Chapter 1

Orientation and background

1.1 INTRODUCTION AND BACKGROUND

The *White Paper on Science and Technology* of the Department of Science and Technology of South Africa (Department of Arts, Culture, Science and Technology, 1998) contains a vision for science, engineering and technology (SET) where the barriers of ignorance are broken down and a society evolves that understands and values SET, as well as the key role that SET can play in ensuring national prosperity and a sustainable environment. It was the vision of the Department of Science and Technology (DST) to create a special period in 1998 during which much of the attention of the public and the media focused on SET. Seven years later, it is still a priority in South Africa to communicate science to the community, to both the literate and illiterate; urban and rural; young and old segments of society. The Department of Science and Technology was established in 1996 and although the name does not reflect engineering, the purpose of the Department is to oversee these three priority fields in South Africa.

The implications of the White Paper of the South African government are that everybody in South Africa, especially the younger generation and children, should be informed about SET. Understanding SET is a necessity, since SET touches everyone's lives. From medicine and transport to computers and mobile phones, the pace of scientific, engineering and technological development is rapid and seemingly inexorable. South African communities' opinions of these developments vary, as is only to be expected.

Within South African society, some people are enthusiastic about change; some are sceptical of the ability of the South African government to regulate science; and others have no interest in science at all. SET, as described by the South African government, is regarded as one concept. Although only the term science is used, it in fact includes engineering and technology as well. The term science does not only refer to the natural sciences, but also includes social and educational sciences. Since the government of South Africa has made it a priority to improve the understanding of natural sciences by the general public, the emphasis in this study is on natural sciences.

The South African government's encouragement to enhance an understanding of SET makes the task of role players in science, and especially the communication of science to the general public, even

more imperative. The role players in science communication have to ensure that the message of science successfully reaches the literate and illiterate; urban and rural societies; old and young people to ensure prosperity and the enhancement of a sustainable environment. Because of the urgency to understand SET, various associations have been established globally, including the National Association of Science Writers in the United Kingdom. The National Association of Science Writers is among the leaders in providing guidelines to scientists and journalists in writing science articles that non-scientists can understand. According to the National Association of Science Writers (2001), the present generation has access to more knowledge, leisure, travel and entertainment than any generation in history, due to the contributions of research scientists and engineers.

However, although topics referring to science are increasingly covered in the mass media, highly technical and sometimes biased articles often dominate the scene. Therefore, to prevent incorrect messages from reaching the non-scientific community, a good relationship must be established between scientists, communication specialists and journalists. Since science is only one of the issues on which South African journalists have to report, it would benefit scientists to have good relations with the journalists from the various media. Good relationships between scientists from higher education institutions (HEI)[1] and communication specialists, as well as between communication specialists and journalists, will ensure that more science topics are covered in the media, including household magazines and newspapers.

Many areas of science have the potential to be visually attractive, which could result in more science experiments being presented not only in magazines, but also on television. This would, however, require communication specialists and journalists to be given the opportunity to accompany scientists on field trips or receive invitations to watch an experiment being performed, resulting in more information on research being available to convey to the various stakeholders, including education, commerce and industry, government and the general public.

Communication specialists in the study are defined as public relations officers, liaison officers, managers and directors in marketing and communication divisions and/or units at HEIs. They are the communicators, or in many cases the spokespeople, of HEIs. Communication specialists should mediate between scientists, who provide the scientific facts; and the media, which distribute the messages of science. Communication specialists should ensure that simplified and comprehensible,

[1] HEI refers to universities and technikons that offer education to students who have passed the Grade 12 school level.

but accurate science facts ultimately reach all segments of society: literate and illiterate; urban and rural communities; young and old people.

In South Africa, unlike other countries with many technical colleges, the core of scientists is centred at HEIs, resulting in the focus on HEIs in this study. The main focus of universities and technikons is on education and research. It is, therefore, the responsibility of universities and technikons in South Africa to ensure that scientists at these institutions, who are the source of science, receive attention from the media, which should distribute the science message via communication specialists at HEIs, who are the facilitators mediating the flow of science messages to stakeholders. The key role players in science communication in South Africa can thus be identified as the scientists, who are the source of the science message; communication specialists at HEIs, who are the facilitators who fulfil a mediation function in conveying the message of science to stakeholders; and South African journalists, who are the final distributors of the message to all stakeholders, including the literate and illiterate; urban and rural societies; young and old people, who are the recipients of the science message. Executive management at HEIs form the fourth key role-player, since they should provide the trust and empowerment to other role players to distribute the message of science.

HEIs in South Africa have an organisational structure consisting of various faculties, each with their own departments. Scientists in different fields of speciality are located in these faculties, including faculties such as natural sciences, engineering, health sciences and social sciences. Besides the faculties, HEIs also have other divisions responsible for the operational issues of the HEI, including a corporate communication and/or marketing division. Although the marketing and/or communication division is supposed to take responsibility for communication to stakeholders and media liaison, there seems to be a lack of trust and understanding, which are elements of a successful relationship, amongst the key role players in science communication.

Often communication specialists are not empowered by executive management to liaise with stakeholders of HEIs at their own discretion. Scientists sometimes prefer to communicate directly with the media and have on several occasions caused embarrassment to their institutions, because they are not always trained to react to journalists' questions (Nelkin, 1995:35). They either make statements that should not have been conveyed to the media, or they are misinterpreted – and misquoted - by journalists. The role of communication specialists at HEIs is therefore important to build a bridge between the executive management of HEIs, scientists and the media in order for the science message to reach all relevant stakeholders, including the literate and illiterate in both urban and rural

areas, as well as the old and young people of South Africa. However, to achieve successful science communication, it is imperative to define the essence of science communication.

1.2 ESSENCE OF SCIENCE COMMUNICATION

Science communication is broadly defined to include communication among scientists on the one hand and mediated communication from scientists to the public on the other hand (Trumbo, 1999:410). The latter, therefore, refers specifically to conveying messages of science-related issues to the non-scientific population. The scientific process is a lengthy, formal method of investigation, with careful structures designed to minimise the publication of 'wrong' results. Goodfield (1981) noted that there is a reluctance among scientists to popularise scientific data through the media. Priest (1998) noted that maintaining the integrity of science representation involves training the general public and the professional community in information literacy.

Such messages should be simplified to enable the general public, literate and illiterate, urban and rural, as well as very young children, to understand the purpose and benefits of science. Activities, awareness programmes, vocal and printed messages to simplify hard science – these all constitute the core of science communication. To convey science information to the general public in a simplified, yet accurate way is the purpose of science communication. Science communication and the communication of science are terms that will be used regularly and in an interchangeable manner in this study.

1.3 BENEFITS AND RISKS OF SCIENCE

The potential benefits and drawbacks of scientific developments are debated in many different forums, including the media, government, academia and the general public. The expectations of society (i.e. the general public) have also changed in recent years, as people are no longer satisfied with statements about scientific discoveries, experiments or developments only. They require explanations of why a statement was made. Institutions, therefore, have to operate in a much more demanding environment in which they are carefully scrutinised as targets.

As identified by Askew (1997), several factors are thought to have contributed to the benefits and risks of science. Both sides of the story need to be communicated to the general public to enable them to participate in public debates and keep them informed on issues that might affect their daily lives. The general public needs to know how new scientific developments can contribute to enhancing their health and safety. At the same time, however, they also need to be aware of the risks these

developments might contain for their health and safety. Numerous sources were used to compile the following list of benefits and risks of scientific developments:

- The globalisation of business and the speed and ubiquity of communication mean that local events no longer just have local meanings and consequences. Fax and Internet provide means of communication that are open to anyone, not just the most sophisticated. Other benefits of science can be seen in the development of new technology, for example DVDs, cell phones and multimedia, as well as several inventions by scientists, such as cloning, genetically modified organisms and DNA testing.
- The general public and governments continuously expect higher standards in health, safety and environmental matters.
- A decline in the influence of traditional leaders (the church and the state) has left a moral vacuum and a general cynicism towards most institutions. This has created a climate for the rise of sophisticated and successful pressure groups, which have adopted ethical stances, understood the importance of emotion as well as logic, and utilised the speed and effectiveness of communication in pursuit of their objectives.
- In a challenging national and global environment, issues can quickly turn into crises. For example, disposable nappies have been attacked as a major cause of waste disposal problems; mobile phones have been alleged to cause brain tumours; and the discharge of waste into river systems in a Third World country has rapidly become an international political issue.
- Furthermore, Hlywka, Reid and Munro (2003) remark that the introduction of biotechnology-derived foods into global commerce through advances in scientific technologies has resulted in a greater scrutiny of the regulatory measures in place to ensure the continued safety of man's food supply. Although the safety of foods derived through biotechnology is evaluated against the standard of safety applied to all foods in general, prior to acceptance into the market, there remains a degree of uncertainty among some consumers and regulators regarding the potential long-term effects on human health.
- Added to the list are the drawbacks of scientific development, including the risks involved in new developments such as cloning. Certain risks attached to the techniques used in cloning may cause physical or emotional defects. No-one can safely predict whether experiments in cloning will have positive results, because the end results might still include premature death or deformed organisms (Massarani, 2002).

