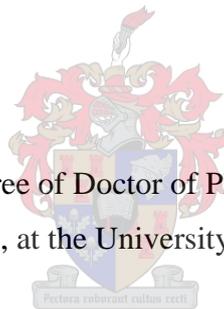


**The stars in our eyes: representations of the Square Kilometre Array telescope in the
South African media.**

by Michael Gastrow

Dissertation presented for the Degree of Doctor of Philosophy in the Faculty of Arts and
Social Sciences, at the University of Stellenbosch



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O ctej "4237

Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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Abstract

The Square Kilometre Array (SKA) radio telescope is set to become the largest telescope on Earth, and also the largest science project in Africa. This dissertation focuses on the manner in which the SKA was represented in the South African media from September 2011 to August 2012. This addresses gaps in the literature on science communication, particularly with respect to science communication in an African context. By drawing on mass communication theory and science communication theory, it models communication processes and outputs using a conceptual framework based on the notion of the public sphere. Empirically, the study is underpinned by key informant interviews and the analysis of news media and social media content.

Systemically, the science communication of the SKA during this period was characterized by a high level of alignment of incentives, strategies, and structures across the main actors in the communication system. Main actors outside the media all aimed to position the SKA in the public sphere in a manner that would grow public support. Primary gatekeeping functions were positioned at the apex of the SKA organisation and public sector actors, but were more devolved within universities. Gatekeeping in the media was primarily driven by news value, as well as institutional culture and organisational attributes. Relationships between scientists and journalists were found to be generally positive and trust-based. The most significant source of information for journalists was the SKA itself, followed by public sector actors. However, other actors were marginalized, particularly local stakeholders. The Afrikaans language media played an important role, particularly among local communities, and published about the SKA relatively more often. The social media represented the SKA in a broadly similar manner to the news media, but the structure of communication outputs was influenced by the distinct attributes of the social media, including the viral propagation of messages and higher levels of agency by individual actors. However, there were indications of substantial media integration, in that major South African media corporations were the source of the majority of messages in both the news and social media.

The tone of media outputs was largely neutral or positive, framing the SKA as a ‘good news story’. The overarching dominant frame for representing the SKA was the site allocation process, in which South Africa and Australia competed in a bid to host the telescope for the international SKA consortium. Science and technology aspects of the project constituted the second most common framing, within which the search for extra-terrestrial intelligence was the most commonly represented research question. Representations of technological aspects of the SKA were generally shallow, with most articles mentioning only one aspect of the project’s technology.

The SKA was also constructed as a symbol, representing an instance of African scientific and technological achievement, African participation in globalized science, and a refutation of Afro-pessimism. The impact of the SKA on the public imagination, and the public sphere, was thus clearly far wider and deeper than only its science and technology accomplishments and contributions.

Opsomming

Die vierkantkilometer-radioteleskoop SKA (“Square Kilometre Array”) sal na verwagting die grootste teleskoop op aarde en die grootste wetenskapprojek in Afrika wees. Hierdie verhandeling konsentreer op hoe die SKA vanaf September 2011 tot Augustus 2012 in die Suid-Afrikaanse media uitgebeeld is. Dit handel oor die leemtes in die literatuur oor wetenskapkommunikasie, veral wat betref wetenskapkommunikasie in Afrikaverband. Deur uit massa- en wetenskapkommunikasieteorie te put, modelleer die studie kommunikasieprosesse en -uitsette met behulp van ’n konseptuele raamwerk wat op die gedagte van die openbare sfeer berus. Die navorsing word in die besonder ondersteun deur onderhoude met sleutelinformante en die ontleding van nuus- en sosiale media.

Die wetenskapkommunikasie oor die SKA gedurende hierdie tydperk was stelselmatig gekenmerk deur ’n hoë vlak van koördinasie tussen die aansporings, strategieë en strukture van alle hoofrolspelers oor die kommunikasiestelsel heen. Al die hoofrolspelers buite die media het die SKA op so ’n manier in die openbare sfeer probeer uitbeeld dat dit openbare steun sou werf. Primêre hekwagterfunksies is aan die voorste SKA-organisasie- en openbaresektor-rolspelers toegewys, maar was verder afgewentel binne universiteite. Hekwagterfunksies in die media is hoofsaaklik deur nuuswaarde sowel as institusionele kultuur en organisatoriese kenmerke bepaal. Verhoudings tussen wetenskaplikes en joernaliste was oënskynlik oor die algemeen positief en gegrond op vertroue. Die beduidendste bron van inligting vir joernaliste was die SKA self, gevolg deur rolspelers in die openbare sektor. Tog is ander rolspelers, bepaald plaaslike belanghebbendes, gemarginaliseer. Die Afrikaanstalige media het veral onder plaaslike gemeenskappe ’n belangrike rol gespeel en het meer dikwels as ander oor die SKA berig. Die sosiale media het die SKA merendeels op ’n soortgelyke wyse as die nuusmedia hanteer, maar die struktuur van kommunikasie-uitsette is beïnvloed deur die kenmerkende eienskappe van sosiale media self, waaronder die virale verspreiding van boodskappe en hoër vlakke van vryewilsoptrede (“agency”) deur individuele rolspelers. Tog was daar aanduidings van beduidende media-integrasie, in die sin dat groot Suid-Afrikaanse mediahuise die bron was van die meeste boodskappe in sowel die nuus- as sosiale media.

Die toon van media-uitsette was meestal neutraal of positief, en die SKA is as 'n 'goeienuus-storie' aangebied. Die oorkoepelende en oorheersende raamwerk waarbinne die SKA uitgebeeld is, was die terreintoewysingsproses, waarin Suid-Afrika en Australië meegeding het om die gasheerland vir die teleskoop van die internasionale SKA-konsortium te wees. Die wetenskaplike en tegnologiese aspekte van die projek was die tweede algemeenste voorstellingsraamwerk, waarbinne die soektog na buiteaardse intelligensie die algemeenste navorsingsvraag was. Voorstellings van tegnologiese aspekte van die SKA was oor die algemeen oppervlakkig, en die meeste artikels het slegs een aspek van die tegnologie van die projek genoem.

Die SKA is ook as 'n simbool van wetenskaplike en tegnologiese vooruitgang in Afrika, Afrika-deelname aan wêreldwetenskap, en 'n weerlegging van Afro-pessimisme uitgebeeld. Die impak van die SKA op die openbare verbeelding sowel as die openbare sfeer het dus duidelik heelwat wyer en dieper gestrek as slegs die wetenskaplike en tegnologiese prestasies en bydraes van die projek.

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Dedication

This work is dedicated to my family – Jerushah, Benjamin Diya, and Thomas Kiran.

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List of Abbreviations

DST	Department of Science and Technology
HartRAO	Hartebeeshoek Radio Astronomy Observatory
IAU	International Astronomical Union
ICT	Information and Communication Technologies
NRF	National Research Foundation
OAD	Office of Astronomy for Development
SAAO	South African Astronomical Observatory
SALT	South African Large Telescope
SKA	Square Kilometre Array
UCT	University of Cape Town
UKZN	University of KwaZulu Natal
US	University of Stellenbosch
UWC	University of the Western Cape
VLBI	Very Large Baseline Interferometer

Chapter 1: Introduction

The 25th of May 2012 marks a watershed moment in African and South African history – notionally representing the start of an era in which Africa is home to the world’s largest telescope, a continual source of some of the world’s greatest scientific discoveries. The questions it aims to answer are some of the most fundamental questions in physics and cosmology – What are matter, energy, space and time? How did the universe start? Why is the universe expanding at an accelerating rate? How were stars and galaxies born? Why is the universe structured the way it is? Is there life on other planets? These questions are not just fundamental to science, but fundamental to who we are as people. The SKA will look out at the universe with the world’s biggest eye and the world’s most powerful supercomputers processing the world’s biggest source of data. The science research objectives of the SKA are at the very frontier of human knowledge – a frontier that now lies in Africa.

Media coverage of the SKA has been an outcome of processes within media institutions and the other institutions in the public sphere – including the SKA itself, government departments and agencies, universities, research institutes, and private firms, as well as within the ‘conversations of the public’. The latter refers to a space that was central to Habermas’s first conception of the ‘public sphere’, as a notional space for debate that could be contested by public institutions as well as by individuals in their capacity as citizens exercising their abilities for deliberation and contestation over public matters (Habermas, 1989).

The space for such ‘public conversations’ has grown thanks to the social media. However, in an increasingly complex media landscape, traditional mass communication channels and social media communication channels both exert a strong influence on the public sphere. In this complex environment, how was this watershed moment in African and South African history reflected in public conversations and in the mass media? How have social actors constructed representations of the SKA in the public sphere? This PhD study aims to answer these questions. The central problem statement of the study is thus:

How is the Square Kilometre Array telescope represented in the South African media?

This problem statement implies two main components to the research question. Firstly, how is the SKA represented in terms of process (how are representations constructed by social

actors)? Secondly, how is the SKA represented in terms of outputs (what are the salient features of media outputs related to the SKA)? Taken together, these questions aim to understand how the science communication process has influenced the construction of media outputs related to the SKA. By answering these questions, this study aims to contribute to the literature on science communication, which has grown in its international scope, but has had an enduring blind spot on the continent of Africa (Schäfer, 2012).

The methodology used to achieve these aims is based on many studies of science communication that have been directed at other aspects of science (such as biotechnology and climate change) or other parts of the world (such as astronomy in Europe). Conceptually, the study is underpinned by the notion of the public sphere, as conceived by Habermas (1989), but as applied to the contemporary public sphere that includes virtual and real spaces and the complex new media institutions that have developed since the time of Habermas's analysis. In this public sphere, individuals and institutions produce and consume messages about public matters, thus shaping perceptions and opinions as well as affecting economic, political, and social changes. In this conception, the SKA is positioned as a 'science and technology movement' within the public sphere.

Empirically, the study is underpinned by three main data sources: data in the public domain, interviews with key informants, and the analysis of media content, both from the news media and from the social media. The analytical method is qualitative, with both inductive 'ground up' and deductive 'top down' methods of analysis, looking first at individual data sources, then across data sources.

The structure of the study is as follows: Chapter two, through a review of the literature, outlines the theoretical context and develops a conceptual framework. Chapter three outlines the methodology, including methods for desktop research, key informant interviews, news media content analysis, and social media content analysis. Chapter four provides background information about the SKA, including key events in its periodization, with a focus on the site allocation process which took place during the period of study (September 2011 to August 2012). Chapter five is focussed on science communication, including the internal science communication processes that characterise the SKA at the global level, the SKA in South Africa, universities, and government agencies. Chapter six focuses on science journalism, including an investigation of the interactions between journalists, scientists, and other social

actors in constructing representations of the SKA in the news media. Chapter seven turns towards the analysis of media content, and focuses on the analysis of a nationally representative database of English language news media items related to the SKA, as well as a case study of an Afrikaans language publication's coverage. Through both 'top-down' and 'bottom-up' analysis processes, key domains of enquiry are identified through the media content analysis, and used to understand the salient features of representations of the SKA in the news media. Chapter eight continues to analyse media content, in this case focussing on the social media, drawing on a nationally representative sample of Twitter posts during the period of study.

Chapter nine, in conclusion, looks across these data sources, returning to the overarching research question and conceptual framework to analyse the science communication of the SKA as a case study of mass communication and a case study of science communication. This analysis applies the mass communication concepts of structure and agency, social responsibility, gatekeeping, and news value, and fills empirical and theoretical gaps in research field of science communication, specifically those related to representations of science in an African context.

Chapter 2: Theoretical context and conceptual framework

2.1. Introduction

The main research question of this study is a starting point for an exploration of a theoretical context and the development of a conceptual framework:

How is the Square Kilometre Array telescope represented in the South African media?

This question implies three main aspects for research. Firstly, it asks how representations of the SKA are constructed – in other words, through what *process*. Secondly, it asks what the characteristics of the resultant representations are, in other words, what are the *outputs* of that process? Taken further, the question of how the process of communication influenced the communication outputs is also implied. The operationalization of this research question requires a clear contextualization within the literatures addressing mass communication and science communication.

