsets. The two service providers MTN and Vodacom buy handsets in bulk from Ericsson, then in-turn distribute these handsets to

wholesalers. These wholesalers are their direct link to the end-user. He added that Nokia has a 30% market share as opposed to Ericsson that has a 17% market share. Nokia sales are said to be ahead of those of Ericsson because of the aggressive marketing strategy that Nokia uses.

Like Nokia, Ericsson is also on a campaign of brand building. They are concentrating on cell phones with more functionality, in order to improve their end-user base. The Ericsson representative rates prices as the most important factor in the diffusion of cell phones.

In response to the questionnaire the representative rated the effectiveness of diffusion mechanisms in this order:

Rate 1: Excellent/Very Good

- Board Participation
- Technology Transfer
- Technical Expertise
- Newspaper Advertising
- Price
- Industry Structure
- Clusters

Rate 2: Medium

- Collaboration
- Outsourcing Agreements
- Gatekeepers
- Corporate Culture

Rate 3: Low

- Competing Technologies

Rate 4: Poor

- Corporate Research
- Long-term contracts

- Radio Advertising
- Convenience versus price ratio

Rate 5: I do not know

- Billboard Advertising
- Expeditions (Expo's)

According to the Ericcsson representative board participation, technology transfer, technical expertise, newspaper advertising, price, industry structure and clusters are the best diffusion mechanisms.

9.2.3 Iridiumafrica Interview

The Iridiumafrica representative pointed out Iridium does not have a licence to operate in South Africa. As a result they provide services to companies which operate outside of South Africa, e.g. Anglo-American and Murray & Roberts. These companies are doing development work where landlines are unavailable, so satellite communication is a solution for them. The representative felt that Iridium would be a solution for South Africa's communication difficulties especially in the rural areas.

Iridium's licence to operate in South Africa has not yet been granted. As a result they are unable to do business with big companies like Eskom and Standard Bank. These companies had indicated they were prepared to use Iridium services to provide Y2K solutions and Iridium already has the infrastructure to do business in South Africa. In addition, MTN has contracted to work with them and already uses them as a roaming service outside South Africa. Like other cell phone suppliers they will use MTN and Vodacom as their distributors, who will, distribute to the wholesalers, who are in direct contact with the end user.

In response to the questionnaire the representative rated the effectiveness of diffusion mechanisms in this order:

Rate 1: Excellent / Very Good

- Gatekeepers

- Technical Expertise
- Radio Advertising
- Expeditions (Expo's)
- Regulations and Legislation
- Clusters

Rate 2: Medium

- Collaboration
- Corporate Research
- Outsourcing Agreements
- Long-term contracts
- Partnership
- Corporate Culture
- Billboard Advertising
- Convenience versus price ratio
- Industry Structure

Rate 3: Low

- Price Influence

Rate 4: Poor

- Joint Ventures
- Competing Technologies

Rate 5: I do not Know

- Board Participation
- Technology Transfer

According to the Iridiumafrica representative, gatekeepers, technical expertise, radio advertising, expeditions (Expo's), regulation and legislation and clusters are the best diffusion mechanisms.

9.2.4 MTN interview

The MTN representative was part of their strategic planning department. She highlighted how MTN adds value to cell phones by providing them airtime. Without airtime cell phones are of no use. She confirmed that MTN has agreed to use Iridiumafrica provide satellite services. According to the MTN representative, they are constantly improving their services by bringing out new packages like the Incomer / Outgoer. This are aimed at subscribers who operate strictly on cash basis and have no credit record and also provides a market for second hand cell phones.

In response to the questionnaire the representative rated the effectiveness of diffusion mechanisms in this order:

Rate 1: Excellent/ Very Good

- Collaboration
- Corporate Culture
- Technology Transfer
- Technology Conferences
- Newspaper Advertising
- Competing Technologies
- Price
- Clusters

Rate 2: Medium

- Corporate Research
- Joint Ventures
- Partnership
- Board Participation
- Technical Expertise
- Radio advertising

- Industry structure
- Regulations and Legislation

Rate 3: Low

- Gatekeepers
- Billboard advertising
- Expeditions(Expo's)

Rate 4: Poor

- Long-term Contracts

Rate 5 : I do not know

- Outsourcing Agreements

According to the MTN representative the best diffusion mechanisms are collaboration, corporate culture, technology transfer, technology conferences, newspaper advertising, competing technologies, price influence and clusters.