The abovementioned factors and many other possible benefits and risks of SET developments have caused scientists and communicators of science worldwide to realise that communicating science

needs much more attention than it has actually received in the past. In several countries this realisation has resulted in policies on how to enhance an awareness of science communication. Although literature is globally available on the topic, not much research has been conducted on science communication, besides the general public's understanding of science and their attitudes towards science, especially in South Africa.

In the USA, the UK and Australia, as well as many other countries, several programmes and forums were developed to improve the communication of science to all stakeholders, including the general public and the media (Massarani, 2002). These countries are also leading the way in developing science activities for both children and adults. New technology, such as electronic mail (e-mail) and the Internet, greatly assists professionals who discuss science communication within groups by sharing experiences and introducing new initiatives to improve an awareness of science communication worldwide. In South Africa the key role players in science communication situated at HEIs should take the lead in following the global leaders by conveying science to the general public, since science communication has become a priority globally.

1.4 PRIORITY OF SCIENCE COMMUNICATION GLOBALLY

The impact of SET on society today certainly cannot be doubted by anyone. Every country globally faces challenges – not only of understanding the current multiple revolutions in SET, but also of how these revolutions affect the future of humanity and the Earth (National Association of Science Writers, 2001). Within the international scientific community there is an increasing awareness of the duty and responsibility of publicly funded scientists to make their work more accessible to the general public (Joubert, 2001). Worldwide science reporting is moving away from 'celebratory' reports about 'space and dinosaurs' towards debate and issues around the impact of science on society. It is no longer a matter of "Professor, please tell us about this fantastic project," but rather "Explain why you are doing this research, who is funding it, what is your agenda?" (Joubert, 2001).

Research International, based in the UK, is a research organisation conducting research on behalf of other organisations. It found that in the UK there has been a move away from the traditional, limiting image of science and scientists as 'boring', 'white, male and middle class'. In many other countries, too, a need was identified for two-way communication between the general public, including children and the illiterate segments of society, as well as the scientific community. Although teaching and the mass media were identified by international research associations, including Research International, as very important routes through which to communicate science to all societies: the literate and

illiterate, urban and rural, as well as young and old people, scientists expressed concern about the role of the mass media. It was the opinion of many scientists worldwide that the mass media often sensationalised and misrepresented science. Covering science accurately and comprehensively is a complex task. Competent journalists, like competent scientists, need to be trained, supported and inspired. Many science-orientated organisations globally consequently decided to focus on the actual marketing and selling of science as an area of improvement. Programmes are aimed at widening the general public's understanding of science and focusing on access to science education (Research International, 2000:2,3).

The National Association of Science Writers (2001) of the UK agreed with Research International and other research institutions that the promotion of science and the communication of science to the non-scientific public is a priority all over the world. Various countries, such as the UK, Australia and South Africa, have conducted studies to determine how the general public perceives science.
They also tested public attitudes towards science. The results of some of these studies are discussed in Chapter 3. However, since science communication is still a new concept globally, limited research has been conducted on the key role players of science communication and the relationship between these key role players.

1.5 IMPORTANCE OF SCIENCE COMMUNICATION IN A POST-APARTHEID SOUTH AFRICA

The new government of South Africa, which came into power in 1994, made the democratisation of science in the country a priority and promoted the popularisation of science as a key driver of socio-economic advancement. According to Joubert (2001), society was to rediscover science, not merely receive its products.

South Africa, like all other countries, is dependent on SET to support industries in order to reach informed decisions and be competitive in the international marketplace. The South African population should be able to develop opinions on the scientific and technological issues of the day, based on their knowledge of SET. However, most stakeholders cannot distinguish between scientific, non-scientific or pseudo-scientific subjects. For these reasons, communicating SET to various stakeholders, including education, government and decision-makers, commerce and industry, the general public and the media, is a necessity.

1.5.1 Addressing the ignorance of science and the accessibility of science messages in South Africa

Many scientists are already engaged in promoting greater public appreciation and understanding of science, engineering and technology, but many are still unwilling to speak to the media about their work. Scientists have to accept that they must operate within the parameters and news values of the media. If they do not engage the media effectively, people with opposing views (anti-science) might jump at the opportunity to express their views. Silence and avoidance of publicity on the part of scientists would simply fuel the public's ignorance and mistrust of science (Joubert, 2001).

As stated previously, scientists are not the only role players in science communication. Communication specialists are responsible for building relationships with their institutions' stakeholders (of which the media constitute a major one) and they should assist scientists by providing guidelines on how to conduct interviews with journalists.

Communication specialists, as one of the key role players in science communication, have to cultivate a relationship of trust and mutual understanding with the other key role players in science communication, namely the executive management of HEIs, scientists and journalists. The executive management of HEIs have to formulate an overall strategy for communicating the science produced by scientists at their institutions. Scientists are the producers of science and, therefore, the senders of the science message, while communication specialists must facilitate the distribution process of science messages by mediation. It should be the task of communication specialists to simplify the messages to enhance mutual understanding between scientists and journalists, who should assist in conveying the correct science information to all stakeholders of HEIs.

This relationship of trust and mutual understanding between the key role players of science communication, as mentioned above, is imperative to convey positive and correct messages of science to the various stakeholder groups. However, without the stakeholders', and most importantly the general public's, positive attitude towards science and technology, all efforts at communicating science effectively and correctly could be in vain, since stakeholders would not be interested in listening to the message communicated to them. Although little research on the general public's attitude towards science has been performed in South Africa, results of these studies have demonstrated a positive attitude towards science and technology, but the implications of new developments in science and technology are not always fully understood by the general public (Blankley & Arnold, 2000:3).

In a developing country like South Africa, where many people are simply trying to survive, a basic understanding of some aspects of science may mean the difference between life and death. Water purification is one relevant example, since communities in the rural areas have a serious problem to purify water for drinking and cooking purposes. However, although running water from a tap next to the shacks in a township may be a scientist's solution to ensure purified water, the people of a specific community might not agree (Meyer, 2002:31). Resistance to science could even result from cultural differences. For example, many women in rural societies use the opportunity to fetch water from a river close by to have a conversation with other women in that same society, whom they would otherwise not have met.

1.5.2 The role of development communication in science communication in South Africa

In the realm of science communication, South Africa faces the problems of both a First World country, and those of an impoverished continent. Thus, it is important to focus on ways to achieve closer relationships between science, the general public and the media, to the benefit of science and all the people in South Africa. The necessity of mediation (the role the communication specialists can fulfil) between scientists and the general public becomes even more important.

Cultural differences, age differences, illiteracy and long distances from the cities where most of the developments take place (rural areas), play a role and affect the way in which the general public accepts new technologies and science discoveries as conveyed by the media (Meyer, 2002:31). To overcome these problems, development communication was implemented to enable inhabitants of rural areas in South Africa to participate in programmes to improve their daily lives. Development communication assists in bridging the gap between science, society, the media and different cultures. It also aims at participation, integration, collaboration, delegation, linkage, coordination and teamwork (Agunga, 1998:29). According to Malan (1998:52), development communication involves "... all forms of communication that are used for the improvement of an individual, community or country's material, cultural, spiritual, social and other conditions". The aim of development communication is to "... inform and motivate at national and local levels" (Snyman, 2002).

Two main paradigms determine communication in a development situation, namely the dominant paradigm and the new paradigm. In the communication field, these two paradigms are referred to as Development Communication (DC) and Development Support Communication (DSC) respectively.

The new paradigm and the DSC approach support the argument of community-centred development that will ultimately lead to sustainable development (Swanepoel & De Beer, 1997).