The study of mass communication in general, and of science communication specifically, has two broad empirical foci, which correspond with the two main components of the research question. Firstly, there is a focus on the *process* of communication, which concerns itself with the internal structures of the media and external social structures which interact with the media, for example the interactions between scientists and journalists. Examples of data sources for this research agenda include key informant interviews, policy documents, and information about actors in the public sphere that play a role in communication. Another focus is on the analysis of *representations in the media* – both as outputs of the communication process, and as inputs into the formation of public attitudes and the framing of debate in the public sphere. The typical methodological approach here is that of media content analysis.

As a case study of mass communication and science communication in an African context, both of these enquiries are included in this study. Key informant interviews have provided new data about the science communication process, and an extensive media content analysis has provided new data about the outputs of the process and the manner in which the public imagination encounters the SKA. Some analyses, for example Nelkin (1995) and Bauer

(2002), draw on both these approaches and attempt to draw relations between the two – the process of science communication and the representations of science that are the result of that process. In the concluding chapter of this study, some possible links are developed in a similar manner.

Enquiry into representations of science in the media (both as media process and as media output) has developed into a global research project, with a substantial research output and an international reach (Schäfer, 2012). However, meta-analysis of the field has revealed some critical gaps. Research into representations of science in Africa is severely limited, accounting for zero percent of a meta-analysis of SSCI-indexed research papers between 1956 and 2010. This gap is particularly concerning in light of the emerging conception of science as a globalized activity. In addition, a methodological gap in the literature is its emphasis on the elite print media, rather than the popular press or the online media.

This study aims to address these gaps by undertaking an analysis of the science communication process of a large globalized basic science project that is located in an African context, drawing on online and popular press outputs as well as elite press outputs. The case study focus is the SKA radio telescope. This lends additional utility, as coverage of astronomy in the media is another gap in the literature on science communication and representations of science in the media (Madsen, 2010; Schäfer, 2012). In addition, the scale and public prominence of the SKA lends itself to case study analysis as it has both a rich social context and a sufficient level of media coverage suitable for analysis.

This literature review and conceptual framework establish a basis for the methodological and analytical frameworks for the study. Firstly, the core concepts of mass communication theory are explored, as these are foundational to the study of science in the media. This includes a review of the main paradigms of media studies research in the social sciences, as well as a closer look at the notion of the public sphere in media studies, the social responsibility theory of the press, structure and agency in the media, and the notions of gatekeeping and news value.

Secondly, the literature on the ‘public understanding of science’ is explored. This field of enquiry has emerged largely independently of media studies (although drawing on media studies tools such as content analysis), and has had a broad focus on the relationship between

the public and the institutions of science. Within this field a literature on representations of science in the media has emerged with a distinct discourse and methodology. Drawing on seminal readings and meta-analytical overviews, the theoretical, methodological, and empirical scope of this literature is reviewed – highlighting the critical gaps mentioned above, and motivating for the research question of this study.

Thirdly, the (very limited) literature on science communication in an African context is explored. This is foregrounded by a problematisation of ‘science in Africa’. It also examines aspects of science communication in Africa and South Africa, as well as the very limited evidence that is focused on representations of science in Africa and South Africa in particular.

This literature review provides a ‘toolbox’ from which to develop a conceptual framework that is suitable for the case study. This draws on the core concepts of mass communication, and, in line with research into representations of science in the media, draws on the ‘public sphere’ as a heuristic. This conceptual framework is applied to the case study to delineate more precisely the research question and sub-questions, the unit of analysis, and the aims and objectives of the study. This in turn provides a basis for the following chapter on the methodology.

2.2. Mass communication theory

2.2.1. Concepts of mass communication

Fourie (2008:96) offers the following basic definition of ‘mass communication’:

‘Mass communication involves the production of a large variety of messages (usually) by an institutional group or a collective communicator. The messages are distributed and transmitted (usually) by means of technological media (channels) to reach large, heterogeneous and widely dispersed audiences who may interpret the messages in a variety of ways. The content of mass communication is a mix of information, views, entertainment and advertisements. The purpose is to mediate meaning and understanding either overtly and/or covertly. By achieving this, the media create a unique kind of public sphere, and are seen to be one of the primary producers of

mass/popular culture and a culture in and for itself. An outstanding feature of mass communication is its publicness compared to the private nature of other forms or levels of communication.’

The key characteristics of the mass communication process pointed out by McQuail (2005:56) are a large-scale distribution and reception of messages, a uni-directional flow of messages, an asymmetrical relation between communicator and audience, a calculative or market relationship between communicator and audience as an impersonal and anonymous process, and standardized content.

The dynamic nature of ‘mass communication’ in the context of globalization and the development of Information and Communication Technologies (ICTs) makes the term difficult to define. The limitations of the above definitions in their application to online mass media are evident. Online mass communication need not emanate from an institution or collective communicator, and need not be uni-directional in nature. The rise of social media and other online channels of communication between individuals and society has broadened the scope and nature of ‘mass communication’. In particular, new forms of mass communication are more interactive (McQuail, 2005:39).

McQuail (2005:58) suggests some main parameters that define the ‘mass media’ as an institution. The main activity of the mass media is the production and distribution of symbolic content (messages). The institution of the mass media operates in the public sphere and is regulated accordingly. Participation in the mass media, whether as a sender or receiver of messages, is voluntary. The organisation of the institution is professional and bureaucratic in form. Finally, ideally, the media are both free (from intervention by society) and powerless (to act directly upon society).

In this context, a term that requires clarification is that of the ‘audience’ – the message recipients. Outside of the electronic media, the audience is largely heterogeneous and unknown to the communicator. However, online audiences may be specifically targeted and also known to the communicator. This difference is central to the shifting nature of contemporary mass communication - the move from audiences as media ‘receivers’ to audiences as media ‘users’ (Fourie, 2008: 101). This shift is also central to the debate about

the media as part of the public sphere, as it implies an increasingly open platform for public deliberation.

The term ‘mass’ in ‘mass communication’ also requires clarification. This refers to a communication with a large, aggregated, and undifferentiated audience. This has in some instances had pejorative connotations, referring to the ‘common people’ (Bramson, 1961). McQuail notes the key characteristics of this mass audience as being large in numbers, widely dispersed, non-interactive, anonymous, heterogeneous, not organized or self-acting, and an object of management or manipulation (McQuail, 2005: 57). Again, this definition requires adaptation if it is to apply to the social media.

Mass communication theory falls within the broader rubric of media studies, with a particular focus on mass communication, as opposed to other kinds of communication (such as private communication or media that do not reach a mass audience). Fourie (2008:xxi) defines media studies as ‘the systematic, critical, and analytical study of the media as one of the important producers and disseminators of symbolic meanings (content) to the public, a group, an organisation and/or the individual’. Media studies have a broad range of applications, including investigations of ‘the owners of the media, the producers of media content, the media content itself, and the users of media’ (Fourie, 2008:xxi). Importantly, the media are investigated in context, such as their social, political, technological, or cultural context(s). This has led research to focus on the ‘(power) relationships between the media and politics, media and culture, media and economy, media and society, and between the media and the public as well as the relationships between the media and democracy, and freedom of expression as a prerequisite for democracy’ (Fourie, 2008:xxi).

Media studies are gaining relevance in a world increasingly using information, knowledge, technology, and media platforms. The media play a key role in everyday life as well as in our social, political, cultural, and intellectual lives – and this role justifies sound theoretical and empirical investigation: ‘As today’s dominant symbolic form of expression through which everyday existence is described and documented, the media call for serious academic scrutiny’ (Fourie, 2008:xxi).

The role of globalization is particularly relevant for media studies. ICT media platforms have played an important role as enablers of globalization, and also heightened the prominence of

the media in society. Despite some reservations by theorists (e.g. Hamelink, 2000; Scheufele and Nisbet, 2002), the new media, particularly the internet, are seen as powerful new catalysts for democracy and social change. This perception has fuelled the growth of empirical and theoretical research at this interface (see Fourie, 2008:xxii; Castells, 2001; Coleman, 1999, 2001; Dahlberg, 2001; Bentivegna, 2002; and Downey, J. and Fenton, N. 2003).

Fourie (2008:112) describes the goals of mass communication studies as describing, explaining, interpreting, predicting, and reforming the media's social relationships. Drawing on Croteau and Hoynes (2003:22), Fourie specifies three types of social relations that fall under this broad rubric. Firstly, there are internal relationships within the media, such as institutional policies and codes of conduct. Secondly, there are the media's relationships with external social structures in society, such as economic and political landscapes and actors. Thirdly, there are the media's relationships with audiences. It is important to highlight that the research focus is commonly on bi-directional relations with a systemic focus – for example, investigating the influence of politics on the media, but also the influence of the media in politics.

Two important concepts to employ in the analysis of these relationships are those of *structure* and *agency* (Fourie, 2008:114). Structure refers to the structure of the mass media, as an example of a 'socialisation instrument'. Media studies can focus on how the media are composed, how they operate, how they are managed, and what values and norms are involved. Agency, on the other hand, refers to the manner in which the free and intentional actions of individuals and collectives impact on structure, in this case on that of the mass media. Structure and agency are inter-related and often in tension. The structure of the mass media shapes the nature of the messages received by media users, thus impacting on perceptions of reality and public norms and values. At the same time, media users and other social structures impact on the structure of the mass media. This distinction underpins much of the mass communication research agenda. It raises research questions, related to both structure and agency, which assess how we can improve the quality of the messages produced by the mass media in a manner that leads to improved perceptions of reality and other socially desirable outcomes. However, there are a wide variety of theoretical approaches towards achieving this common goal.

2.2.2. Research paradigms and approaches

McQuail (2005:14) identifies five broad types of mass communication theory, namely social scientific theory, cultural theory, normative theory, operational theory, and common-sense theory. Of these types, social scientific theory is most relevant to the present study. This involves ‘general statements about the nature, working and effects of mass communication, based on systemic and objective observation of media and other relevant sources, which can be put to the test and validated or rejected by similar methods’. This approach is dominant in research into the mass communication of science, and accounts for the large majority of this sub-field’s theoretical and methodological scope (Schäfer, 2012).

The study of mass communication includes both descriptive and normative theories. Descriptive theories are primarily aimed at measuring and understanding mass communication, while normative theories attach values to this understanding – they are concerned with the manner in which the media *ought to* function. Normative theory in this context thus seeks to establish measures against which the media can be assessed in terms of quality, accountability, and performance. These measures could then in turn inform the control or transformation of the media (Fourie, 2007:178).

McQuail (2005:62) identifies a ‘dominant paradigm for theory and research’ that has emerged as the most common theoretical approach in mass media studies – and indeed in the study of science communication – as well as an alternative or ‘critical’ paradigm. These paradigms are not coherent bodies of theory, but rather broad approaches within which competing theoretical positions can be approximately located. Nor are the two paradigms simplistic ‘opposites’. Rather, they are based on different interpretations of the core concepts that underpin mass communication theory.

The normative aspect of the dominant paradigm rests on the assumption that the media have a role to play in supporting an ideal-type ‘normal’ society, which embodies essentially Western normative values of democracy, liberalism, pluralism, and social order (McQuail, 2005:62). The role of the media can be assessed against their success in supporting these values in society. The empirical aspect of this dominant paradigm is essentially positivist. This approach emphasizes scientific method – a largely hypothetico-deductivist approach based on the analysis of empirical data produced from the ‘observable world’. The focus is on the

study of objective (external) phenomena, as opposed to subjective (or internal) phenomena. In the positivist approach the media are studied as objects to be scientifically described and understood. This positivist approach supports a methodological focus on quantitative or mixed-methods research and the analysis of variables indicating aspects or functions of media structures and outputs. This research agenda was summarized by Harold Lasswell (1948) as ‘who says what, in which channel, to whom, with what effect?’ The positivist approach has a long history, for example Lippmann (1922), Lazarsfeld, Berelson and Gaudet (1944), Katz and Lazarsfeld (1955), Klapper (1960), and Lowery and De Fleur (1983). The advent of the internet and the ICT revolution necessitated a re-appraisal of the methods used for evidence and analysis (Holliman *et al.*, 2009), but the underlying positivist approach remains useful for understanding mass communication in the current age.