9.2.5 FCB Interview on behalf of Vodacom

At Vodacom a Communications Consultant [55] pointed the author of this report in the direction of Lindsay Smithers, who look after their marketing.

The representative from FCB pointed out that in this industry the suppliers, service providers and wholesalers work together. They all need each other to be in business. The suppliers need the service providers to promote and sell their handsets because they do not have direct access to the end user. The service providers need supplier's handsets to add value to their airtime, so they actually need the suppliers to make the equipment, for them to be able to give the airtime service. They also do not have direct contact with the end user so they need the wholesalers to distribute their services to the end user. As either a package meaning that one could get a free cell phone on contract or one would purchase a cell phone and just buy airtime. He emphasised that they use billboard advertising just for brand building, while radio and newspaper advertising is used to promote the service provider.

Vodacom also sponsors events like music shows (e.g. Roberta Flack shows) and sports events in conjunction with companies like Siemmens and Telkom. It is very cost effective because of the exposure that Vodacom gets through these concerts, which increase the number of subscribers. He pointed out how effective it is to use stores like Jet, Edga's and Game, at one point they seemed to be selling more cell phones than clothes.

In response to questionnaire the FCB representative rated the effectiveness of diffusion mechanisms in this order:

Rate 1: Excellent / Very Good

- Collaboration
- Joint Ventures
- Partnership
- Gatekeepers
- Board Participation
- Billboard Advertising
- Radio Advertising
- Newspaper Advertising
- Price
- Convenience
- Clusters

Rate 2: Medium

- Corporate Research
- Long-term contracts
- Corporate Culture
- Competing Technologies
- Industry Structure
- Regulations and Legislation

Rate 3: Low

- Outsourcing Agreements

- Technology Transfer
- Technology Conferences
- Technical Expertise

Rate 4: Poor

- Expeditions (Expo's)

The representative from FCB says that the best diffusion mechanisms are collaboration, joint ventures, partnership, gatekeepers, board participation, radio and newspaper advertising, price, convenience and clusters.

10 Discussion of Diffusion.

10.1 Discussion of Diffusion

In the cellular industry in South Africa, collaboration plays an important part, an aspect already mentioned in previous chapters. The suppliers need the service providers to diffuse their hardware (cellular phones). In return the service providers need the suppliers to add value to their airtime by providing them with cell phones.

For the purpose of this research the author looked at two suppliers: Ericsson and Nokia. Ericsson and Nokia have no access to the end users. For their hardware to get to the end users, the suppliers need the retailers or wholesalers (Jet, Saleshouse, etc.) to sell their cell phones. In order to get the cell phones to the retailers, the suppliers have to go through the service providers (distributors), who have set-up shop for the retailers.

Figure 10. 1 A Summary of the Structure of South Africa's Cellular Industry.