According to Agunga (1998:36), since 1989 a number of communication scholars have embarked on improving the professionalism of communication in development. Until 1998, the task of communication for development was left to extension workers, trained more in technical agriculture than in communication. There is a general feeling that project managers and policy administrators are handling the communication function in development poorly.

As early as 1983 Chambers (in Agunga, 1998:36) remarked that the management of rural development remained a 'blind spot' in the sense that there is hardly any institution of higher learning that prepares graduates specifically for development management. It is now 22 years later and the problem has not been solved. HEIs still do not prepare their graduates to communicate or to manage development. Due to a lack of management training, programme managers in a developmental context do not understand the dynamic and complex nature of the development process, nor do they have the communication skills to promote human behavioural change by helping beneficiaries to make appropriate use of the assistance provided (Agunga, 1998:38).

Communication management strategies are criticised from a DSC perspective, since such strategies are preoccupied with the needs of the communicator or the developer (sender), and do not take the needs of the beneficiaries (recipients) into consideration. According to Burger (1998:145), top-down, authoritarian, one-way communication and controlling stakeholders dominate the process by controlling the message, using the mass media from a centralised venue and keeping the power with the initial communicators. This is quite in line with DC-thinking, as stated by Burger (1998:145). In most cases the intention of the communicator or communication planner includes an element of persuasion. A typical DC approach will, therefore, be to diffuse information, but still aim at controlling the information that reaches the community, thereby retaining power. True participation, as suggested by the DSC perspective, however, does not take place, because the beneficiaries do not take final ownership of the message (Burger, 1998:146).

An example of the DC approach can be found in the Masakhane case study where nationwide roadshows were used to explain reasons for payment and to motivate rural societies to pay for their municipal services (Burger, 1998:146). These roadshows offer a suitable example of a DC campaign, mainly because of its inherent top-down communication methods. Other local case studies include the Nkomazi irrigation expansion programme, the Winterveld Development Programme and the Cape

Grassroots community media projects (Burger, 1998:146; Malan & Grossberg, 1998:173). Opposed to the aforementioned three projects, which experienced mostly communication problems, the Tswaing Crater Development Project was a successful project in terms of the communication process, since a facilitator contributed to ensure successful communication between role players.

The Tswaing Crater Project formed part of the Human Sciences Research Council (HSRC) Development Support Communication (DESCOM) programme of 1996 to 1997. The programme aimed to analyse, develop and test communication strategies that are used for community development and empowerment. The facilitator in the project played a crucial role in facilitating between all other role players in order to keep the development process on track and translate messages between the role players (Malan & Grossberg, 1998:173). Over a five-year period, communication at the Tswaing Crater Development Project has proved itself to be an exemplary model for culturally, environmentally and communally sensitive development communication, empowering the community to make its own decisions.

The Tswaing Crater Development Project can also be used as a model for empowering the rest of Africa's uneducated masses. According to Agunga (1998:29), Africa's largely uneducated masses must be empowered if they are to become major role players in the development process. Communication is essential to empowerment. Africa, with the assistance of South Africa and by learning from South Africa's experiences, can develop faster and be more sustainable if communication is given serious attention in the development policies of donor agencies and government leaders. Science communication is imperative to contribute to the development of rural communities. Understanding the importance of science to enhance living conditions is a necessity. In the process of conveying the science message from scientists to illiterate communities, communication specialists can play a vital role to facilitate the translation of scientific facts into simplified messages.

South Africa's government also realised the need of empowering uneducated segments of society and in 2002 South Africa hosted the United Nations World Summit on Sustainable Development (WSSD), known as the Johannesburg Summit. Although the focus was on sustainable development, a few scientists were involved in creating an awareness of science. The Johannesburg Summit has laid the groundwork and pavement for action. Yet, among all the targets, timetables and commitments that were agreed upon, there were no silver bullet solutions to aid the fight against poverty and a continuously deteriorating natural environment (Johannesburg Summit, 2002).

As an implementation-focused Summit, the Johannesburg Summit did not produce a particularly dramatic outcome, but some important new targets were established, namely:

- to halve the proportion of people without access to basic sanitation by 2015;
- to use and produce chemicals by 2020 in ways that do not have significant adverse effects on human health and the environment;
- to maintain or restore depleted fish stocks to levels that can produce maximum sustainable yields on an urgent basis, where possible, by 2015; and
- to achieve a significant reduction in the current rate of loss of biological resources by 2010.

However, it is not only the activities mentioned above that are required to empower rural communities with knowledge on science to improve the quality of their lives. Science must maintain a solid relationship with the society that supports it. Re-forging those ties with South African communities is perhaps the single most important challenge facing science in the immediate future. Educators and journalists have a role to play, but scientists too must recognise that they have a responsibility, according to the US Congress Report (1998).

Although science issues affect society as a whole, not all segments of society voice their opinion on the benefits or risks of scientific developments. Lack of interest, lack of information or lack of access to information can all lead to society feeling excluded from the crucial debates led by politicians on policy formulation, the introduction of new products to the market and the development of new technology that may cause risk to human beings and animals. Although science communication programmes and activities such as science festivals, the National Science, Engineering and Technology Week, various science-related olympiads, as well as competitions and exhibitions of science activities aim to address the lack of knowledge and understanding of science, they still do not always reach all stakeholders, especially people in rural areas, who are the main target groups for these activities.

Further in-depth discussions on development communication and the theories associated with it in addressing a specific stakeholder (for example, rural communities) of an HEI does not form part of this study.

1.6 WHY SHOULD SCIENCE BE COMMUNICATED IN SOUTH AFRICA?

As discussed in the previous sections, it is important to communicate science to ensure prosperity and a sustainable environment in South Africa. However, it is difficult to determine what to communicate

and what to withhold from the community to ensure security and safety. The HIV threat is a good example in this regard: should statistics on how many patients are affected by the virus be communicated to the public, causing major panic worldwide, or should the South African public rather be kept in the dark? To be able to make the best decision on how much science information or results of scientific studies should be conveyed to the public, it is important for South Africa to have a proper SET infrastructure to be able to make decisions to the benefit of everyone in South Africa. For example, the establishment of a discreet scientific board that includes representation from all levels of society and the media would allow the general public to receive correct, important and necessary information about science (Joubert, 2001).

The Australian Department of Industry, Science and Tourism (1996:3-6) suggests the following reasons why scientists all over the world should be allowed to communicate information related to scientific developments:

- to transfer to society or industry the benefits of research;
- to inform policy-makers and leaders about progress that can advance the interests of the community;
- to prepare the public for the advent of new technologies and technological change;
- to share with industry, other scientists and users the findings of research and experience, so they may be combined into a workable technology;
- to bolster economic competitiveness and a lower reliance on imported technological solutions;
- to remedy, and if possible avert, environmental damage caused by the unwise use of technology and resources; and
- to involve the next generation in technological progress appropriate to their evolving society.

In addition to the above reasons, the South African Ciba Foundation Conference report (1987:3) provides several reasons why science should be communicated and promoted in South Africa:

- knowledge of science will result in the electorate making better political decisions;
- understanding the basis of modern science and technology brings economic returns;
- scientific knowledge will eliminate superstition and non-rational views of the universe;
- scientific knowledge defines consequences of behaviour and knowledge will change behaviour; and
- familiarity with the scientific method will lead to a more ethical worldview.

Joubert (2001) argues that in a diverse country such as South Africa, with its 11 official languages and various cultural groups, it is necessary to know what should be achieved and who should be reached with science communication. In her opinion, effective science communication can help in the following ways:

- It can communicate the specialised outcomes of research within the science community itself. Scientists must know about critical areas for development in disciplines other than their own, and be aware of South Africa's role in international collaborative research projects.
- It can gather the support of decision-makers and policy-makers in government and industry, thus ensuring financial and political support for science and technology.
- It can demystify science for people who are not scientists, but who are literate and economically active. The general public should understand enough about science and technology to make informed decisions and improve their quality of life. Their support for scientific research, moreover, is crucial for the growth and expansion of science and technology.
- It can interest young people in career opportunities that ensure the future skills base of the country in science and technology, and enable future entrepreneurs to use science and technology productively.

South African born Mark Shuttleworth is a walking example of how young children can be motivated to become aware of the importance of science. More such examples are required to promote science, especially to the younger generation. All over the world, science can be regarded either as a source of hope or as a threat, and only by communicating it clearly to the public, can the fear of science be reduced (National Association of Science Writers, 2001).