The main theoretical underpinnings of the dominant paradigm stem from diverse sources. From sociology, the concept of functionalism has been applied to the media. This focuses attention on the function of communication in society, which can be modelled in terms of the functions of social actors and processes (e.g. Lasswell, 1948). Another source of ideas has been information theory, originating in the work of Shannon and Weaver (1949), which delineated the core components at work in the process of information transmission – for example an information source, information transmission in the form of a signal, through a communication channel, to a receiver, who transforms the message for a destination. Noise or interference can modify the message as it moves from sender to receiver. A third source of essential concepts is psychology and social psychology, which provide tools for investigating the attitudinal and behavioural effects of mass communication.

The dominant paradigm has been criticized on several fronts (McQuail, 2005:64). The linear approach that characterizes its theoretical and empirical projects has been criticized as being too simplistic and not in line with the complexity that characterizes the media and society. It has also been criticized for being inherently biased towards Western values – primarily the liberal-capitalist order.

The ‘alternative’ or critical paradigm refers to a broad range of theoretical approaches which challenge the normative and methodological aspects of the dominant paradigm. Critical approaches focus on informing a critique of the media with a view to transforming it to better serve society. This is not necessarily incongruent with a positivist approach – but it has a

different emphasis and goals. The critical approach to media studies also has a long history, originating in a concern by social theorists that technological change and mass media consumption were having a detrimental effect on society. The Frankfurt School was a central proponent of this view. Max Horkheimer's critical theory aimed to point out the myths and contradictions of society, and within this broader project critical theorists analysed the media. Several prominent thinkers from the Frankfurt School, including Adorno, Marcuse, Fromm, and Benjamin questioned the notion of the media as neutral or benevolent transmitters of information – and hence culture.

On the whole, the Frankfurt School criticized the media for reproducing the dominant capitalist ideology of the ruling classes and actors in society – by selectively representing reality and reproducing cultural messages to reinforce the hegemony. In this context the Frankfurt School delineated the concept of popular or mass culture – which was seen as intentionally produced by powerful actors in order to control the 'masses' – as distinct from 'high culture', a pre-industrial aspect of culture that was spontaneously developed and used by its social participants. Later analyses have argued that the distinction between high culture and popular culture has collapsed, or that 'high' culture is no longer a relevant social force (Postman, 1986; Minow, 1991).

The critical approach takes on 'a more sophisticated notion of ideology in media content which has allowed researchers to "decode" the ideological messages of mass-mediated entertainment and news, which tend towards legitimizing established power structures and defusing opposition' (McQuail, 2005:66). Such an approach sees meaning as constructed within a social, political, and ideological context, both in terms of sending and receiving messages. The media, in the critical approach, are seen as politically and ideologically non-neutral, leading to concern about the media's role in domination according to class, gender, ethnicity or alternative subculture. Methodologically, these concerns have lent themselves to qualitative research – such as discourse analysis, ethnography, and cultural studies.

Since its origins, critical media theory has grown and diversified substantially. Some of the main features of contemporary critical theory are pointed out by Fourie (2007). Firstly, the media are seen as channels for symbolic forms of expression in which beliefs, values and attitudes are communicated in a structured manner. The immediate explicit content of the message is framed by the assumptions and implicit or latent content of the message. Critical

media theory also maintains a focus on the inter-relationships between the media, politics, and the economy - a theme that is often referred to as the 'political economy of the media'. This political economy is often the focus of criticism (e.g. Murdock and Golding, 1977), including critiques of capitalism with respect to the media. Globally, market liberalization has led to a decline in public sector ownership and control of mass media (McQuail and Siune, 1998; van Cuilenberg and McQuail, 2003), while at the same time mergers and acquisitions have concentrated media ownership in the hands of fewer firms, giving them disproportional power. This critique is particularly relevant to South Africa, where a handful of private firms control most of the country's media channels, and the government retains control of the public broadcaster. These actors present and frame messages to their best interests, whether that of commercial gain or power retention.

Thus, within the broader scope of the critical media studies approach, a critical focus on the political economy of the media examines institutions such as ownership, governance, capitalist ideology, and hegemony upheld by media that 'manufacture' messages for the consumption of the manipulated masses (Herman and Chomsky, 1988). However, in the context of the more participative ICT-driven media, the balance between structure in the media and agency in the media seems to be shifting and becoming more complex. Interactivity allows the public to play a greater role in the construction of messages, while at the same time mass communicators grow increasingly sophisticated in the organizational and technological control of mass media and its messages (McQuail, 2005:39; Peters *et al.*, 2014).

2.2.3. Mass communication and the public sphere

Of these approaches towards mass communication emerging from the Frankfurt School, Jürgen Habermas's notion of the 'public sphere', and how this situates the mass media, has remained relevant to subsequent efforts to model and understand the media in society, particularly following the translation, in 1989, of Habermas's book 'The Structural Transformation of the Public Sphere'. Habermas defines something as 'public' if it is 'open to all, in contrast to close or exclusive affairs' (Habermas, 1989:1). The 'public sphere' is thus defined 'society engaged in critical public debate' (Habermas, 1989:52). Habermas specified four main characteristics of the public sphere. Firstly, the public sphere influences the formation of public opinion. Secondly, all citizens have access to the public sphere.

Thirdly, this access is free of economic or political control, implying social freedoms such as freedom of assembly, freedom of association, and freedom of speech. Finally, the public sphere provides a space for debate over the general rules governing social relations.

Habermas's conception of the public sphere was developed as a description applied to the bourgeois public sphere which emerged in eighteenth century Europe. In this context, private citizens met in public spaces to undertake rational and critical debate and discussion. As literacy rates, access to information, and the ranks of the bourgeois increased, this public sphere grew in its influence: "In its clash with the arcane and bureaucratic practices of the absolutist state, the emergent bourgeoisie gradually replaced a public sphere in which the ruler's power was merely represented before the people with a sphere in which state authority was publicly monitored through informed and critical discourse by the people' (Habermas, 1989: xi).

This process unfolded in the context of the ascendancy of liberal democracy in Europe, which lent increasing support to institutions that act as enablers for the public sphere, such as publishing enterprises, newspapers and discussion forums. Importantly, these institutions were as a consequence free of both church and government influence. However, they did not remain free of influence for long, as the success of the new political class undermined the functioning of the public sphere. Habermas (1989) argues that, as the capitalist class increased in power, and consumerism as a social mode and as an ends became of greater interest than political debate, political control of the public sphere was ceded to capitalist forces such as advertising and publicity.

The public sphere thus became an 'arena' which was contested by an array of powerful actors, and one of the main means of wielding this power was through the mass media. Capitalist forces thus sought to control the mass media, and through process of content selection to frame public debates and communication in their own favour. The media are thus central actors in the public sphere, providing 'specific means for transmitting information and influencing those who receive it' (Habermas, 1989:136).

In eighteenth century Europe, the 'arena' of the public sphere was largely in public meeting spaces such as coffee houses (in Britain), salons (in France) or 'Tischgesellschaften' in Germany, and the media were largely print media. The theory thus needs considerable

adaptation when applied to the contemporary context, and to the non-European context. An important application of this is to better understand the social media as new means of creating a notional space for the public sphere. This has been interrogated in the new media literature, for example Fuchs (2014), which presents a detailed effort to understand the contemporary media landscape using a public sphere conceptualization.

Habermas's analysis has been criticized as 'the idealizing of a bygone and elitist form of political life' (McQuail, 2005:182, quoting Curran, 1990). However, it is the form, rather than the content, of its ideas on the public sphere that have had more durability. The notion of the public sphere situates the media in a conceptual map of social actors and their relationships, implicating the media in both influencing these actors and being influenced by them. The initial impetus behind this conception of the media was to critique this structure – to identify areas where powerful social actors or other factors distorted media representations or otherwise compromised the social good. However, this conceptual framework is also useful for contextualizing a positivist research agenda. It identifies actors and relationships that may be introduced as variables or analytical foci in an effort to draw on data to undertake a more positivist (descriptive-analytical) approach towards understanding the media and its role. This includes the analysis of science communication (e.g. Bauer, 2003, 2005).

2.2.4. Four theories of the press and social responsibility theory

The 'Four theories of the press' (Siebert *et al.*, 1956) asked why the mass media took on different forms and purposes in different countries and contexts. The core argument was that 'the press always takes on the form and coloration of the social and political structures within which it operates. Especially, it reflects the system of social control whereby the relations of individuals and institutions are adjusted.' (Siebert *et al.*, 1956: 1–2). Their analysis was supported by four case studies, or 'theories of the press', of different forms and purposes of the press, identified in the subtitle of the book: 'The Authoritarian, Libertarian, Social Responsibility and Soviet Communist Concepts of What the Press Should Be and Do'. The choice of example was influenced by their historical context, with post-war concern with authoritarian and communist modes of mass media. It seems that this work filled a gap in contemporary media theory, and the book became a seminal work in the field (Nordenstreng, 2006) and popular with both academics and media professionals. Although it is now widely believed to be historically dated and analytically flawed, it still plays a central role in the

analysis of mass media in its socio-political context, and the fourth ‘theory’, the social responsibility theory of the press, remains a relevant approach towards normative and positive studies of the mass media.

The Social Responsibility theory of the press maintains that the importance of the press in modern society makes it necessary that an obligation of social responsibility be imposed on the media of mass communication. This theory of the press was based on a report published in 1947 by the Hutchins Commission in the USA. This elaborated the idea of social responsibility applied to the media, and sought to lay a philosophical and moral basis for the idea that the press owed a responsibility to society because of the dependence of democracy on a flow of trustworthy information and a diversity of relevant opinions. On this basis the Social Responsibility theory of the press requires that journalists receive an appropriate education, that journalists be free from obligations and influence, that publications host free opinion pages, that content be controlled at a local level, and that an independent Ombudsman should be the advocate of the reader. McQuail (2005: 172) outlines the five main principles of the social responsibility theory of the press as: 1) The media have obligations to society, and media ownership is a public trust; 2) News media should be truthful, accurate, fair, objective, and relevant; 3) The media should be free, but self-regulated; 4) The media should follow an agreed-upon code of ethics and professional conduct; 5) under some circumstances, government may need to intervene to safeguard public interest.

Despite being somewhat dated and subject to criticism, the Social Responsibility Theory remains relevant to contemporary media studies. For example, this approach underpinned criticism against the South African Press Ombudsman’s ethical code of conduct and its process of self-regulation, which argued that the social responsibility of the press was under-emphasised. This led to a thorough revision of the code and the self-regulatory system of the South African Press Council with a stronger emphasis on the social responsibility of the press in 2011-2012 (<http://www.presscouncil.org.za/>). Another example can be found in the 2012 British Leveson Inquiry into phone-hacking and privacy invasion, which also emphasised the social responsibility of the press to its public (<http://www.levesoninquiry.org.uk/>).

2.2.5. Gatekeeping

Pamela Shoemaker's 1991 review of the gatekeeping literature (updated in several editions up to 2009), provides an overview of the concept: 'Simply put, gatekeeping is the process by which the billions of messages that are available in the world get cut down and transformed into the hundreds of messages that reach a given person on a given day' (Shoemaker, 1991:1). Gatekeeping is the process through which information is filtered by the media system before being released through various possible channels of communication and dissemination. Shoemaker and Vos (2009:1) define gatekeeping as the 'process of culling and crafting countless bits of information into the limited number of messages that reach people every day, and it is the center of the media's role in modern public life. [...] This process determines not only which information is selected, but also what the content and nature of the messages, such as news, will be.'