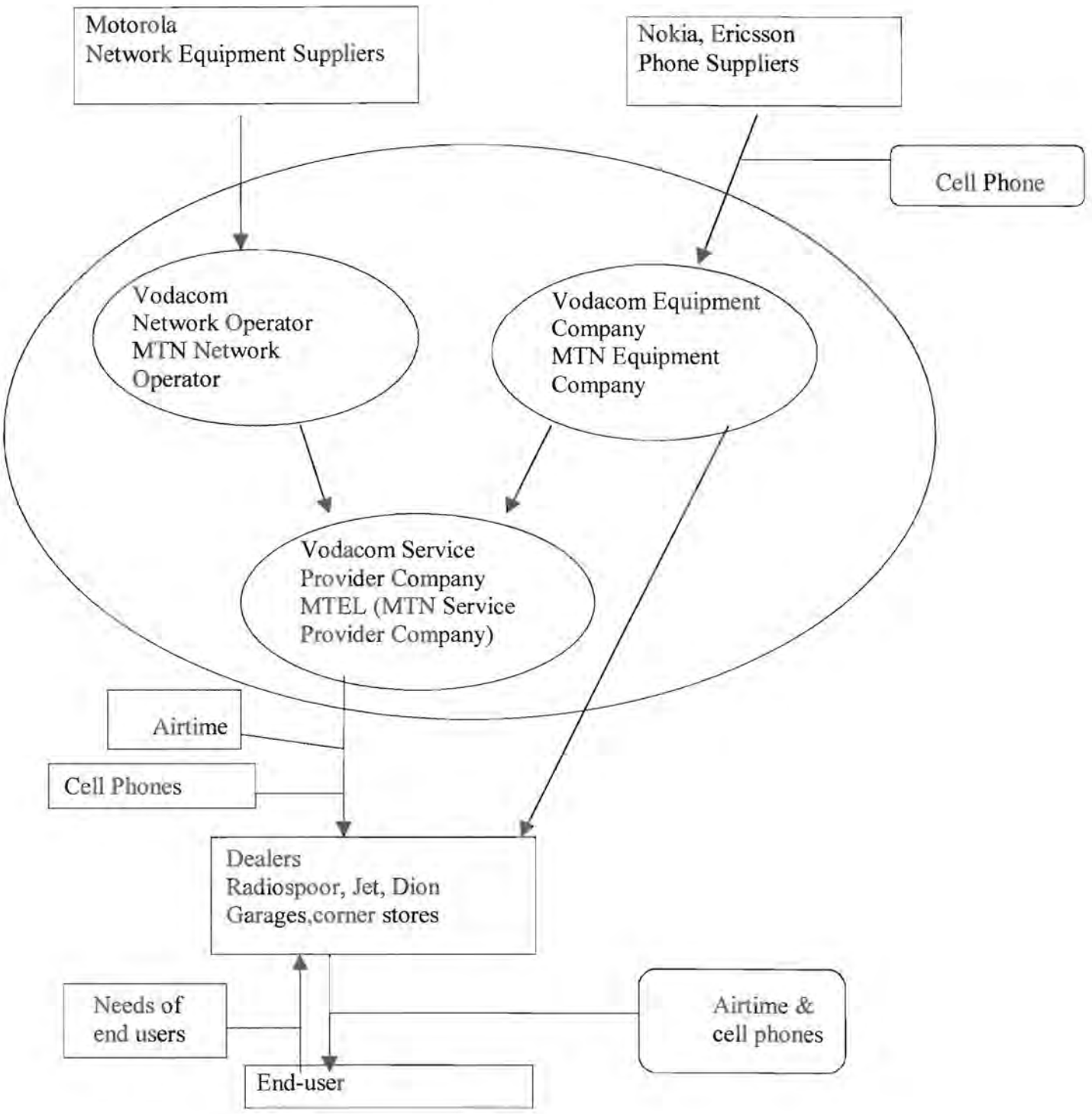


Figure 10.1 illustrates the links between different players in the cellular industry in South Africa. There are links from the Network equipment supplier to the network operator, from the network operator to the service provider, from the service provider to the dealers then eventually to the end-user. There are links from the phone suppliers such as Nokia and Ericsson to the service providers, from the service provider to the dealers and then from the dealers to the end-user. There are links from the phone suppliers to the Vodacom equipment company to the dealers and then to the end-user. The service providers are responsible for setting up the dealership infrastructure, which is the interface between the end-user and the network operator. What happens in this industry is that in order for the cell phone from the supplier to reach the end-user, two routes can be taken. The first is that the cell phone goes from the supplier to the service provider who adds value to the cell phone by supplying airtime. Then, the cell phone and the airtime are supplied to the dealers by the service providers to be sold to the end-users. The second route is that the cell phone comes from the supplier directly, then to the equipment company, then directly to the dealers, then from the dealers to the end-user. In order for the cell phone and airtime to reach the end-user, the use of innovation and diffusion theory takes place. With regards to innovation service providers, network operators, equipment companies and suppliers scanned the environment for processes and products that would satisfy the end user. In addition these players worked together as a team to ensure that product/service innovation took place. The interplay between the dealers, suppliers, service providers and end users contributed positively in the marketing arena by enabling the service providers to position their products and enter target markets successfully. To sustain the industry, the service providers need the support of the other players in the industry. The support system relies on interaction, integration and links of the different components of the industry.