According to Paterson (2004:19), science communication in South Africa is essential, dynamic, challenging, exciting and rewarding. He believes that science communication adds to the quality of life; the quality of the future workforce; public and political support; and the establishment of science as culture and heritage. To demonstrate the essentials of science communication, Paterson (2004:19) summarises the characteristics of science communication, stating what it is and what it is not (see Table 1.1).

Table 1.1: Science communication in South Africa

SCIENCE COMMUNICATION IS NOT	SCIENCE COMMUNICATION IS ABOUT
Promoting an institution	Dialogue
Glorifying science without asking questions	Engagement
One-way flow of information	Respect for audience and context
	Science and how it matters to society
	Scientists as key actors

Source: Paterson (2004:18)

The description of the characteristics of science communication in the above table inevitably suggests the next important element of science communication – the responsible senders of science communication.

As suggested by Joubert (2001), science communication should be the responsibility of everyone involved with science in one way or another. The following are some examples of South African institutions that have representatives acting as practitioners of science communication:

- Government / Government agencies
- South African education institutions
- Science centres and museums
- Science-funding agencies
- Scientific institutions and societies

In South Africa, the Government has specifically tasked the Department of Science and Technology to assist the scientific community, the HEIs, various private and non-governmental organisations, companies, individuals, the media and society at large in promoting, conveying and receiving the message of science.

South African education institutions are encouraged to participate in various roadshows, mobile science demonstrations, science festivals and visits to laboratories and science centres to demonstrate the benefits of science to learners. Various science centres and museums are open to the general public and are located in all the capital cities in the various provinces to convey the importance of science to the whole nation.

Science-funding agencies have been established to provide the necessary funding and contribute to the financial needs of science activities all over South Africa. Scientific institutions and societies are mostly functionaries that assist in providing human resources, material and other assistance with regard to science activities where and when required.

Current science activities and venues in South Africa include the Gateway Discovery Centre Trust, better known as the Discovery Centre, National SET weeks, Sasol TechnoX and SciFest, science centres, planetariums, and mobile science centres, such as the Tsebo Koloing (meaning "technology in motion") truck of the University of Pretoria.

Although these science activities are initiated by government, science organisations, schools, HEIs and scientists, they are not the only ones who are responsible for communicating science. Industry and the media should also contribute towards communicating science to the general public (Joubert, 2001).

According to Joubert (2001) South Africa offers unique opportunities for promoting an interest in, awareness of and curiosity about science. These opportunities include magnificent night skies, environmental diversity and a rich fossil heritage. Archaeology, palaeontology and astronomy are recognised as premium channels for switching on the curiosity of children and luring them into science and technology.

However, there is unfortunately not a sustained, coordinated effort to communicate science, with the result that communication about current science initiatives such as science festivals occurs largely on an *ad hoc* basis. A more sustained and coordinated effort, backed by research, infrastructure and expertise, could put South Africa's science communication on the map.

Practitioners of science communication (scientists, communication specialists and journalists) lack a network and therefore work largely in isolation. Their activities compete with, rather than complement one another, and therefore have little national impact and attract sparse media attention (Joubert, 2001).

1.7 ORIENTATION TO THE RESEARCH PROBLEM

Defining the research problem is perhaps the most important responsibility of the researcher (Dillon, Madden & Firtle, 1993:25). It is the responsibility of the researcher to assure that the problem at hand is defined accurately and precisely.

The problem at hand in this study is that although science communication is regarded as a priority, science messages do not reach the general public effectively. There are various possible reasons why the general public is not well informed about science. One of the reasons is that scientists find it difficult to simplify scientific facts for the layman to understand. Secondly, there is no relationship of trust and mutual understanding between scientists and journalists, resulting in inaccuracies in science articles in newspapers, magazines and television. Thirdly, communication specialists at HEIs, who are supposed to take responsibility for media liaison, experience a lack of trust and empowerment by their executive management to liaise with stakeholders, including the media, at their own discretion. Executive managements at HEIs do not empower their communication specialists to discuss matters with the media without having the executive management involved (De Beer, 2001:84). Fourthly, a lack of training in writing science articles results in inaccurate coverage of science in the media. The role of communication specialists at HEIs is therefore very important. It must be the task of these communication specialists to build a bridge between an institution's management, scientists and the media as stakeholder of HEIs.

For the purpose of this study, a distinction is made between key role players in science communication and stakeholders of HEIs. Stakeholders refer to every person receiving science messages from an HEI, while key role players refer to people involved in the distribution of science messages (i.e. the executive management, scientists, communication specialists at HEIs and the mass media). Since science communication has been identified as a high priority by government, the editors of newspapers must also recognise the importance of science and should pay attention to science when determining the agenda-setting function. Science should be a highly prioritised item on the agenda. Although editors form an integral part of the mass media, for the purpose of this study, only journalists were included, since they are the writers of science articles and are also the first contacts when dealing with the media.

1.7.1 The role of key role players in science communication

In any higher education institution, science is of high importance and it is fully supported by executive management. However, the perception exists that although executive management supports research and science, the communication of science to stakeholders is not regarded as a priority.

According to Dozier *et al.* (1995:128), key to communication excellence and effective science communication is the support of executive management, in other words a management that trusts and empowers its communication specialists to communicate with all stakeholders. Executive management constitutes the outside layer or supporting system of the sender (scientists) and the facilitators (communication specialists) of science communication. It is, therefore, imperative that executive management relies on communication specialists to provide the expertise, knowledge, opinions and behavioural predispositions of all stakeholders of an institution.

Scientists often claim that they do not have the marketing skills and/or personality needed to communicate science to non-scientists. Scientists are originators, and therefore the senders of the science message. They therefore constitute an essential component of the science communication relationship between the key role players.

Communication specialists at HEIs also have a very important role to play in making the work of scientists known to stakeholders, including schools, students and the general public. In other words, the communication specialists are the facilitators in the communication process. It is their duty to mediate the communication process between the originators or senders (the scientists) and the final destination of the message, namely the various recipients. Although communication specialists agree that this is a huge responsibility, members of the executive management of these institutions often obstruct the communication specialist's efforts to communicate with the media, since the communication specialist is not trusted or empowered by the HEI to use his/her own discretion to convey scientific matters.

According to Grunig (1992:485), power comes to communication specialists from different sources. The value that executive management attaches to the communication function is one key way, while the expertise of specialists, leading to increased professionalism, is another.

Another very important component lacking in many educational institutions is trust in communication specialists to act correctly when dealing with the media. Axley (1996:161) states that trust is one of

those qualities that affects almost everything of importance about human relationships. The actions of trusted people have a different meaning than the actions of distrusted people. Distrust taints everything it touches in a team: communication, leadership, decision-making, problem-solving, even a team's very culture, if it persists long enough. Relationships based on "positive" power resources such as trust, liking, respect and love are both more effective and efficient. Such relationships can themselves be excellent motivators to accomplish agreed-upon goals (Axley, 1996:81).

Communication specialists at HEIs are often tasked with the organisation, participation in and management of science activities. They also constitute a very important link between scientists and journalists. Without the communication specialist who is responsible for editing science articles from scientists; establishing contact with journalists of the various media; being responsible for building relationships with stakeholders, the general public and students; and conveying the image of the institution, a relationship between scientists and journalists alone will not be completely successful. Furthermore, an important question to ask is, in their role as facilitators and spokespeople of HEIs, are communication specialists regarded as strategists, managers or technicians in carrying out their task of science communication at their respective institutions? According to Steyn and Puth (2000:20), the strategist role, which is played at the macro or top management level of an organisation, is to constitute a strategic role for the most senior corporate communication specialist responsible for the corporate communication function. In science communication, could it be argued that the executive management should fulfil the role of a strategist?

The manager role, played at the functional, departmental or divisional level of an organisation, is to develop a corporate communication strategy and policy for the organisation. It is the manager's role to decide what should be communicated to stakeholders to solve problems that have developed in the relationship with stakeholders. Could this be the function of communication specialists in science communication?

The same questions could apply to communication specialists at HEIs who are responsible for the science communication plan and strategies to achieve the institution's objectives. If these questions are answered affirmatively, it would be the role of the manager (communication specialists) to implement the standards set by the strategist (the executive management) in developing the relationship with stakeholders. The role of technician is played at the implementation or programme level. This person would be responsible for implementing communication plans or campaigns directed

at the organisation's stakeholders (Steyn & Puth, 2000:20). In science communication, could the communication specialist perhaps also have to play the role of technician?