Barzilai-Nahon (2008: 1501) includes a useful set of definitions and typologies:

- Gate – “entrance to or exit from a network or its sections.”
- Gatekeeping – “the process of controlling information as it moves through a gate. Activities include among others, selection, addition, withholding, display, channeling, shaping, manipulation, repetition, timing, localization, integration, disregard, and deletion of information.”
- Gated – “the entity subjected to gatekeeping”
- Gatekeeping mechanism - “a tool, technology, or methodology used to carry out the process of gatekeeping”
- Network gatekeeper – “an entity (people, organizations, or governments) that has the discretion to exercise gatekeeping through a gatekeeping mechanism in networks and can choose the extent to which to exercise it contingent upon the gated standing.”

In part, the notion of gatekeeping is a practical description of what is required by the mass communication process. Every news medium must have a 'surveillance' function, through which a large number of possible news stories are brought into the system through a range of channels. However, in any medium there is a limited time and space for presenting this news, so a 'culling' procedure is necessary. Studies of gatekeeping focus on this process, examining how certain stories or information are selected for communication while many others are not.

There is much debate about what the criteria for selection are, and how they may differ across contexts. DeFleur and Dennis (2002) noted that in any news (or media) organisation there exists a complex sub-culture with a specific set of criteria for assessing news stories for publication. This sub-culture includes contested definitions of newsworthiness, organisational policy, ideas about audience reception, and beliefs about the social obligations of journalists. These factors are taken into consideration at several levels of the organisation, including editors, news directors, and any other actors who must select news stories for publication out of a larger set of possible news stories.

Literature on gatekeeping is largely focused on issues of selection – looking at how one (news) story is chosen over another. Another, less common, focus is on the selective framing of a story – the manner in which ‘news value’ influences the selection process (e.g. Johnstone, Slawski, and Bowman 1972; Gans 1979). McQuail (2005:310) defines ‘news value’ as an attribute of a news event that transforms it into an interesting ‘story’ for an audience. He identifies the primary news values in Western media as: a large scale of events, closeness to home, clarity of meaning, short time scale, relevance, consonance, personification, negativity, significance, and drama and action. News stories with these attributes are more likely to be selected.

There is also a substantial literature addressing the issue of framing (e.g. Chong and Druckman, 2007). McQuail (2005:379) defines framing as ‘a way of giving some overall interpretation to isolated items of fact’. He notes that it is ‘almost unavoidable for journalists to do this and in doing so depart from pure “objectivity” and to introduce some (unintended) bias’. Information emanating from news sources may already be ‘framed’ to suit the source’s interests. The analysis of framing, using content analysis, has been commonly employed for a variety of purposes in the communications literature (e.g. Hartman and Husband, 1974; McNair, 1988; Horsti, 2007; Bell and Entman, 2011). This includes content analysis focused on science news (Bauer, 2005; Bonfadelli 2002; Ernst and Singh, 2009; Gastrow, 2010; Pigliucci, 2010).

Gatekeeping can be subject to various forms of systemic bias. These are outlined in Soroka (2012), and include organization-level factors such as administrative characteristics, working procedures, and cost and time constraints (e.g., Gieber 1964; Bass 1969; Donohue, Olin, and Tichenor 1989; Berkowitz 1991; Shoemaker *et al.* 2001), story-level factors such as the

geographic proximity of the story, visual features (for television), the clarity (ready interpretability) of the story, and story types—disasters, economics, crime, etc. (e.g. Galtung and Ruge 1965; Abbott and Brassfield 1989), extraorganizational, or professional, factors such as journalistic values and norms. South African research has investigated a related professional factor – that of journalistic ignorance about science and how this has influenced the accuracy of science communication (Claassen, 2011a).

The gatekeeping literature probes various hypotheses about its function in the media. Shoemaker, Eichholz, Kim, and Wrigley (2001) studied news gatekeeping of coverage of US Congressional bills, and found that institutional gatekeeping criteria (such as newsworthiness) had a far greater effect on selection than individual criteria (such as the personal preferences of journalists). Singer (2003, 2006) has studied the effect of new online tools on gatekeeping. She found that the content appearing in online editions of newspapers largely originates in content that appears in print versions. However, she also noted increased interactivity over time. She concludes that ‘the power of gatekeepers seems to diminish in a modern information society. The internet defies the whole notion of a ‘gate’ and challenges the idea that journalists (or anyone else) can or should limit what passes through it’ (Singer, 2006: 265). However, the extent of the changes created by ICTs and the social media should not be over-estimated. Peters *et al.* (2014) show that science communication, at least in Europe, continues to rely more on the traditional media than the social media, and that established gatekeeping processes continue to apply to this extent.

2.3. Science communication and representations of science in the media

2.3.1. Theoretical and empirical scope

The study of science communication focuses on science messages aimed at nonscientific audiences (<http://www.oxfordbibliographies.com/view/document/obo-9780199756841/obo-9780199756841-0031.xml>). One of the main aims of this literature is to better understand the relationships among the main actors in the communication systems that construct these messages, with a core focus on scientists and science journalists. The study of ‘science and the media’ has received steadily growing attention as the role of media and ICTs has escalated in society (Schäfer, 2012). The first major review of the topic was conducted by Kriehbaum (1967), and in the subsequent decades a number of overviews and edited

collections have surveyed the empirical and theoretical terrain, including Goodall (1977), Goodfield (1981), Silverstone (1985), Friedman *et al.* (1986), Nelkin (1995), Wilkins and Paterson (1991), Friedman *et al.* (1999), Lewenstein (1995), Gregory and Miller (1998), Bucchi (1998), Weigold (2001), and Schäfer (2012).

Schäfer (2012:650) notes that ‘the presentation of science in the mass media is one of the central questions facing social scientists who analyse science... Science coverage in the mass media was and still remains the major channel that bridges the gap between science and the general public’. As a result, assessments of science communication argue that media coverage makes a major contribution towards science’s public image. This includes aspects related to legitimation, public support, and funding (Weingart, 2005). This has led to increased expectations that scientists communicate with the mass media, and the establishment by science institutions of interfaces with the media (Royal Society, 1985; Peters *et al.*, 2008a, 2008b;). Science itself has become a major topic in the mass media (Nelkin, 1992, 1995: 31; Felt, Nowotny and Taschwer, 1992: 244). This includes the participation of scientific experts in controversial media debates such as climate change, genetic modification, and health (Stehr, 1992; Peters, 1994; Peters *et al.*, 2008).

Coverage of science in the media has become the focus of several journal publications, notably *Public Understanding of Science* and *Science Communication* (this research is reviewed in Bauer, Allum and Miller (2007), which reviews 25 years of research into the public understanding of science). There are also several introductions to the field, such as Dunwoody, Baldrice and Long (1993), Lewenstein (1995), Weigold (2001), Bauer and Bucchi (2007) and Bucchi and Trench (2008). Schäfer (2008) found that research into media coverage of science had grown rapidly for the prior decade, and had experienced sustained long-term growth since the 1950s. Nelkin (1995) noted that prior to the 1990s research into the public communication of science and technology remained small and scattered. As media become more central to society through the 1990s, the literature expanded and consolidated. An early example of this is the establishment of the journal *Public Understanding of Science* in 1992.

For a case study of science in its social context – how messages about science are socially constructed – media content analysis can be a useful methodology (Farr, 1993). Many studies have illustrated the utility of analyzing media outputs as sources of technology-related

information for the public. For example, Wade and Schramm (1969) examined how the mass media informed the public with respect to knowledge about public affairs, science, and health knowledge. Griffin (1990) took a case study approach, focusing representations of science related to the energy crisis in the 1980s. Mazur (1981) looked specifically at the role of the media in relation to scientific controversies. Coleman (1993) looked at how science communication influenced the public's perceptions of risk. Dunwoody & Peters (1992) surveyed previous research on scientific and environmental risk in the USA and Germany. More recent examples include Bauer (2008), which focused on the critical role of the public in relation to science.

The analysis of scientific controversy in the media is one of the main areas of investigation in the broader field of science in the media, as these are areas where the social, economic, and political stakes are raised. Such areas of scientific controversy include biotechnology (e.g. Krimsky, 1982; Neresini, 2000; Nisbet and Lewenstein, 2002; Nisbet, Brossard, and Kroepsch, 2003; Holliman, 2004; Kua, Reder, and Grossel, 2004; Bauer, 2002, 2005; Horst, 2005; O'Mahoney and Schäfer 2005), climate change (e.g. Weingart, Engels, and Pansegrau, 2000; Boykoff, 2007, 2008), nanotechnology (Cobb, 2005; Lee, Scheufele, and Lewenstein, 2005; Dudo *et al.*, 2011), cold fusion (Simon, 2001), and general coverage of technological and environmental risks (Mazur, 1981; Dunwoody and Peters, 1992; Friedman, Dunwoody, and Rogers, 1999). These studies of scientific controversy in the media take a variety of approaches, the most common of which is the use of media content analysis to establish how these controversies are represented in terms of tone, sensationalism, and framing by actors in the public sphere (for example Neresini, 2000; Bauer, 2005; Bonfadelli, 2005; Gastrow, 2010). Other approaches include discourse analysis (for example Weingart, Engels and Pansegrau, 2000; O'Mahoney and Schäfer 2005), a focus on internal media processes (Nisbet and Lewenstein, 2002; Cobb, 2005), the relationship between media representations and public attitudes (Mazur, 1981; Bauer, 2002; Lee, Scheufele and Lewenstein, 2005) or a combination of these approaches (Holliman, 2004)

However, there is only limited evidence of any controversy in the area of astronomy (Madsen, 2001), as it is usually directed at basic science with low levels of risk or profit for vested interests. However, the lens of analysis for conflict and controversy is relevant to the SKA, particularly for the controversial process of the site allocation for the infrastructure of

the project, as well as the less prominent areas of contestation related to shale gas fracking and the local development context.

A useful overview of the field of science in the media is found in Nelkin (1995). This focuses on the relationship between scientists and journalists, and how this shapes media representations. Her investigation was based on a selection of issues that attracted extensive media coverage, and included a search for dominant themes and recurring metaphors that ‘project an image of science and technology to the public’. The theoretical basis of Nelkin’s study draws on studies from *Public Understanding of Science* focusing on the relationship between scientists and journalists (e.g. Dunwoody and Peters, 1992; Lewenstein, 1992; Wilkins, 1993) as well as studies from the disciplines of sociology (e.g. Merton, 1973; Altimore, 1982) and communications (e.g. Friedman, 1981; Dunwoody and Ryan, 1985). She also draws on reviews of earlier periods of literature on the subject, ranging from the 1920s to the 1980s (Hay, 1970; LaFollette, 1990). The empirical aspects of Nelkin’s investigation were based primarily on the discursive analysis of print media outputs and key informant interviews with scientists, journalists, and public relations officers. Other important sources were science policy journals, professional journals of science, engineering and medicine, and public relations firms.

Another study of the relationship between scientists and the media is that of Peters (2005), which shows that scientists are motivated to engage in public communication by their desire to ‘teach’ the public about their work, to build a society that enjoys science, and also to benefit from the instrumental value, to themselves, of publicity.

A useful methodological and analytical framework has been developed for the study of biotechnology in the media, including Nisbet and Lewenstein’s (2002) paper analyzing coverage of biotechnology in the elite press in the USA, as well as Bauer (2005) and Bonfadelli’s (2005) analyses of biotechnology in the European media, using the same dataset from 12 European countries. Together, these provide an adaptable methodology for the measurement and analysis of representations of science in the media. This includes methodological guidelines for sample selection, coding, and analysis. The studies share an general framework of key variables for media coding, including parameters for measuring frames, themes, actors, and tone – a framework that facilitates the analysis within the social, political and economic contexts. This approach is closely aligned to the conceptual

framework, empirical requirements, and analytical requirements of this study, and as such is a core source for its methodological framework.

Another strand of the science communication literature focuses on science journalism in the context of broader media coverage. While research into science communication has grown, science journalism appears to be facing increasing constraints. Science reporting in the traditional media (newspapers, television and radio) has been curtailed, especially since the global financial crisis at the end of 2008. As Claassen points out in his national survey study of scientists and the media (2011a), a study by the Project for Excellence in Journalism (2008) found that people watching cable news in the United States for five hours on a given day, would only have been exposed to more or less one minute of science and technology news. Mooney and Kirshenbaum (2009:6) argue that in the US, the number of newspapers ‘featuring weekly science or science-related sections shrank by nearly two-thirds’ between 1989 and 2005, from 95 to 34.