Once this has been achieved a second level of innovation is needed, namely process innovation. Process innovation aims to improve processes within a company, industry or collaboration. It is focused on the current position and direction of a business. In the cellular industry, process innovation is focused on making the industry more efficient by improving certain functions and activities. In figure 10.1 links between the different players are shown, which indicate that there is a lot of communication between the players and that means there is a communications network that has to be managed effectively to

ensure that all players are synchronized. The type of management used here is innovation management; in other words, management by learning. Because new knowledge and technology is being introduced and then diffused and disseminated.

The objective of this research is to analyse the diffusion process (as discussed in the previous paragraphs) of personal telecommunications. The service provider in the personal telecommunications industry has to make sure there are end users who need their services (airtime); by the same token, suppliers need end users to whom to diffuse their hardware (cell phones). For this to take place diffusion theory has to be implemented. Figure 10.1 shows an "end user" category that can be referred to as a social system. This is a requirement for diffusion service provider/supplier has to have an adopter system to adopt the innovation or service in the market. Secondly communication is necessary in order for diffusion to take place. This is illustrated, in figure 10.1, where arrows indicate the communication channels between the role players in the industry. Communication also fulfils other requirements for diffusion, such as advertising for marketing and the exchange of ideas and know-how, which improves, the efficiency of the process and product innovation. Included would be the management of the Collaboration within the cellular industry.

Another interesting facet within the cellular industry is that one of the role players, namely the network operator, is in control. This network operator has been able to manipulate the total system to its advantage. The network operator influences all other role players, from the supplier to the end user. The network operator can even influence regulations in the industry. In the next paragraph, detailed description of some of the processes is given.

In order for these cell phones to be sold, some awareness campaign or information about the cell phones has to get to the end users. This is done through advertising. The suppliers cross subsidise the retailers for advertising purposes. This is done such that, for example a Nokia cell phone can be bought from the retailer Radiospoor. Before this stage is reached, Nokia's brand awareness has to take place, which means Nokia on its own has had to do some ground work for its merchandise. This is to ensure that end-users are aware of what it is selling and that it is meeting the demands of the target market. For Nokia to get this right it has to understand its customer profile. The customer profile has to be defined from the up market end, to the other extreme, which is low-end market extreme. Once this has

been achieved then a supplier can now market along side a retailer to actually sell the actual merchandise.

The network operator influences the actual sales of the cell phone. The reason for this is that the network operator offers airtime through its service providers, at rates that the end user will afford. Included in this should be their value adding services that the service provider offers to the end user. In the days when contracts were the only way to get mobile the subscriber levels were increasing, but not at the rate that, subscribers are increasing since the introduction of the prepaid packages. Once we saw an introduction of the prepaid we observed a defined increase in the subscriber levels. This is because it has become quite easy to get mobile. Subscribers no longer have to be credit worthy to become mobile. This has definitely influenced the growth of the market size and a new penetration in the market. Service providers influence the market penetration through the price of their airtime in the market. The lower the cost of being mobile, the higher the subscriber levels.

The author of this report can deduce that the network operators control the cellular industry. Another factor is that the network operators through their service provider companies are the main distributors for the dealers and as a result the author could say the network operators control the cost of the handset. The service providers advertise their value-adding services and packages. At service provider level advertising is done at tariff level and what services they actually provide. There are also special deals that the service providers advertise, in conjunction with their dealers who do business with the end user. For example, the service provider offer the in-comer and out-goer packages, targeted at the lower end of the market. These have proven to be affordable for people who are not heavy users of cell phones. The rates are fixed during the day at peak hours and there are discounts after peak hours. Airtime for incoming calls is unlimited in this market segment. Contracts are advantageous for people who use cell phones frequently, because they have peak and off peak tariffs.