Although the media can be the channels through which the science message is conveyed, journalists and editors (especially the latter) are also the gatekeepers in the science communication process. As gatekeepers, they decide what information will eventually reach the audience through the mass media. Each individual in society will receive messages from the mass media through filters or frames of reference. These filters may have either a positive or a negative effect on the message received (De Beer, 1998:17).

The role of the editor is to decide which articles will be published and what the main article will be, opposed to the journalist who writes the articles. The editor bases his decision on what will appear in the news on the articles written by the journalist. Therefore, if the journalist writes articles that are not in the interest of the general public or are not understandable by the audience, the editor will not publish the articles. Journalists also fulfil a gatekeeper's function, because they need to determine whether a particular event is newsworthy or not. Should they decide that an event is newsworthy, it is imperative that the facts are correct and are correctly interpreted by the journalists.

Training on how to write science articles that can be understood by the general public is specifically important when a journalist has to report on scientific developments and research results. It is only once scientists, communication specialists and journalists are properly trained in writing science articles, that the integrity of science representation can be maintained (Priest, 1998). Currently there seems to be a lack of training courses in South Africa to enable journalists to write proper science articles.

Unfortunately, some scientists still doubt the ability of journalists to report accurately and responsibly on their work, while journalists complain that scientists are bad communicators, hiding behind jargon. This misunderstanding between scientists and journalists leads to concerns about the relationship (or lack of a relationship) between scientists and journalists. This misunderstanding is also linked to a lack of proper training to enable journalists to write factually correct and reliable science articles. Since neither scientists nor communication specialists or journalists are usually properly trained to perform media interviews with regard to science, facts are skewed or oversimplified when printed in newspapers, which has a negative effect on the recipients (stakeholders). Again, the role of the

communication specialist is highlighted to facilitate a proper relationship by fulfilling a mediation function in the science communication process.

1.7.2 The relationship between key role players in science communication

The end receiver of the science message is the general public or other stakeholders of the HEI, including even the specific HEI's competitors. Since the general public, as one of the stakeholders of the HEI, has been identified by the South African government to be the recipient of science communication, the focus in this study is on the general public as the end recipients of the science communication message. However, the second phase of the study focuses on the mass media, as another stakeholder of HEIs.

The stakeholders are not only the recipients of science communication, who should be provided with information regularly, preferably on an interpersonal basis. It is also important that their input be requested and considered when science communication activities are discussed. This is necessary to ensure a proper two-way flow of information between HEIs and their stakeholders.

Furthermore, it is imperative for communication departments to be aware of the expectations and perceptions of stakeholders before possible problems arise (Steyn & Puth, 2000:203). In any institution, company or organisation[2], communicating with relevant stakeholders remains a critical component of excellent communication departments, especially when specific messages should reach identified stakeholders, such as in communicating science to them.

To enhance the promotion of science communication to all stakeholders, including cultural groups, the literate and illiterate segments of society in South Africa, it is important that a relationship of trust should exist between key role players, namely executive members at HEI, scientists, communication specialists at HEI and journalists. Without a positive and working relationship between these role players, the science message will not reach other stakeholders effectively.

Ledingham and Bruning (2000:178) quote Berko, Rosenfeld and Samovar in defining the term relationship as follows: "The connection that exists when the interactants are aware of each other and take each other into account; there is some exchange of influence and there is some agreement about

[2] Although institution, company or organisation will be used alone or exchanged for one of the other two concepts throughout the study, the use of one will each time refer inclusively to all three.

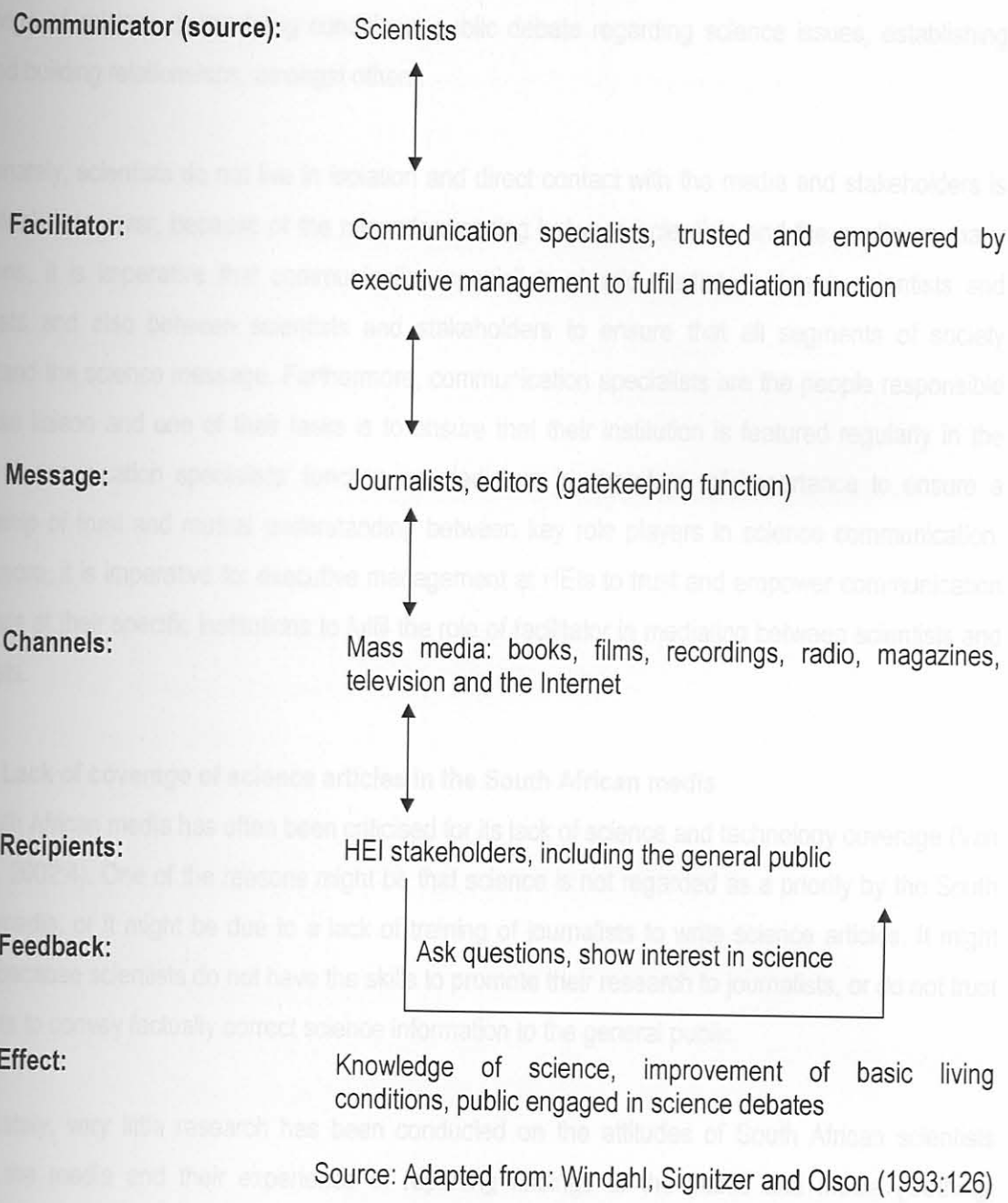
what the nature of the relationship is and what the appropriate behaviours are, given the nature of the relationship."

Because relationships can have a powerful influence on media decisions and perceptions or satisfaction, communication specialists should develop relationship programmes grounded in relationship dimensions such as those of trust, openness, involvement, investment and commitment (Ledingham & Bruning, 2000:169). These relationship programmes must be designed to provide benefit to both the institution and the key public. Borchelt (2002:19) suggests a 'portfolio of trust' including elements such as competence, integrity and dependability, which should be controlled by role players in any successful relationship.

This is not only applicable to this study, but also particularly important in science communication and in the relationship between the key role players, since it suggests that the cornerstone on which relationships are built is trust (Ledingham & Bruning, 2000:169). All role players in science communication at HEIs should, therefore, engage in relationship-building activities, actions and communication.These activities build the role players' credibility, reputation, reliability and dependability, as well as promoting honest communication and active participation in the relationship. However, for many, the relationship between scientist and journalist remains difficult, sometimes even hostile. Overcoming the "us and them" dynamic, therefore, requires commitment from both parties, and communication specialists at HEIs should act as facilitators to improve this relationship.