Schäfer (2012) presents a meta-analysis of studies on the media’s coverage of science in the form of a systematic empirical overview of the literature. This is the most recent and comprehensive systematic overview of the field, drawing on a sample from the Social Sciences Citation Index (SSCI) of 215 publications, 201 journal articles, and 14 books, ranging in date from 1956 to 2010. Due to this sampling frame, the study excludes research that is not included in the SSCI – a category into which the few research papers examining science communication in South Africa fall. Nonetheless, Schäfer (2012) provides an excellent reference point for situating the case of the SKA, indicating clearly how the gaps in the international literature can be addressed by the case study.

Schäfer’s overview delineates the range of analytical foci in the literature. Firstly, most of the literature is focused on a single scientific discipline (89.3% of the sample) rather than examining science coverage in general. Schäfer examines how these ‘single discipline analyses’ are constituted. It was found that the disciplinary coverage has been fairly broad (see Table 1), ‘Ranging from stem cell research (e.g., Leydesdorff and Hellsten, 2005; Nisbet, Brossard and Kroepsch, 2003) to genomics (e.g., Kua, Reder and Grossel, 2004; O’Mahony and Schäfer, 2005; Schäfer, 2009), cloning (Holliman, 2004; Horst, 2005; Neresini, 2000), cold fusion (e.g., Lewenstein, 1992; Simon, 2001), research on climate change (Boykoff, 2007, 2008), space research (Clark and Illman, 2003), particle physics

(Schäfer, 2009), and nanotechnology (e.g., Cobb, 2005; Lee, Scheufele and Lewenstein, 2005).’ (Shafer, 2012:654).

Table 1: Studies of representation of science in the media by field of research

	Total	1960s–1980s	1990s	2000s
Natural sciences (total)	92.9	82.4	82.3	96.4
Biology/Biotechnology	33.8	5.9	13.7	51.1
Medical science	19.8	17.6	33.3	17.5
Geography/Climate science	12.2	0.0	19.6	12.4
Physics	10.1	11.8	21.6	8.0
Chemistry	2.1	11.8	0.0	2.2
Nanoscience	1.7	0.0	0.0	2.9
Psychology	1.3	5.9	0.0	1.5
Neuroscience	0.4	0.0	0.0	0.7
Social sciences	6.3	17.6	15.7	2.9
Arts	0.8	0.0	2.0	0.7

Source: Schäfer, 2012:655

The disciplinary focus is almost entirely on the natural sciences. The most commonly studied research disciplines are biotechnology, medical science, and geography/climate change science. Astronomy receives very little coverage - not enough to feature in the summary above, although it is possible that some coverage of astronomy may overlap with, and therefore be included in, coverage of physics disciplines, which accounted for 8% of studies in 2008. Overall, however, dedicated research into the coverage of astronomy in the media is a gap in the science communication literature.

Schäfer (2012) also examines the geographical coverage of the literature. Most of the literature is focused on a single country (83% of the sample) rather than having a regional or global scope. Importantly, the analysis revealed a clear and sustained bias towards Western countries (see Table 2).

Table 2: Studies of representations of science in the media by geographical focus

	Total	1960s–1980s	1990s	2000s
Europe (total)	54.7	23.5	51.6	59.5
United Kingdom	24.7	23.5	22.4	26.0
Germany	7.2	0.0	5.2	8.3
France	4.6	0.0	8.6	3.9
Netherlands	3.4	0.0	6.9	2.8
Italy	2.3	0.0	1.7	2.2
Denmark	1.9	0.0	1.7	2.2
Greece	1.9	0.0	0.0	2.8
Spain	1.9	0.0	0.0	2.8
Others	6.8	0.0	5.1	8.5
North America (total)	40.0	64.7	43.1	34.8
United States of America	37.3	64.7	41.4	31.5
Canada	2.7	0.0	1.7	3.3
Oceania (total)	4.1	11.8	5.1	3.4
Australia	3.0	11.8	1.7	2.8
New Zealand	1.1	0.0	3.4	0.6
Central/South America	0.8	0.0	0.0	1.1
Asia	0.4	0.0	0.0	0.5
Africa	0.0	0.0	0.0	0.0

Source: Schäfer 2012:655

At no point since the 1950s have more than 1.6% of analyses focused on non-Western countries. There were no studies focusing on Africa in the sample, highlighting that media coverage of science in developing countries, and in Africa particularly, is a major gap in the literature. Schäfer (2012:658-659) notes that ‘this contrasts sharply to descriptions of science as a global system, e.g., of an “astonishing growth of international scientific collaboration” (Stichweh, 1996:334) or an ongoing transnationalisation of scientific organisations (Held *et al.*, 1999: 57). Many scholars think that science is already working on a global basis and that its outcomes are produced in and affect countries around the world (Beck, 1992, 2007). This is not reflected in the research’.

Another bias is towards the elite print media. More than two thirds (70.7%) of the sample focused exclusively on the print media (as opposed, for example, to the online media). Within this set, the focus tends to be on the elite media – defined as the newspapers, magazines, television shows, and other media that influence the political agenda of other mass media (Chomsky, 1997). According to Chomsky, ‘the elite media set a framework within which others operate.’ The analytical utility of such an approach is that research findings from the elite media can be more easily generalized. Since 2000, more than half of all research publications have focused on the elite print media, such as *The New York Times* (US), *The Times* (UK), and the *Frankfurter Allgemeine Zeitung* (Germany) (e.g., Hampel *et al.*, 1998;

Bucchi and Mazzolini, 2003; Major and Atwood, 2004). Surprisingly, analysis of internet coverage of science is low, at only 3.8% of the sample since 2000, but has grown from a lower base in previous years (see Table 3):

Table 3: Studies of representations of science in the media by main media focus

	Total	1960s–1980s	1990s	2000s
Print media (total)	78.7	50.0	79.2	80.1
National newspapers	46.0	21.4	41.4	51.2
Regional newspapers	11.0	14.3	10.3	10.0
Magazines	12.2	10.7	17.2	10.4
(Popular) science magazines	5.6	0.0	5.7	6.6
Other print media (comics etc.)	3.6	3.6	4.6	1.9
Radio	3.9	3.6	3.4	4.3
Television (total)	12.5	42.7	12.5	8.0
Television news	5.3	7.1	6.9	4.7
Television science programmes	3.6	21.4	1.1	1.9
Other television programmes	3.6	14.2	4.5	1.4
Movies	1.2	3.6	1.1	0.9
Internet	2.7	0.0	1.1	3.8
News agencies	0.3	0.0	1.1	1.4

Source: Schäfer, 2012:656

Overall, this review of the literature highlights that this is a growing field that is gaining increasing significance, but which is characterized by particular gaps in its coverage and approach. Some of the main gaps correspond to the parameters of the case study of the science communication of the SKA, namely media coverage of science in developing countries, and particularly in Africa, the broader analysis of science coverage beyond the elite media, the analysis of science communication through the social media, and representations of astronomy in the media.

2.3.2. Astronomy in the media

Astronomy is commonly considered a ‘pure’ science. The Eurobarometer in 1992 and 2005 asked how ‘scientific’ respondents believed various research disciplines to be. Astronomy was reported to be the ‘most ‘scientific’ of the disciplines, ahead of medicine and biology (European Commission, 1992, 2005). This is in line with the function of astronomy. Peters (2001) describes astronomy, and the communication thereof, as ‘science centred’ basic science, rather than ‘problem centred’ applied science. The purpose of applied science, and the nature of its application, more commonly leads to contestation and mistrust.

Most research on astronomy in the media focuses on science communication from a practitioner's point of view (e.g. Heck and Madsen, 2003), including case studies of public relations efforts of scientific projects (e.g. Madsen and West, 2000; Christensen, 2002; Finley, 2002; Griffin, 2003). Lewenstein (1993) offers a history of public relations in NASA from its beginnings until 1986. However, there is a precedence of studies of astronomy in the media. Madsen (2001) and Madsen and West (2001) are particularly useful as they employ a media content analysis using a set of variables specifically relevant to astronomy and space science. This provides a useful point of departure for methodological design, although this is limited by the broader focus of the Madsen (2001) study, which includes space science as well as astronomy, and conflates the data for these two domains, and thus renders a coding system and findings that are not directly comparable to the case of the SKA. However, the overall methodology is similar to those of Nisbet and Lewenstein (2002), Bonfadelli (2005) and Bauer (2005), with the empirical core being a coded media content analysis in the context of key informant interviews and desktop research. This methodology and analytical framework informs the approach to this study of representations of the SKA in the media.

Madsen (2001) reviews coverage of astronomy in the European media. He found that most coverage of astronomy in the media has its origins in press releases. Boffin (2009) also notes that one of the main sources of information about astronomy for science journalists is press releases, and that one of the main gatekeeping tasks for science journalists is to continuously scan incoming press releases to select the most newsworthy stories for further investigation and publication. In a small survey of journalists, Boffin found that the main selection criteria for an astronomy story were the subject of the story (where the solar system and exoplanets were dominant) and the availability of an attractive image or video.

There is very little extant research into astronomy coverage in developing countries. Dutt and Garg (2009, 2012), in their analysis of science news coverage in English-language Indian dailies, found that astronomy occupied 15.4% (in 1996) and 5.6% (in 2008) of science journalism editorial space, and had the highest level of accompanying visual illustrations. However, these findings form part of broader surveys and lack specific further analysis relevant to astronomy.

2.3.3. The Public Understanding of Science and the heuristic of the public sphere

A substantial body of research focusing on the relationship between the public and the institutions of science has arisen under the broad rubric of the ‘public understanding of science’ (see Bauer, Allum and Miller, 2007; Gregory and Lock, 2008; and Felt and Fochler, 2008 for overviews). This rubric encompasses a body of literature that emerged in the UK in the mid-1980s following a Royal Society report into the issue of the public understanding of science in the UK (Royal Society, 1985), and centred upon the journal *Public Understanding of Science*. The scope of this research has covered public attitudes towards science, public understanding of science content, the public understanding of scientific methods and science institutions, and the field of science communication (see Bauer *et al.*, 2007).

Within this literature, science communicators (such as journalists or public information officers) are seen as vital in the process of science institutions and the public engaging to build scientific knowledge and constructive attitudes towards science (Burns *et al.*, 2003). The model supports a bi-directional analysis, in which public attitudes and knowledge influence science institutions, and science institutions in turn influence public attitudes and knowledge. The media are critical mediators in this process (Royal Society, 1985; Bauer *et al.*, 2007; Bauer, 2005).

Within the ‘public understanding of science’ framework for situating science and media in a broader socioeconomic context, a conceptual framework is employed by Bauer (2002) in his development of a heuristic for the analysis of the systemic context of biotechnology as a ‘technology movement’. This heuristic was later applied in a large research project to measure media representations of biotechnology in Europe (Bauer, 2005). This case study of the SKA draws on this conception of the public sphere to underpin the core structure of its conceptual framework, which is essentially based on a public sphere approach.

Bauer (2002) applied the notion of the public sphere in order to contextualize science and the media as a communication system in which actors mobilize in three main arenas: 1) regulation and policy making, 2) the mass media, and 3) everyday conversations and perceptions. Public opinion comprises the mass media and everyday conversations and perceptions. Regulation and policy making are functions of governance. Each arena has its own operational rules, each has a limited capacity, and each needs to select issues for attention. Although these arenas are relatively autonomous, they can also influence one

another in terms of what messages are brought to attention, and when. For a ‘technology movement’, the public sphere provides support or resistance, or a mixture of these, from various social actors.