Collaboration in the cellular industry is done for strategic purposes. The network operators ~~service providers~~ and suppliers have teamed up because they both specialise in different facets of the personal telecommunications. The other reason could be that individual players do not have the capital or skill to put on a one-man show in the industry. The supplier uses the service provider's capabilities whilst the service provider on the other

hand uses the capabilities of the supplier. This is done strategically to enter certain markets and sell certain products on the market. For example: Vodacom works together with Nokia with the goal of selling Nokia's cell phones and Vodacom's airtime. Nokia has no access to the end user and therefore uses its strategic partner to access the end user. Vodacom has access to the end user through its dealers. Through the dealers needs from the end user are channelled through the service provider to the equipment company then to the supplier. These needs are used to develop technology or improve existing technology. Working closely with users facilitates for technology development and enhancements. As an illustration Nokia has responded to the need of mobile subscribers who want to access their data files on their cellular phones. It has responded by developing cellular phones with big screens such that end users may view their files on their screens. In addition service providers have already taken the liberty of training end users to use data communications by offering its subscribers fifteen text messages per month. This is done to wet the appetite of WAP users. Another facet illustrated by figure 10.1 is the entrepreneurial aspect of it. This industry is set up in such a way that new businesses must be developed to facilitate the diffusion of personal telecommunications. For example distribution channels were set up to be able to bring the innovation to the end user. To achieve the goal of taking the innovation to the end user new business centre had to be set up.

For the cellular industry to operate there must be some form of regulation in it. There must be some regulatory body to run this industry. In the case of South Africa it is SATRA, which focuses on telecommunications regulation, which is becoming an outdated way of running this industry. Telecommunications and Broadcasting are converging technologies. In the past telecommunications and broadcasting were separated by the fact that they had separate markets with no common characteristics in both infrastructure and service aspect. Another factor is that both telecommunications and broadcasting belonged to monopoly market structures that were traditionally state owned. Even when these markets were privatised it was imperative to focus mainly on the core business. This era has now come to an end where these industries were separate. Because of developments such as liberalisation in the telecommunications sector and digitalisation in broadcasting, these markets have converged and a single regulatory body for both broadcasting and telecommunications has become necessary.

The purpose of regulations is to safeguard against anti-competitive practices from Public Switch Telephone Network (PSTN) monopoly operations and to ensure fair competition and an increased operating efficiency in the mobile communications market, which strengthens market competitiveness.

In this context liberalisation means the political desire to open up the emerging market to different operators. This is so consumers can be given a chance to choose from alternative solutions. It is a difficult task because main contenders like service providers find it difficult to retain their market share. In addition rapid technological evolutions lead to the globalisation of markets, with the result that operators compete beyond their traditional national markets. This is where strategic alliances come into play, because once companies start to compete beyond their borders they need to join forces for a number of different reasons.

Joint ventures are formed to create alliances between two or more competitors. In the telecommunications industry competitors join forces so that they can enter markets in advanced telecommunications services. The parent companies of these joint ventures remain independent competitors on neighbouring markets, which means that the joint venture is a vehicle for co-operation with the goal of ensuring that parent companies co-ordinate their activities in the markets where they remain competitors. This results in reduction of competition in markets. In addition joint venture between companies operating in different economic sectors often creates or strengthens the dominant position of either joint venture or the parent company.

The regulator has to look after asymmetrical (mis-proportioned) regulation, which normally seems to favour former monopoly service providers. This is because they have the advantages of market knowledge, which sometimes ensures that they already have a reputation amongst consumers. Economies of scale are taken advantage of by broadening of services offered. Included is the availability of developed, distributed infrastructure and financial resources. On the other hand it allows for new entrants to leapfrog, by using the latest technology without worrying about its returns.

As far as symmetrical (proportioned) regulation is concerned, it is supposed to favour newcomers. This is because the former monopolies find themselves burdened with the

costs of supplying the basic services to non-profitable areas plus social categories. The basic assumption is that the telecommunications markets are competitive and that regulation should be as limited as possible.

For the purpose of this research two supplier companies (Nokia & Ericsson) were asked to participate in a questionnaire. In addition the two service providers (MTN & Vodacom) as well as Iridium, also participated.

The goal of the questionnaire was to establish, the most effective diffusion mechanisms, as prescribed by the companies. These were their responses.

Scale of 1 to 5

1. Excellent/Very Good;
2. Medium;
3. Low;
4. Poor;
5. I do not know.

Table 10. 1 Results from Questionnaire Administered in Industry.