Figure 1.1 is adapted from a model by Windahl, Signitzer and Olson to illustrate the flow of communication (Windahl, Signitzer & Olsen, 1993:136). Figure 1.1 attempts to accommodate the proposed flow of communication in science communication at HEIs.

Figure 1.1: A proposed illustration of the flow of science communication at HEIs



Source: Adapted from: Windahl, Signitzer and Olson (1993:126)

In Figure 1.1, scientists (as the source) generate science and through the facilitators (communication specialists who mediate the communication process) the message is conveyed to the media. The journalists and editors, who are supposed to distribute the message to the recipients (all HEI stakeholders, including the general public), are also gatekeepers. The editors have the power to decide whether the science message is important enough to be distributed. This decision forms part of the agenda-setting function of editors. The journalists decide on the content of the message (article) and determine what facts to be included. Therefore, it is critical for journalists to receive training in

science writing. Stakeholders, including the literate and illiterate, urban and rural societies, as well as old and young people, provide feedback on the message they have received. The effect should be knowledge of science, better living conditions, public debate regarding science issues, establishing trust and building relationships, amongst others.

Unfortunately, scientists do not live in isolation and direct contact with the media and stakeholders is unavoidable. However, because of the misunderstanding between scientists and the media on many occasions, it is imperative that communication specialists should mediate between scientists and journalists and also between scientists and stakeholders to ensure that all segments of society understand the science message. Furthermore, communication specialists are the people responsible for media liaison and one of their tasks is to ensure that their institution is featured regularly in the media. Communication specialists' function as mediators is, therefore, of importance to ensure a relationship of trust and mutual understanding between key role players in science communication. Furthermore, it is imperative for executive management at HEIs to trust and empower communication specialists at their specific institutions to fulfil the role of facilitator in mediating between scientists and journalists.

1.7.3 Lack of coverage of science articles in the South African media

The South African media has often been criticised for its lack of science and technology coverage (Van Rooyen, 2002:4). One of the reasons might be that science is not regarded as a priority by the South African media, or it might be due to a lack of training of journalists to write science articles. It might also be because scientists do not have the skills to promote their research to journalists, or do not trust journalists to convey factually correct science information to the general public.

Unfortunately, very little research has been conducted on the attitudes of South African scientists towards the media and their experience of reporting findings to the public and media (Gething, 2001:4).

1.8 PROBLEM STATEMENT

The problem in this study is that the message of science is not effectively communicated to the general South African public, including both the literate and illiterate; urban and rural; young and old segments of society, by key role players in science communication, because the relationship between these key role players in science communication in this country has not yet been established as a relationship of trust and mutual understanding.

1.9 CLARIFICATION OF TERMS AND DEFINITIONS

In the previous sections, certain terms and definitions were used, such as science communication, key role players, stakeholders, etc. However, for the sake of uniformity, these terms and definitions have to be clarified.

1.9.1 The relationship between communication, science and science communication

The essence of science communication has been discussed in detail previously in this chapter. However, to summarise, science communication means to convey messages of science-related issues to the non-scientific population, but what is the relationship between communication and science?

In describing approximating or achieving conveyance of a message, the word **communication** is used to refer to an outcome or end-effect (Mody, 1991:41). Another use of the term refers to the process (Axley, 1996:11). The word 'communication' comes from the Latin *communis,* which means 'common'. The word 'community' comes from the same Latin word. The aim of communication as an outcome is to 'make common', to share. Communication is achieved when the sender and the recipient have meaning in common, i.e. when the meaning the sender wanted to share is identical to the meaning the audience receives (Mody, 1991:41).

According to King (2002:1), there is not a single definition for **science**, but science can be described as:

- theory, conjecture, experiment, observation, etc;
- a social construct put together over many centuries by people, each with limited cognitive capabilities, but in a manner following norms and principles.

Fetzer (1993:5) suggests that science aims to discover the laws of nature (such as erosion of ground water tables), which can provide a foundation for empirically testable explanations. It also hints that science is descriptive. Another definition reads: "Science, to put its warrant as concisely as possible, is the organised, systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable laws and principles" (Ridley, 2001:21). Nelkin (1987:21) offers a variation of the definition and describes science as the superior form of knowledge; and those who have reached its pinnacle have some special insight into every problem.

For clarification, in this study science is referred to as any new idea, concept, experiment or product that was in one way or another systematically obtained and tested according to a known and acceptable method that has an influence on society at large. This includes anything from a new mathematical rule to an innovative technological device. **Science communication** can then be seen as sending messages of these new developments to the general public, including children and the illiterate and literate segments of society.

To facilitate the process of science communication, science communication activities and programmes were identified to promote science to the general public. These activities provide hands-on experiences to the general public to explore the application of science by playing, touching and experimenting certain sciences and include, amongst others, the following South African examples:

- Science weeks (where schoolchildren participate in science experiments).
- Science festivals (displays of science experiments, talks and hands-on science experiments open to the general public).
- Science centres (displays of science experiments, hands-on science experiments to play with for groups of schoolchildren and anyone else interested in science).
- Mobile science centres (e.g. the Starbus of the South African Astronomical Observatory and the University of Pretoria's mobile technology laboratory, Tsebo Koloing).

1.9.2 The relationship between all stakeholders and key role players in science communication

In this study, **stakeholders** refer to the general public, composed of non-scientists, government, private companies, the illiterate and literate segments of society, and the media, to name but a few. In comparison, the key role players in science communication include executive managements, scientists and communication specialists at South African HEIs, as well as the media, specifically South African journalists. For the purpose of this study the term **executive management** includes the Rector (Principal) and Vice-Rectors (Vice-Principals) at HEIs in South Africa.

In 1902, Huxley defined scientists as wizards and magicians, socially isolated from society. "The scientist appears akin to the medicine man ... the multitude thinks of him as a being of quasi-supernatural and romantic powers". Today scientists still appear to be remote, but superior wizards, above ordinary people, culturally isolated from society (Nelkin, 1987:14). However, although perceptions of scientists differ, the fact remains that they do such specialised and important work that they operate outside a common intellectual or cultural tradition (Nelkin, 1987:20).

In the present study, the term **scientists** refer to the experts at HEIs who explore, investigate, discover and design new ideas, concepts and devices in the natural, medical and agricultural sciences, as well as in the engineering and technology fields.

A **communication specialist** is defined as the person who is responsible for marketing, internal and external communication, media liaison, public relations and stakeholder relationships within an HEI in South Africa. The **journalist** is the person who writes articles on subjects covering education, environment, health and general news. Science in itself, depending on the type of media, is normally not a category on its own, and in most mass media in South Africa, any science news is categorised according to one of the four categories mentioned above, namely education, environment, health or general news. For the purposes of this study, media also refers to mass media and the two terms are used interchangeably. Mass media implies messages that are distributed to a mass of people at the same time. The words, print media and press both refer to print media, such as newspapers and magazines. Once again, the two terms are used interchangeably.

Editors and journalists are part of the media, since they are the representatives of the media. Editors are the agenda setters, as editors decide which articles should appear in the printed media and which should not, while journalists are gatekeepers, since they decide on the content of a particular article and whether it is newsworthy enough to report on.

Due to the importance of distributing the message of science effectively, a relationship of trust and mutual understanding between all the key role players in science communication is vital.

1.10 AIM AND OBJECTIVES

1.10.1 General research aim

The general research aim of this study is to investigate the relationship between key role players in science communication and to determine the role of the key role players in science communication. The key role players refer to executive management, scientists and communication specialists at HEIs, as well as South African journalists.

Following from the general research aim, six research objectives have been identified. The first objective pertains to how important science communication is to key role players, these being executive management, scientists, communication specialists at South African HEIs and South African

journalists. The second objective addresses the relationship between these key role players. The third involves the role of communication specialists in science communication. Specific focus on the three levels of communication specialists as mentioned above, namely strategists, managers or pure technicians, will contribute to determining the requirement of the role of communication specialists in science communication. The fourth objective addresses the training of scientists, communication specialists and journalists in conveying the science message to other stakeholders of HEIs. The fifth objective pertains to the coverage of science in selected print media in South Africa, while the sixth concerns the content of scientific articles that appeared in selected South African print media over a three-month period. A comparison with a study conducted in 2002 by Van Rooyen (2002:1) is also done. The fifth and sixth objectives are included in the study to determine the success of communication specialists in their relationship with the media. One of the responsibilities of communication specialists is to ensure that science is communicated to the media. If the coverage is sufficient, it will imply that communication specialists have succeeded in their task of building a relationship with the media. For ease of reference, the research objectives are stated next.