This model thus conceptualizes different aspects of science and technology as ‘social movements’ with systemic relationships to social actors, including economic, political, media, and public sector actors. In this framework, science and technology, or a particular aspect thereof, is considered a ‘social movement’ that is an outcome of and input to social processes (Bauer *et al.*, 2007; Bauer, 2005). At the centre of this heuristic is the ‘technology movement’ as a social phenomenon – a concept that can be adapted to encompass science, rendering a ‘science and technology movement’. This has several characteristics: Firstly, science projects need to mobilize support, whether from firms, governments, academics, or the good will of the public. Secondly, imagined future scenarios and reasoned arguments more or less determine this support in society. Thirdly, the technology movement is not homogenous and may have internally conflicting goals. Fourthly, the actors of this movement encounter a public sphere where they are represented in a manner that informs attitudes and public perceptions of the technology. Finally, a technology movement is not a unified movement, but rather consists of integrated competition among actors, for example over public good will or regulatory arrangements (Bauer & Gaskell, 1999; Bauer, 2002).

Figure 1: Heuristic for understanding science and technology in the public sphere

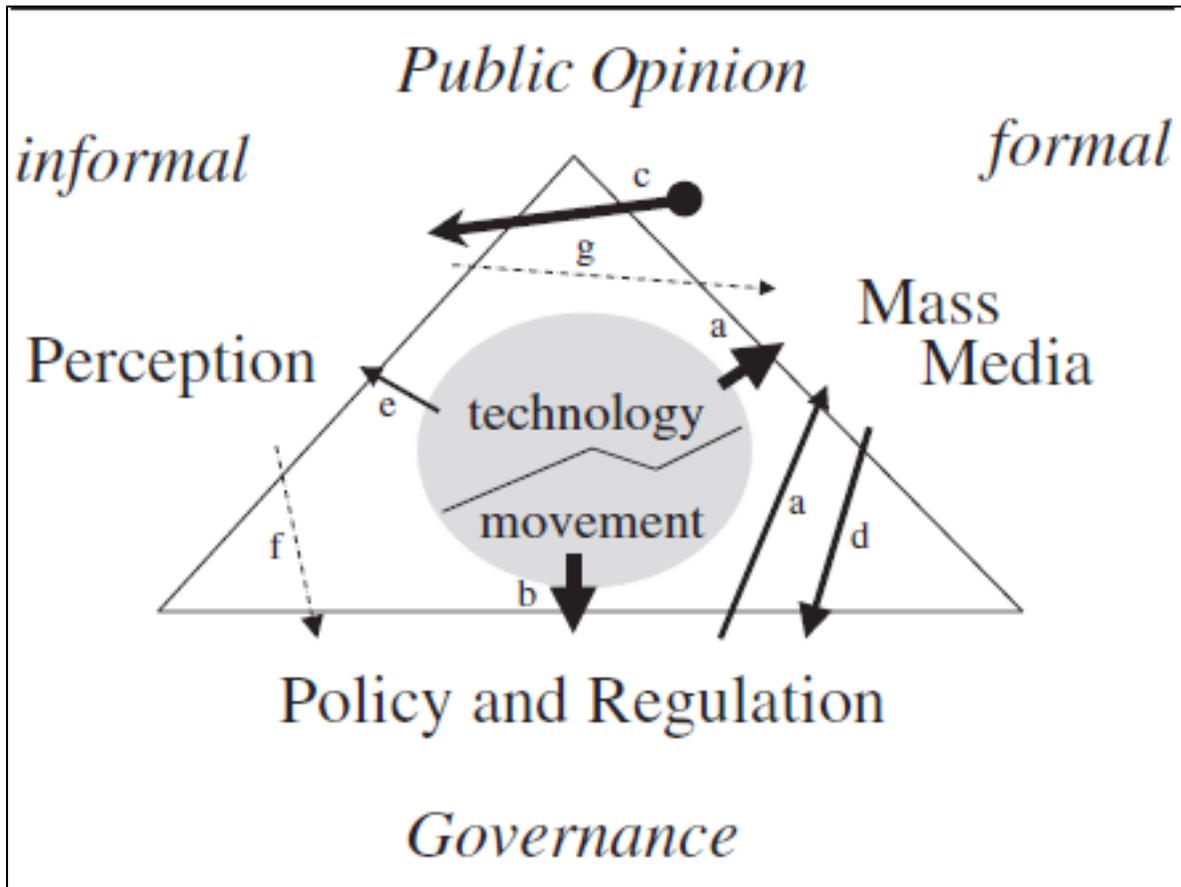


Figure 1: Triangular Model of the Public Sphere of Science and Technology

NOTE: The triangular model of the public sphere of science and technology shows its four main constituencies. The technology movement is at the center, surrounded by the three arenas of the public sphere: regulation and policy making, mass media coverage, and public conversations and perceptions. The triangular model integrates various nonoverlapping distinctions: governance versus public opinion; within public opinion, that between informal and formal public opinion; and the conflicting formations within the biotechnology movements. The arrows suggest principal directions of influence and the hypothetical strength of influences that are subject to empirical testing. The following seven relations can be identified: (a) public relations; (b) lobbying; (c) media effects on public perceptions; (d) media effects on policy making; (e) public lecturing and education; (f) relatively direct contacts with the public, for example, public discussions, consensus conferences, and so on; and (g) feedback effects from audience to mass media production.

Source: Bauer (2002: 150)

The circle at the centre represents a ‘technology movement’, a network of actors that are more or less for or against aspects of science or technology. This network is constrained (in the sense of both enabled and resisted by) the structures and processes occurring in the public sphere, including the regulatory framework, mass mediation through the formal media, and the informal conversations of the public. In this context the ‘public sphere’ is conceived as ‘a communication system where interested actors mobilize attention in public arenas’ (Bauer,

2005:8), including arenas of policy-making, mass media, and the perceptions and conversations of the public. Representations of science and technology can be understood within this framework to form bi-directional causal relationships with public opinion and the policy environment.

The relationships between actors in the public sphere are complex. On one hand, many actors, for example in politics and business, refer to the media as an index of public opinion – i.e. it is partially a reflection of public opinion. On the other hand, the media circulate messages widely and thus inform public opinion too. It is also important to recognise that powerful social actors have an influence over controlling and framing news, including representations of science. These include actors from governments, firms, lobby groups, non-profit interest groups or pressure groups, and scientists. These actors compete to frame science-related issues in their own interests (Krimsky, 1991). The contribution of these actors and relationships to the trajectory of science is a key empirical question in the literature, for example in Bauer (1991, 1995, 2008) and Nelkin (1995).

Of the many relationships between actors in the public sphere, the relationship between scientists and journalists is of particular interest in the effort to understand the factors that shape media representations of science (e.g. Nelkin, 1995). The first report for the British Royal Society on the communication between scientists and the media (Royal Society, 1985) noted that there was a lack of understanding about the relationships between journalists and scientists that lay behind the media images that constitute science news. In South Africa, Claassen (2011a) profiled the relationships between scientists and journalists, pointing out how problems in this relationship could undermine the quality of science reporting. Clayton and Joubert (2012) also identify several challenges in the relationship between scientists and journalists in the broader African context, particularly in terms of finding appropriate scientists and then establishing communication with them.

Bucchi (2004: 108-109) identified the predominant attitude of scientists as the ‘diffusionist’ conception, ‘indubitably simplistic and idealized, which holds that scientific facts need only be transported from a specialist context to a popular one ... On the one hand, it legitimates the social and professional role of the “mediators” – popularizers, and scientific journalists in particular – who undoubtedly comprise the most visible and the most closely studied component of the mediation. On the other hand, it authorizes scientists to proclaim

themselves extraneous to the process of public communication so that they may be free to criticize errors and excesses – especially in terms of distortion and sensationalism. There has thus arisen a view of the media as a “dirty mirror” held up to science, an opaque lens unable adequately to reflect and filter scientific facts.’

2.4. Science and the media in an African context

2.4.1. Problematising ‘science in Africa’

Science, innovation and technology are commonly seen to be key drivers of economic growth and social development. This acceptance of ‘science’ requires prior acceptance of a complex of associated assumptions: a shared understanding of the epistemic and ontological validity of science, scientific method, rationality, and empiricism. In other words, science is an intellectual elaboration of a *world view* that incorporates a conceptual complex that includes rationality, empiricism, and belief in the scientific method (hypothetico-deductivism). Science, in turn, is embodied or codified in *technology*. This complex may have originated in Enlightenment era France (Koselleck, 1988; Adas, 1989), although this notion has been challenged by claims that it has precursors in Asia and the Middle East (Huff, 1993; Marks, 2002; Elman, 2005; Talhami, 2008). Whatever the case, ‘science’ now had a global nature, expressed in terms of a ‘global scientific and technological frontier’ that is common parlance within innovation studies (Fagerberg and Verspagen, 2007; Martin, 2008; Alder, 2010). Science and its related concepts and products have achieved broad global acceptance and have been appropriated by many cultures (Abramowitz, 1986; Marks, 2002).

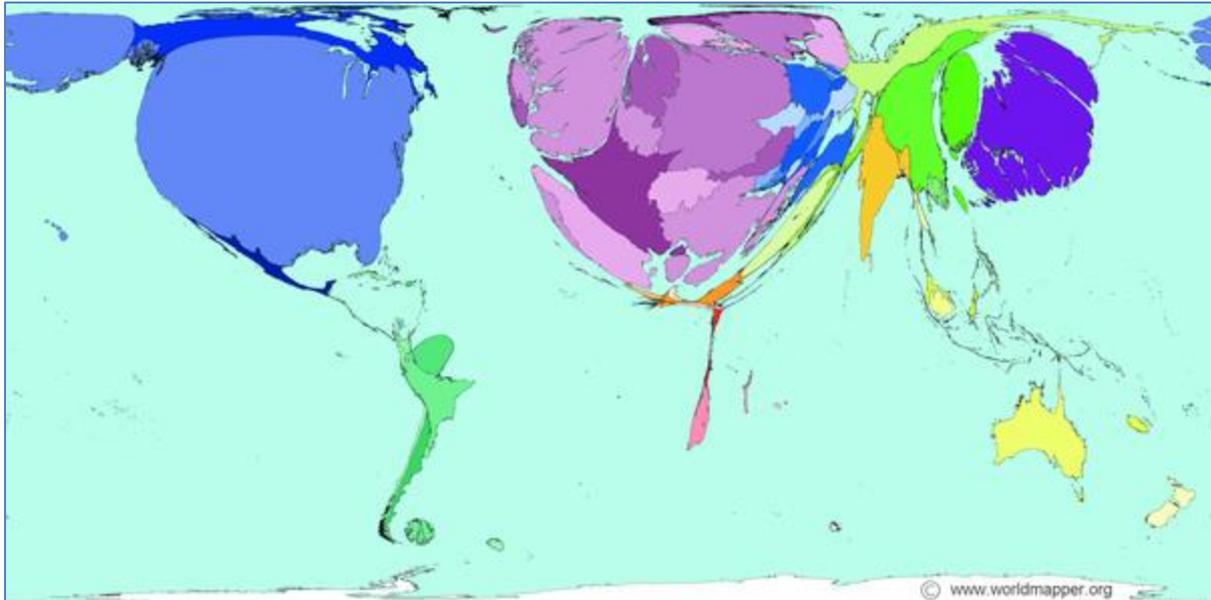
Science and technology have radically reconfigured intellectual, social, cultural, economic and political structures. These changes have largely been viewed as ‘positive’, ‘progress’ etc., particularly in the literature on the ‘public understanding of science’ and ‘science communication’ (Bauer, Allum and Miller, 2007), and in the innovation studies literature (Fagerberg and Verspagen, 2007; Martin, 2008;). At the same time, science and technology have also been used as tools to achieve political and economic ends that have resulted in negative humanitarian consequences. A critical literature has examined the means by which science and technology have been used for domination and destruction, whether related to environment, social, cultural, or political factors (Adas, 1989). Famously, science and technology enabled the colonialist project of Europe in the eighteenth and nineteenth

centuries (Adas, 1989; Diamond, 1997). Science and technology have to some extent been destructive to African culture and also destructive to livelihoods and the environment, in that they are enablers of Western-imposed ‘development’. Examples here include controversial big dam projects, genetically modified crops, cash crops, and kleptocratic resource extraction. Science and technology have also undermined traditional African cultural practices and social structures (Wane, 2005).