Diffusion Mechanisms	Supplier	Supplier	Service Provider	Service Provider	Satellite	Average Score
	Nokia	Ericsson	Vodacom	MTN	Iridiumafrica	
Cluster		1	1	1	1	1.0
Newspaper Advertising	1	1	1	1		1.0

Diffusion Mechanisms	Supplier	Supplier	Service Provider	Service Provider	Satellite	Average Score
	Nokia	Ericsson	Vodacom	MTN	Iridiumafrica	
Collaboration	1	2	1	1	2	1.4
Price		1	1	1	3	1.5
Corporate Culture	1	2	2	1	2	1.6
Technology Conference	2	1	3	1	5	2.2
Industry Structure		1	2	2	2	1.8
Partnership	2			2	2	2.0
Joint Ventures	1		1	2	4	2.0
Radio Advertising	2	4	1	2	1	2.0
Corporate Research	1	4	2	2	2	2.2
Technical Expertise	4	1	3	2	1	2.2
Outsourcing Agreements	2	2	3		2	2.3
Convenience Versus Price	2	4	1		2	2.3

Diffusion Mechanisms	Supplier	Supplier	Service Provider	Service Provider	Satellite	Average Score
	Nokia	Ericsson	Vodacom	MTN	Iridiumafrica	
Ratio						
Regulations & Legislation	4		2	2	1	2.3
Gatekeeper	5	2	1	3	1	2.4
Board Participation	3	1	1	2	5	2.4
Technology Transfer	2	1	3	1	5	2.4
Billboard Advertising	2	5	1	3	2	2.6
Long-term Contracts	2	4	2	4	2	2.8
Competing Technologies	5	3	2	1	4	3.0
Expeditions (Expo's)	4		4	3	1	3.0

In table 10.1 above, an average score was calculated on every diffusion mechanism and the list was arranged according to the score. The lowest average is given the highest rating according to the rating scale. The most highly rated mechanisms are **clusters** and **newspapers** with the average rate 1.0. The second highest is **collaboration** with an average rating of 1.4. Third rated mechanism is **price** with an average rating of 1.5.

Fourth is **corporate culture** with an average of 1.6. Fifth position is **industry structure** with a score of 1.8. **Partnership, joint venture** and **radio advertising** are sixth with an average of 2. **Corporate research, technology conference** and **technical expertise** are seventh with an average of 2.2. Eighth is **convenience versus price ratio, regulation legislation** and **outsourcing agreements** with an average of 2.3. In the ninth position are **gatekeepers, board participation** and **technology transfer** with an average of 2.4. Tenth is **billboard advertising** with an average of 2.6. **Long-term contracts** with an average rating of 2.8 are eleventh and **competing technologies** and **expo's** are rated lowest with an average rating of 3.

Judging from the above mentioned it is clear that according to the leaders in this industry, the most effective diffusion mechanisms are clusters, newspaper advertising, collaboration, price, corporate culture, industry structure, joint venture, partnership and radio advertising. Diffusion in this industry is done by joining forces: from the supplier through the equipment company, the service provider to the dealer, then from the dealer to the end-user. This diffusion process has to be managed. Management of this industry is both vertical and horizontal. The industry requires management that is knowledgeable at all levels and with strong links and interrelationships that are very strong. The risk involved in managing an industry like this should be spread across the players, so that everybody understands their stake and is willing to share responsibility.

11 Conclusion and Recommendations.

11.1 Conclusion

In this research the diffusion of personal telecommunications is examined. The literature review included theories like, diffusion theory, competition theory, forecast theory, cluster theory and managing innovation theory. These theories all encompass diffusion of an innovation. According to these theories firms almost never innovate in isolation and purely from their own resources. The direction of an innovation and its form are influenced by the way firms interact with one another within their industry.

For innovation to place and be diffused it must be done within a regulatory framework. This regulatory system does not only formalise rules and regulations but helps shape public policy within the environment. In addition one has gathered that an innovation/technology does not translate into profit on its own. It needs the diffusion process to achieve that. By description diffusion is a social process that relies on channels of communication, through which knowledge, skill and competence can be spread.