1.10.2 Research objectives

- **Objective 1:**
  To determine the importance of science communication amongst key role players of science communication, (executive management, scientists, communication specialists) at HEIs in South Africa, as well as journalists in the South African media.

- **Objective 2:**
  To determine if a relationship of trust and mutual understanding exists between key role players in science communication in South Africa.

- **Objective 3:**
  To determine if the role of communication specialists is a role of strategist, manager or technician in the facilitation process in science communication at HEIs in South Africa.

- **Objective 4:**
  To determine the extent of training provided at universities and technikons in South Africa for scientists, communication specialists and journalists to enable them to write science articles.

- **Objective 5:**
  To investigate the coverage of scientific topics in articles in the South African mass media.

- **Objective 6:**
  To analyse the content of articles on science in selected South African media from 1 March to 31 May 2004 and to compare the results of this study with Van Rooyen's study conducted in 2002.

Cooper and Schindler (2001:14) stated that the term 'empirical' points to the requirement for the researcher to test subjective beliefs against objective reality and have findings open to further scrutiny and testing. In this study, empirical research is used to test the six objectives stated above.

1.11 CONCEPTUAL FRAMEWORK

By stating the general aim in relation to possible sources for solutions, the theoretical and empirical logic of this study is clarified. The nature of the research problem necessitates a brief explanation of the interrelatedness of the domains within which this study falls, as well as the various theories that govern this study. These domains and theories are summarised in Figure 1.2 and are discussed below and later in the study.

1.11.1 Meta-theoretical approach

The meta-theoretical approach applicable to this study is systems thinking within a systems approach.

The systems approach is an abstract perceptual framework that is an exceptionally good aid to understanding and practising communication. The approach identifies the principles common to all systems, the most important of which are wholeness, hierarchy, self-regulation, openness and adaptability (Lubbe & Puth, 1994:41).

The development of the general systems theory is one manifestation of the fundamental changes in the nature of scientific analysis. Rather than investigating the universe in a cause-and-reaction frame of mind, researchers have realised that any cause-and-reaction relationship takes place in a more complex system of relationships. Nothing is analysed in isolation, but in terms of its relationship with others within a larger system (Turner, 1991:118).

These systems of inter-influential happenings indicate that the whole is larger than the sum of its parts. Among the modern scientists, Ludwig von Bertalanffy was the first to advocate a general systems approach. Various other scientists joined in and the groundwork was established for the general systems theory (Turner, 1991:118).

The theories on which the theoretical framework is based in the theoretical part of this study can be summarised as: Science communication as information (information theory, Chapter 2) that has to be communicated to stakeholders (stakeholder theory, Chapter 3) through mediums such as mass communication (mass communication theory, Chapter 2). However, to achieve science communication successfully, strategic science communication planning is required. Therefore, the general theory of excellence in public relations/corporate communication management and corporate communication strategy are discussed in Chapter 4. To conclude the theoretical framework, the roles of the key role players in science communication are discussed in Chapter 5.

1.11.2 World view

According to Steyn and Puth (2000:188): "interactivity implies communication and communication has the natural consequence of relationships". Relationships will last when the needs and objectives of stakeholders are positively matched with the needs and objectives of the institution.

Theories of organisational relationships support the idea that there is a functional connection between the quality of communication – the excellence of public relations – and the nature of relationships between organisations and their stakeholders (Steyn & Puth, 2000:195). According to Dozier *et al.* (1995:82), the excellence study (which is discussed in detail in Chapter 4) should confirm or modify that connection.

Ferguson (in Dozier *et al.*, 1995:83) identifies attributes of relationships to define and measure the quality of an organisation's relationships with stakeholders:

- dynamic vs static relationships;
- open vs closed relationships;
- the degree to which both the organisation and stakeholders are satisfied with the relationship;
- distribution of power in the relationship; and
- the mutuality of understanding, agreement and consensus.

Like all partnerships, stakeholder collaboration is a two-way working relationship that combines the capabilities of partners for their mutual benefit. Since knowledge is such a fluid, intangible asset that can be transferred easily, and since its value increases when it is shared, it provides powerful justification for stakeholder collaboration. Stakeholder collaboration does more than gain resources and political support: it allows joint problem-solving to increase the institution's store of valuable knowledge of scientific developments (Halal, 2000).

Dozier *et al.* (1995:83) and Grunig and Hon (1999:8) suggest that the value of public relations can be determined by measuring the quality of relationships with stakeholders where value indicates trust and credibility.

1.11.3 Domains

The essence of the general aim falls within two domains, namely science communication and strategic communication management.

Dimensions such as the importance of science, the role of each key role-player at HEIs, the specific role of the communication specialist as facilitator of the communication process, the participation of internal and external stakeholders, and the relationship between the role players within the context of the research objectives all point to the two domains of this study.

1.11.4 Theories

The specific theories relevant to this study are explored in chapters 2 to 5. These theories include the communication theory, information theory, mass communication theory, stakeholder theory, the general theory of excellence in public relations/corporate communication management, the gatekeeper theory and, to a lesser degree, the agenda-setting theory.

1.11.5 Major concept

The major concept is derived from the general aim and is thus defined as "the role of key role players in science communication". This concept is further explored in chapters 4 and 5.