This tension needs to be taken into account when positioning the SKA in an African context, for example focussing on the development context of the project. However, the case of the SKA is less heated in this regard than other applications of science in Africa. The SKA is an example of ‘pure science’, basic research that has few immediate economic implications beyond the expenditure required by the science itself. This lends focus: in this case it is less likely that notions of ‘science’ and ‘technology’ will become conflated with notions of ‘development’ or ‘Westernisation’, along with the attached discourses of imperialism, exploitation, etc. However, it remains important to retain a critical approach towards science and its institutions – asking whether structures of power and voice are inclusive of the local population.

Despite evidence of the increasing globalisation of science, Africa appears to have been largely excluded from the global scientific community. Africa has produced relatively few measurable science outputs, such as patents and the publication of articles in internationally recognised scientific journals. The view of Africa as a scientific laggard is graphically illustrated in Figure 2, drawn from the London School of Economics website, which shows a map of the world, with countries sized according to their output of peer reviewed scientific publications in the early 2000s . This view, of Africa as being largely excluded from global science, arguably characterises not only global perceptions, but the self-perceptions of Africans. Establishing the manner in which ‘globalised science in an African context’ is constructed in the media, and in the public imagination, thus forms part of a broader project of developing a more nuanced understanding of the functioning of science and technology movements in the public sphere in Africa.

Figure 2: The world according to science output



Source: <http://blogs.lse.ac.uk/impactofsocialsciences/2013/04/29/redrawing-the-map-from-access-to-participation/>

2.4.2. Astronomy in the South Africa public sphere

Astronomy and cosmology occupy distinct places in the African and South African cultural and political landscape. Firstly, astronomy has a politico-symbolic value that has resulted in substantial support from the South African government. As noted by Gottschalk (2005: 1):

‘In its first twelve years of rule the African National Congress (ANC) government spent more on astronomy than all governments combined between 1913 and 1993. Three factors drove this unexpected development: (a) national prestige; (b) the dignity of the continent of Africa; and (c) Black dignity. Both astronomy and astronautics project an image of modernity – the cutting edge of high technology. When the government supports initiatives such as SALT, SKA, the proposed national space agency, and microsats, it does so because it perceived these as having a political importance far beyond their intrinsic importance to astronomy. These project “soft power” – an image of modernity to foreign powers and foreign investors – which contribute to their intangible perceptions of South Africa.’

This analysis suggests that the case study needs to assess the SKA as a *symbol* within the context of the public sphere, including its possible construction as a symbol of science and

technology achievement, prestige, and membership of the global scientific and technological community.

Since 2005, the trend of increased public funding has escalated, with public expenditure on the SKA being between 600 and 700 million Rands per annum in the medium term expenditure framework, and projected to grow by an average of 45.8% per year (National Treasury, 2013):

Table 4: Public science and technology expenditure: 2009/10 – 2015/16

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	MTEF
	Outcome			Revised estimate	Medium-term estimates			Average annual growth
R million								
National departments	3 507	3 360	3 691	4 067	4 616	4 716	5 565	11.0%
Public entities	7 712	9 291	10 021	11 030	11 679	12 678	13 361	6.6%
Total	11 220	12 651	13 713	15 096	16 294	17 394	18 926	7.8%
<i>Of which:</i>								
<i>Square Kilometre Array</i>	502	13	11	231	641	661	715	45.8%
<i>Human capital and science platforms</i>	1 119	1 244	1 408	1 434	1 707	1 858	2 346	17.8%
<i>Research and infrastructure</i>	449	485	531	603	738	792	1 036	19.8%

(National Treasury, 2013).

This again raises the question: given the high level of public investment in the SKA, are its scientists responsive to this public in terms of their engagement with the media?

Astronomy in Africa is closely investigated in the literature on paleoarcheology, indigenous knowledge systems, and ‘African cultural astronomy’, which seeks to record and analyse indigenous astronomical knowledge and practice in current and historical African culture (e.g. Moore and Collins, 1977; Evans, 1992; Snedegar, 1999, 2007; Holbrook, 2007; Chabalala, 2012). This literature makes it clear that astronomy has a long history in Africa, and that African culture has integrated astronomical knowledge into its indigenous knowledge systems and cultural practices for millennia. Current astronomy is thus perceived as a ‘resurgence’ of a traditional African practice. The search for and analysis of this discourse is thus an important component of the media analysis and interview research questions.

2.4.3. Representations of science in the African and South African contexts

2.4.2.1. The media in South Africa

South Africa has the oldest and most advanced media sector in Sub-Saharan Africa – dating back to the late 18th century and currently driven by high-end technology and skills (Wigston, 2008). The media sector is characterized by ongoing tension between private and public actors. The relationship between the state and the media in South Africa has been complex. Broadcasting has historically been dominated by the state controlled South African Broadcasting Corporation (SABC), although more recently the privately owned satellite services have gained market share. The 2011 All Media Products Study (AMPS) survey by the South African Audience Research Foundation found that 27.0% of households had such satellite television. On the other hand, the print media has been dominated by commercial enterprises, which has resulted in an often strained relationship with the government, both in the case of the Apartheid regime and the present ANC regime. This has resulted in numerous threatened and actual restrictions on press freedoms. Roelofse (1996:70-71) identifies this as one of the main themes that have characterized the history of the South African press. Related to this are efforts by journalists to circumvent undemocratic laws, and the state viewing the press as a threat to ‘peace and security’.

Other important themes include the division of the press based on language and race. Historically (Roelofse, 1996: 70) the main divisions were seen to be the ‘English’ press, the ‘Afrikaans’ press, the ‘Black’ press and the ‘alternative’ press. In the post-Apartheid context, and in the context of globalization and the new media, these divisions seem outdated and require revision (Switzer and Adhikari, 2000).

These themes, however, do remain relevant to the systemic positioning of the SKA relative to the government. Clarifying the role of government in the science communication process, both as a shaper of messages and as an actor portrayed in those messages, is thus an important component of the empirical and analytical methodologies of the case study. At the same time, differentiating between media channels based on language and other demographic features remains important to an understanding of the science communication process.

2.4.2.2. The media in Africa

Research focusing on the African media takes a variety of perspectives, for example Wigston (2001), Spitulnik (2002), and Banda (2007). Curran (2002:3-34) classified these accounts into different ‘narratives’, each of which constructs a particular lens through which to view the evolution of the African media. These include: the liberal narrative, with a focus on the manner in which press freedom has empowered the people; the feminist narrative, with a focus on gender representations and equality; the libertarian and anthropological narratives, which focus on how the media have promoted social tolerance and inclusive representation, and the ‘radical’ narrative, which draws on a Habermasian conception of a public sphere in which reason is used by a restricted membership to debate public issues – but which over time is undermined by manipulation and control of powerful actors and interest groups.

Fourie (2008:84-85) provides an overview of the historical development of the media in Africa. He proposes three overlapping epochs in his history, namely the colonial, post-colonial, and globalised periods. During the colonial period, the press functioned to promote the project of colonial expansion. This included the channeling of European culture to the African colonies, and media support for capitalist and missionary expansion. On the other hand, where African interests had influence over media channels, the media also facilitated African decolonisation. During the post-colonial era, under the control of newly independent states, the media were used for nation-building, mass education, and the effecting of further ‘decolonisation’, while at the same time becoming a tool for suppressing dissent. The current era, that of globalization, saw fundamental departures from these trends. The process of globalization included aspects of liberalization, deregulation, privatization, commercialisation, and technological convergence – particularly the increased role of ICTs and the internet in transmitting media. It is therefore important to examine the ICT-driven social media, and to consider the effects of globalization on communication and the positioning of the SKA in the public sphere.

There are also some challenges that are particular to the African media. There remain substantial restrictions on freedom of expression. Governments have largely retained constitutional and legislative restrictions on press freedom, under guises of national security, public safety, public morality, and defamation (Fourie, 2008:82-83). Most African governments have been unwilling to enact laws that promote access to public information (Media Institute of Southern Africa, 2006:13). This includes South Africa, where the national

government has engaged in a protracted battle with advocates of press freedom over the controversial Protect of State Information Bill, known as the ‘secrecy bill’, that aims to inhibit public access to information and punish infringements of these limitations. ‘Insult laws’ in many countries make it an offence to question the integrity, ‘honour’ or dignity of state officials. These restrictions on press freedom have endangered the lives of journalists. This insecurity is in many cases exacerbated by weak organisation of the journalism profession at the national level.

However, the relevance of these challenges to the SKA is not as significant as it might be for other issues or areas of reporting. It seems unlikely that the lives of African journalists would be threatened in the line of reporting on the SKA. The SKA is not overtly attached to politically subversive messages, nor does it directly threaten the interests of authoritarian African states.

2.5.3. Representations of Science in Africa

The body of literature focusing on media representations of science in an African context is severely limited. The only extant research on representations of science and technology in Africa is Lugalumbi *et al.* (2011) in a study for UNESCO that included content analysis of media from Cameroon, Kenya, Ghana, Namibia, South Africa, and Uganda. The theoretical framework was based on the public understanding of science literature, rendering a methodology using coded media content analysis of one major national daily in each country, and key informant interviews with scientists, policy-makers, and journalists. Although the scale of the study was small (93 newspaper articles and 90 interviews), it provides useful contextual information as well as a methodological benchmark (that included the interview instrument and the content analysis coding form).

Lugalumbi *et al.* found that 6.5% of the sample reported on astronomy, but provide no further detail of this sample. With respect to the context of science reporting, they found that in almost all cases, media organisations in Africa did not have explicit policies guiding the coverage of science and technology, but were generally guided by the availability of information and the potential for reader interest – which is greatly determined by the extent to which the science in question affects readers’ lives. The limited training and skills of African

journalists with respect to the coverage of science constrained the extent of science reporting – there is almost no training in science journalism in Africa, with the exception of a single postgraduate course at the University of Stellenbosch, and the occasional training course paid for by international donors. There are however efforts underway by the South African National Editors Forum, UNESCO, and the South African Department of Science and Technology, to further develop training in this area (<http://www.dst.gov.za/index.php/media-room/communiques/1085-dst-sanef-and-unesco-partner-to-improve-science-journalism-training>).

The only available extant research focussing on the science journalism in Africa is that of Clayton and Joubert (2012) in a research paper for UNESCO on ‘The Need for an African Science News Service’, based on a survey of journalists and science institutions. This outlines the challenges for science communication in Africa, particularly with regards to a lack of local news-feed, and notes an emphasis on non-African science stories:

‘At present, it is considerably more difficult for African science journalists to obtain information about research being carried out within universities and other institutions on their own continent than about research in the developed world. As a result, African newspapers and other media tend to carry lengthy descriptions of research in the United States and Europe – often provided by wire services and used without any effort to mould it to local circumstances. But they carry relatively little about the achievements of African researchers on their own continent’ (Clayton and Joubert, 2012:5).

Clayton and Joubert (2012) also provide evidence of the main sources for journalists trying to report on scientific research in Africa. These included ‘internet aggregator sites (for example, Science Daily and Live Science), international and other African media for story leads, and press releases from research bodies, development agencies and governments. About one-third listed the international news services EurekAlert!, AlphaGalileo and SciDev.Net. Also mentioned were the importance of institutional press officers, and personal contact with scientists and doctors’ (Clayton and Joubert, 2012:6).

The report also highlighted problems in the relationships between scientists and journalists. One source in their survey commented that ‘researchers are unavailable, don't communicate in plain language and are arrogant. Researchers think journalists misreport, misrepresent and

sensationalise. This amounts to mutual lack of confidence, trust and understanding.’ (Clayton and Joubert, 2012:9). Scientific organisations responding to the survey highlighted the need for ‘scientists to understand better how the media works and to improve their interactions with the media, as well as to be more open and understand that the media is not the enemy’ (Clayton and Joubert, 2012:9).