This flow of information should come from customers and should be fed back into the innovation process. It should also flow between companies, strategic alliances and clusters. For the diffusion process to take place it also needs flexibility in operation to meet diverse and emerging company needs. The flexibility mentioned here is such that one can also deduce that there are different rates of diffusion across firms, which result sometimes in output growth, which translates into new employment opportunities. This is seen especially in communications and information sectors. What it means then is that diffusion should not only be aimed at disseminating technology and knowledge to firms. It should also enhance the ability of firms to identify, absorb and build on technologies in the future. To be able to achieve this firm needs to be able to learn.

Diffusion policies should be used to foster the learning process within companies. Learning is imperative since diffusion is complex: it involves interactions with different actors, companies with different roles, for example suppliers, producers, adopters, information networks and non-adopters. This can only be achieved through space, time

and between different industries and companies, bearing in mind that it depends on a particular product or service.

In conclusion: for diffusion to be successful, companies must be encouraged to work together to accumulate information, learning and strengthen ongoing business technology development. This type of networking may be horizontal, vertical and in firms of different industries but with shared interest in technology.

This whole process of innovation and diffusion has to be managed somehow. In this process of management clear business objectives and strategies have to be formulated. What is even more important is the handling of the product including the target market. Analytical tools must be used to analyse activities and information flows. Furthermore external analysis of competitors, customers, suppliers, legislation and value must be identified in order to gear the strengths of firms and weaknesses and opportunities.

From the literature review and discussions with leading players in personal telecommunications companies in South Africa, namely Nokia, Ericsson, Iridiumafrica, Vodacom and MTN, the following conclusions about the South African cellular industry can be reached.

It is an industry, which has shown rapid growth. The main driving force behind this rapid growth is the cost of airtime and the price of the handsets. In addition subscribers do not have to be creditworthy to be mobile. In a nutshell one does not have to enter into a contract with the service providers and earn a monthly salary in a certain bracket to be able to be connected.

Another contributing factor is the ease with which subscribers can get cellular phones and airtime vouchers. The accessibility of these facilities has definitely contributed to the increase of the subscriber base, and the cash-and-carry phenomenon with no strings attached, has worked magic for the South African industry.

The awareness campaign, which Vodacom engaged in seven months before the industry went operational, was worth the investment in every sense. It did not only benefit Vodacom but also benefited MTN. By the time Vodacom went operational, the subscribers who could afford the service, flooded Vodacom with requests for connection.

One can also concluded that the network operators are controlling the industry. The reason is that the network operators operate as a hub or central point in the industry. They control the link between the suppliers and the end users. The service providers have set up dealers to sell airtime and the hardware to the end users. The dealers have to work through the service providers to purchase the hardware (cell phones) from the suppliers. With this in mind it can be seen that competition in this industry is thus both horizontal and vertical and has boundaries so to speak. It is also competition that has helped in the rapid diffusion of the cellular phone. This is illustrated by the fact that the network operators set up distribution channels through their service provider companies as wide as possible and as quickly as possible in order to beat their competitor in capturing the desired market. The suppliers have a dedicated market of supplying equipment in which they compete at supplier level and at retail level. The service providers compete at the level of service providers with services they offer and also at the level of retailers. In order for this industry to survive and keep growing players continually have to develop competencies such as teamwork, networking, systems thinking, creativity, resourcefulness, rapid learning ability and adaptability because they will be skills that employers will value and reward for they need them according to Buys [57].

This whole diffusion process has to be managed from the development of the product to the use of the product and service. The different levels of the industry all have to be managed: the supplier, service provider, dealer and end user. At each level an integrative type of management has to be administered, ensuring that all the interrelationships of the industry are maintained and strengthened from time to time, both vertically and horizontally. SATRA is the regulatory body who regulates competition and administers regulation and legislation within the industry. The regulator should be pro-active in making sure that it introduces policies that are in line with other countries of the world. So as to encourage a more dynamic environment for the telecommunications industry. The regulator should also have incentives for encouraging competition amongst players in the industry.

Since the industry is flourishing, one can conclude that; experts in technology management are managing the telecommunications industry, in South Africa.