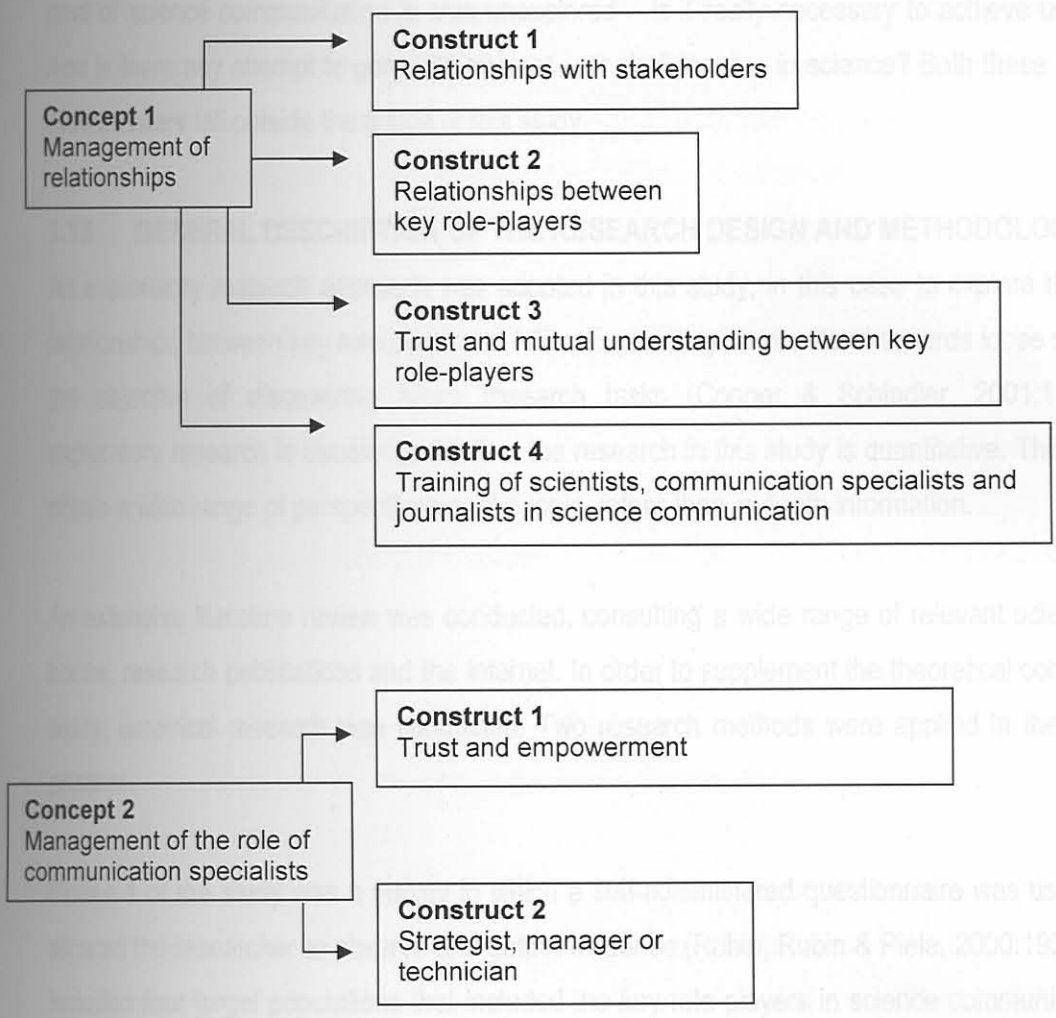
Figure 1.2: Conceptual framework

Meta-theoretical approaches	Systems thinking ⇩ Systems approach	
World view	Relationship management within a communication approach	
Domains	Science communication	Strategic communication
Theories	• Communication theory • Information theory • Mass communication theory • Gatekeeper theory • Agenda-setting theory	• Stakeholder theory • General theory of excellence in public relations/corporate communication management • Corporate communication strategy
Major concept	The role of key role players in science communication	
Concept 1	Management of relationships	
Constructs	• Relationships with stakeholders • Relationships between key role players • Trust and mutual understanding between key role players • Training of scientists, communication specialists and journalists in science communication	
Concept 2	Management of the role of communication specialists in science communication	
Constructs	• Trust and empowerment • Strategists, managers or technicians	

1.11.6 Concepts and constructs

The purpose of academic research is either to develop new theory, or to change or expand existing theory. In this study, communication theories are used to apply existing theory to science communication. Empirical research is applied to measure the building blocks or concepts. Concepts are generally accepted as bundles of meanings or characteristics associated with certain events, objects, conditions, situations and behaviours (Cooper & Schindler, 2001:39). However, a bundle of meanings do not provide a clear framework for research. Therefore, constructs are used to turn these bundles of meaning into an image or idea specifically invented for a given research and/or theory-building purpose (Cooper & Schindler, 2001:41). In this study each concept is linked to the major concept and the constructs derived from these concepts contribute to the empirical investigation of the research objectives. As illustrated in Figure 1.2, two concepts with their constructs are identified. For ease of reference these concepts and constructs are represented in graphic format in Figure 1.3 and are discussed afterwards. Emphasis is placed on the relationship between the key role players, since they are the core elements to communicate science and in their successful relationship the other constructs are intermingled.

Figure 1.3: Conceptual framework underlying this study



1.12 DELIMITATION OF THE STUDY

The study is exploratory in nature due to the fact that limited prior research has been conducted in South Africa on this topic. Since the study focuses only on South African HEIs, the results and recommendations may not be generalised to a wider context.

Stakeholders (recipients of science messages) of HEIs include the general public, consisting of a wide variety of social groups, for example the government, schools, students, the illiterate and literate segments of society, industry, the media and parents, to name but a few. Because the key role players in science communication are also stakeholders of HEIs and due to the fact that this study is exploratory in nature, only key role players as representatives of all stakeholders were included in this study.

The politics of science communication has barely been explored. People must still be empowered to ask the right questions, challenge decision-makers, and hold government accountable. The ultimate goal of science communication is also unexplored – is it really necessary to achieve understanding? And is there any attempt to generate interest – or confidence – in science? Both these questions and their answers fall outside the scope of this study.

1.13 GENERAL DESCRIPTION OF THE RESEARCH DESIGN AND METHODOLOGY

An exploratory research approach was adopted in this study, in this case to explore the role of and relationships between key role players at HEIs. Exploratory studies tend towards loose structures with the objective of discovering future research tasks (Cooper & Schindler, 2001:134). Although exploratory research is usually qualitative, the research in this study is quantitative. The purpose is to obtain a wide range of perspectives on the topic, rather than in-depth information.

An extensive literature review was conducted, consulting a wide range of relevant scientific journals, books, research publications and the Internet. In order to supplement the theoretical component of the study, empirical research was conducted. Two research methods were applied in the two research phases:

Phase 1 of the study was a survey in which a self-administered questionnaire was used, because it allowed the researcher to observe and gather evidence (Rubin, Rubin & Piele, 2000:193). The sample included four target populations that included the key role players in science communication, namely executive management, scientists and communication specialists at HEIs, as well as journalists. Data collection was done by means of an electronic questionnaire survey, with only close-ended questions. Descriptive statistics were used to analyse the data obtained. Results are presented graphically by means of tables and bar charts.

Phase 2 of the study was conducted by means of content analysis. According to Lindenmann (1997:398), media content analysis is defined as the process of studying and tracking what has been written and broadcast, translating this qualitative material into quantitative form through some type of counting approach that involves the coding and classifying of specific messages.

Therefore, the research conducted by the content analysis was quantitative in nature to gain a wide range of perspectives on the topic of science communication. These perspectives included the amount of coverage, local vs foreign sources, coverage according to 'new discoveries' and 'feature' articles, evaluative tone of coverage, use of visuals and infographics, discourse of benefits and risks,

prominence of coverage and weighting of the scientific fields covered. The unit of analysis was science articles for the period 1 March to 31 May 2004. The sampling frame was the printed media, which was divided into three groups: daily newspapers, weekly newspapers and family magazines. Data collection was done by selecting science articles in the selected sampling frame on a weekly basis and compiling a unique electronic database. Data analysis was done by predetermined categories, which were coded to be analysed statistically with the help of an SAS statistical programme. The results are presented in table format and bar charts, and they are compared with a similar study conducted in 2002 (Van Rooyen, 2002:3).

1.14 THE IMPORTANCE OF THE STUDY

Science communication is still a new and vague concept to many South Africans. Limited research has been conducted on the key role players of science communication, the specific role of communication specialists at HEIs in science communication, as well as on the relationship between the key role players.

This study aims to contribute to the body of knowledge in science communication in three ways. Firstly, it describes the current state of science communication and the importance of science communication for South Africa. This is followed by a discussion of the facilitator role of communication specialists in science communication and the value they can add in general regarding the promotion of science communication and the increase in the volume of science communication in the country. Thirdly, an explanation is offered on the relationship between the key role players that can ensure the improvement of science communication in South Africa.

1.15 DEMARCATION OF CHAPTERS

This study comprises eight chapters, including the current chapter. Table 1.2 provides a summary of the demarcation and content of each of the chapters.

Table 1.2: Demarcation and content of chapters

CHAPTER	CONTENT
Chapter 1: Orientation and background	The reader is introduced to the problem that the study investigates. An overview is provided of the research objectives, research design and literature. The conceptual framework underlying the study is also described.
Chapter 2: The development of science communication	Besides the history and development of science communication, the tools for communicating science are also discussed. A description is offered of the theories on which the science communication domain is based, namely information theory and mass communication theory.
Chapter 3: The general public's awareness and attitudes towards science	Previous studies conducted in various countries to analyse the public's attitude towards science are quoted and compared to studies performed in South Africa. The stakeholder theory, which provides an important theoretical base for this study, is also included.
Chapter 4: The strategic management of science communication	Perspectives on communication strategy and its importance in science communication are discussed. The excellence study in public relations and strategic management and the role of communication departments are also explained.
Chapter 5: The key role players in science communication	The role of each of the key role players in science communication is described and their relationship with the media is outlined. The gatekeeper theory and the agenda-setting theory that underpin the theoretical framework are also described.
Chapter 6: Research methodology	The research methodology followed in this study is described in terms of research strategy, design, methods and techniques.
Chapter 7: Research results and interpretations	Results of Phase 1 (the survey), as well as of Phase 2 (content analysis) are provided and interpreted.
Chapter 8: Conclusions and recommendations	Conclusions are drawn from both the theoretical and empirical components of the study. Recommendations for future research are made.

The demarcation of chapters is illustrated visually in Figure 1.4. Chapter 1 is central to the study, since it provides an introduction and background to the study. Chapters 2 to 5 follow in sequential order and represent the theoretical component of this study. Chapters 6, 7 and 8 deal with the research methodology, research results and interpretations, and conclusions and recommendations respectively. There is a constant interplay between Chapter 1 and chapters 6, 7 and 8, as illustrated by the double arrow, as well as between chapters 6, 7 and 8.

Figure 1.4: Demarcation of chapters