11.2 Recommendation

The regulatory body, should, foster successful competition in the market. This could be achieved by doing the following:

- Defining the most appropriate market form and formalities that govern the entry of new operators;
- Managing the conditions under which the various operators can carry out business;
- Managing the possible market exit of some of the operators;

In addition, if the dominant provider is already vertically integrated, favourable interconnection terms must be set for the newcomer, or the newcomer must be allowed selective entry into the profitable markets. The responsibility for providing universal service is the obligation of the incumbent.

Another important task is to encourage unbundling with regards to potential newcomers, by preventing them from acquiring whole packets that are prepared by dominant providers.

Innovation is a process that needs diffusion in order to make an impact or be profitable. It has now been established that for diffusion of an innovation to take place, the ideas can stem from many sources, including the recognition of markets. This means that a great amount of communication takes place. Knowledge and information are shared between firms, consumers, laboratories etc, and feedback from product development and marketing is also part of the sharing of information.

The distribution of knowledge is becoming, increasingly important and it is necessary to develop knowledge distribution networks. For the knowledge distribution networks to be effective and effective linkages between them have to be established and the diffusion of technology has to be effectively managed.

It is recommended that technology management be used exploit knowledge management.

11.3 Further research:

A topic for further research could be:

How can technology management as a tool be used to advance knowledge management?

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13 APPENDIX: Questionnaire

Definitions

- **Diffusion**: Spread of an innovation through a social system.
- **Collaboration**: Working towards a mutual goal through cooperation as opposed to competition.
- **Outsourcing**: Contracting out of work, instead of having it performed in-house.
- **Joint Venture**: Business arrangement where two or more companies form a jointly owned/managed business for a specific purpose.
- **Gatekeepers**: Person controlling flow of information through a single channel.
- **Long-term contracts:** Collective agreement which is negotiated for periods of two or more years; any contract between two parties which is intended to last for a period of several years.
- **Partnership:** Type of business organization where, unlike a limited company, the partners who own the business do not have limited liability.
- **Corporate Culture:** Beliefs, values and customs, which characterize how a company functions and the attitudes of its personnel to the market, the organization and themselves.
- **Technology Transfer**: How a customer learns to use a new technology that has been introduced to the market.

Instructions

Using a scale of 1 to 5, please select [encircle] the figure which illustrates your impression about the best diffusion mechanisms in your industry.

1. Excellent / Very good
2. Medium
3. Low
4. Poor
5. I do not know.

As a method of diffusing cell phones do suppliers use the following methods:

Is collaboration effective in the diffusion of cell phones?	1	2	3	4	5
Is corporate research effective in the diffusion of cell phones?	1	2	3	4	5
Are outsourcing agreements effective in the diffusion of cell phones?	1	2	3	4	5
Are joint ventures effective in the diffusion of cell phones?	1	2	3	4	5
Are gatekeepers effective in the diffusion of cell phones?	1	2	3	4	5
Are long-term contracts effective in the diffusion of cell phones?	1	2	3	4	5
Is partnership effective in the diffusion of cell phones?	1	2	3	4	5
Is board participation effective in the diffusion of cell phones?	1	2	3	4	5
Is corporate culture effective in the diffusion of cell phones?	1	2	3	4	5
Is technology transfer effective in the diffusion of cell phones?	1	2	3	4	5
Are technology conferences effective in the diffusion of cell phones?	1	2	3	4	5
Is technical expertise effective in the diffusion of cell phones?	1	2	3	4	5
Is billboard advertising effective in the diffusion of cell phones?	1	2	3	4	5
Is radio advertising effective in the diffusion of cell phones?	1	2	3	4	5
Is newspaper advertising effective in the diffusion of cell phones?	1	2	3	4	5
Are expeditions effective in the diffusion of cell phones?	1	2	3	4	5
How do competing technologies influence diffusion of cell phones?	1	2	3	4	5
How does price influence the diffusion of cell phones?	1	2	3	4	5
How does convenience versus the price ratio influence diffusion of cell phones?	1	2	3	4	5
How does the Industry Structure influence diffusion through cooperation and competition?	1	2	3	4	5
How do regulations and legislation influence diffusion of cell phones?	1	2	3	4	5
How do Clusters influence diffusion of cell phones?	1	2	3	4	5