According to one of their survey participants: ‘It is easier to get a quote from scientists in Europe or the US on a story I’m doing here in Nigeria, than getting a Nigerian or African scientist to comment. The African scientists will want to know first how you got his or her cell phone number, what publication you work for, and why must it be him/her that must comment on the issue. Then they take years to get back to you, even after answering all his/her questions.’ (Clayton and Joubert, 2012:9-10).

2.5.4. Representations of science in South Africa

Science communication research in South Africa has shown that the South African media mostly neglect reporting on scientific discoveries and developments, although some attention is given to reporting on technology, environmental affairs and medical matters (Claassen, 2011a). When journalists do report on science, the quality of reporting is often open to criticism from the scientific community, as a national survey of South African scientists and journalists shows (Claassen, 2011a). Other studies have shown that South African journalists regard scientists to be fairly inaccessible communicators of their research to the public, who are mostly funding them either directly or indirectly (Claassen, 2001a; 2001b; 2011a).

Van Rooyen (2004) examined the state of science and technology coverage in the print media in South Africa. She found that science and technology received low levels of coverage in this context, receiving only 1.8% of editorial space in some of the country’s top publications (Van Rooyen, 2004). She attributed this low level of coverage to a shortage of dedicated science journalists, and the effects of gatekeepers within the news media. She found that the Afrikaans-language news media employed relatively more dedicated science journalists, and thus had greater capacity in terms of science reporting. The tone of science coverage was largely positive (70% of the sample) and a significant proportion highlighted the benefits of science (42% of the sample). Of all the science topics, biomedicine was the most commonly reported on (18% of the sample), and astronomy the second most (14%). Van Rooyen

suggests that this relatively high profile for astronomy may be related to the media interest in the visit to the international space station by South African entrepreneur Mark Shuttleworth during the period of study.

Gastrow (2010) examines coverage of biotechnology in the South African media, using both key informant interviews and coded content analysis of media outputs. This study also found that strained relationships between scientists and journalists, as well as inadequate institutional support, limited the scale and scope of science reporting.

The status of science news reporting in the popular local media is reflected in the fact that although most of these media do report on science, it does not occur in a structured media environment where science editors are treated as equals to other editors in the news process (Claassen, 2011a). A survey of the South African media's structures for science journalism has found only one South African newspaper (*Business Day*) had a structured and organised science desk, managed by a designated science editor with a team of trained science journalists (Claassen, 2011b). Since then one other weekly newspaper (*Mail & Guardian*) has initiated a dedicated science editor. This low profile is in contrast to structured political, business and financial, sports, arts, culture, lifestyle and other designated news desks run by senior editors in those specialist fields, and also to the status of science reporting in many European and American media, as noted for example by Knip (2002).

2.6. Conceptual framework

The conceptual framework for the case study draws on mass communication studies, science communication studies, and issues related to the problematisation of science in an African context. Concepts from mass communication studies are foundational, in that they establish the basic ideas and structures with which to make sense of the communication process and its outputs. Concepts from science communication studies form the core of the conceptual framework, as they have established, through precedent, cogent ways of understanding science communication in particular. Finally, issues related to the problematisation of 'globalised science in an African context' are drawn on to contextualize the conceptual framework and align it with the research question.

The framework outlined below thus underpins the conceptual basis of the study, and provides concepts, theory, and methodological guidelines for operationalizing the research question and component sub-questions in the context of the case study of representations of the SKA in the South African media.

2.6.1. Foundation: mass communication studies

Some of the key concepts drawn from mass communication studies, as described in the literature review, include the concepts of ‘media studies’, ‘mass media’, and ‘audience’. The mass communication literature also highlights that the implications of ICT-based media platforms and globalization are increasingly central and of direct relevance to the case study. As pointed out by Fourie (2008:12), the main goals of mass communication studies are to describe, explain, interpret, predict, and reform the media’s social relationships. This case study has a descriptive-analytical focus, and will constrain its scope to describing, explaining, and interpreting the mass communication process related to the SKA. Policy-driven aspects (predicting) and normative aspects (reforming) will remain outside of the scope of the case study, although these are likely to be fruitful avenues of research thereafter.

As indicated by Croteau and Hoynes (2003), the case study will investigate, in a structured manner, the ‘social relations’ that characterize the mass communication process related to the SKA. This includes internal relationships within the media, relations between the media and other social structures in society, and the media’s relationship with audiences. These three fundamental types of relationship will structure the conceptual modelling and empirical activities of the case study. Another central concept for mass communication studies, in the context of these relationships, are those of ‘structure’ (of the media as a ‘socialisation instrument’) and ‘agency’ (the capacity of individuals in the public to influence the media).

In terms of McQuail’s broad typologies of mass communication theory, this case study will be located in the ‘social scientific theory’, which investigates the ‘nature, working and effects of mass communication, based on systemic and objective observation of media and other relevant sources, which can be put to the test and validated or rejected by similar methods’ (McQuail, 2005:14). This broadly described approach frames the concepts and methods employed in the case study. However, the case study does not require a clearly articulated position within either the ‘dominant’ or the ‘alternative/critical’ paradigms of mass

communication research. Instead, the study will draw on aspects of both ‘paradigms’ as required by the research question.

The ‘dominant paradigm’ and its emphasis on scientific method and replicable empirical study will inform several aspects of the study, particularly the media content analysis. The conceptual modelling of the study will draw on some of the main ideas underpinning this ‘dominant paradigm’. These include the ‘functionalist’ view of the media in society (Lasswell, 1948), which is compatible with an ‘actor-network’ conceptualization, in which the media is one of many social actors, which are related to each other in a variety of ways. Key variables can be modelled in this context in an attempt to describe and explain the system of actors and their relations.

Concepts from information theory (Shannon and Weaver, 1949) are also central, as they continue to be used to conceptualise the core elements of information transmission in the context of media studies. Thus, within the broader actor-network conceptualization, elements for conceptual modeling and for analysis include information sources, information transmission (a signal), communication channels, information receivers, information transformation for a destination, and noise (interference) can modify the message as it moves from sender to receiver.

The political economy of the SKA is complex, and involves several aspects of interest to the research agenda of science communication studies. There are numerous political, economic, intellectual, and institutional actors, including the media, that have played a role in the evolution of the SKA project and its presence in the public imagination. The SKA has served political interests – such as the advancement of African science and technology as a socio-cultural symbol. It has served economic interests, primarily those of investors and firms in the supply chain, over which there has been fierce competition for multi-billion Rand contracts by firms all over the world. It serves intellectual interests – the technological and scientific aims of the SKA consortium, which together seek to unlock some of the most challenging and fundamental mysteries of physics and cosmology.

Drawing on the heuristic of the public sphere, investigating the motivations, actions, influences, and inter-relationships amongst these actors in the context of the case study fills a gap in science communication research. The scope of the case study is to measure and

analyse the roles of the actors in the science communication process, from the micro (scientist-journalist relationships) to the macro (geopolitical positioning by nation-states), to describe and explain the SKA's science communication process, and to describe and assess how this influences the construction of message in the news media and the social media.

The methodological approach towards issues of political economy is generally more qualitative. This is reflected in the methods for key informant interviews, and the subsequent analysis. Importantly, such analysis is compatible with the overarching actor-network conceptualization which frames the case study and which also subsumes the media content analysis component. Some of the key concerns of critical media theory are also included in the media content analysis. This includes differentiation between the explicit content of messages and their latent (or implicit) content – in other words the framing of the message.

The critical paradigm is also the source of a core heuristic for the case study conceptualization, namely that of the Habermasian public sphere, a conceptualization of the media as situated in a notional 'space' for public debate. Although Habermas's application of this construct was initially to critique the role of the mass media in undermining true public debate and democracy, the conceptualization can be used for other applications, notably those of Bauer (2002, 2005), which use this heuristic to model the public sphere around a specific aspect of science and technology, and apply this model to better understand aspects of media representations, public attitudes, governance, and the roles of social actors.

Another aspect of mass communication that is relevant to the case study is the social responsibility theory of the press. Since the SKA project is publically funded, the media have had a social responsibility to bring information about it to the public. The SKA as a case study can thus examine how the social responsibility of scientists from the SKA to communicate their intricate science to the public has influenced communication processes and been reflected in the media.

Concepts of gatekeeping are also important to understanding the communication process. Gatekeeping activities within the media include surveillance, culling, selection criteria, news value, agenda-setting, framing, and systemic bias within the media. These processes are central to describing and modeling the overall science communication process, including the

processes that occur inside the media, processes that occur within other social actors, and processes that occur in their interactions.

2.6.2. Core: science communication and representations of science in the media

Building on this platform of fundamental concepts from mass communication studies, the literature on science communication, particularly on analyzing representations of science in the media, provides a clear conceptual (and empirical) framework within which to locate this study. The research field of the public understanding of science provides a theoretical context in which to locate investigations into science communication, and has generated an extensive literature in this area.

Not all research into representations of science in the media draw on a public understanding of science perspective, but they do share some common empirical approaches based on media content analysis, at times complemented by interviews with key informants. These data are used to describe and explain the science communication process and its outcomes, with reference to a number of central themes. This framework has been used by many studies over an extended period of time (Schäfer, 2012). The literature provides many examples from which to gauge methodological best practice, including the identification of content analysis and interview methodologies.

One of the primary themes is to understand how a controversial scientific issue is presented in the media. This is relevant to all parties to the controversy, particularly government actors, who want to understand how the controversy is framed in the public sphere and hence in the public imagination. This theme is relevant to aspects of science such as nuclear energy, biotechnology, and climate change. The SKA in itself is not as controversial, but there are aspects of the SKA that are indeed controversial, and to this extent the study will aim to measure, describe, and understand representations of these controversies. Firstly, the split-site allocation of the SKA, spread between South Africa and Australia, was a controversial decision and received significant press coverage – and indeed forms the dominant frame for representations of the SKA in both the news media and the social media. Another controversial issue is the ongoing effort by oil companies to introduce shale gas fracking near the SKA core site, which has the potential to compromise the efficacy of the project. Finally,

some contestation over the development context of the SKA could also be seen as controversial.

In examining the set of relationships that influence the science communication process, a central theme in the study of science communication is the relationship between journalists and scientists, as embedded in the broader institutions of the media and science. This is one of the main aspects of the key informant interviews, which include interviews with both scientists and journalists. However, investigating the other relationships is also important, as indicated by Bauer's (2002) 'three arenas' heuristic of the public sphere, which highlights a number of relationships between social actors as being significant to the representation of science. The focused investigation of these relationships forms a part of the methodology of the study, and is also compatible with the overarching actor-network approach. These actors include the media, the SKA itself, actors in the public sector such as government departments and agencies, universities and research institutes, private sector organisations such as industry bodies, and private firms.

2.6.3. Context: problematisation of 'science in Africa'

In the African context, science, and science as a 'world view', are historically problematic, and have been used for exploitation and colonization. Sensitization to these issues is important. The case study thus includes an investigation of how locally affected communities are represented in the media, as well as debates related to the development context, such as whether the large South African public expenditure on the SKA is justified, given the country's enormous challenges and resource constraints.

The African media, as elsewhere in the world, have been affected by liberalization, privatization, globalization, and the emergence of ICT platforms. Investigating the roles of these trends is thus an important component of the study. The South African media have historically been dominated by government and firm actors, providing further cause to investigate their role in the science communication process and the manner in which they are represented in the media. Another important historical issue in the South African media is differentiation based on language and other demographic features. The study therefore includes these as variables for empirical investigation and analysis.

The limited body of research that examines representations of science in Africa and South Africa also raises some relevant issues. The only currently available study on representations of science in Africa (Lugalumbi *et al.*, 2011) provides a context against which to compare the representations of the SKA in the media. Previous research on representations of science in the South African media provides some points of departure for further investigation. Firstly, analysis has revealed low levels of coverage of science (Van Rooyen, 2004), the lack of a structured media environment for science reporting, inadequate institutional support, as well as problematic relations between scientists and journalists (Claassen, 2011a, 2001b). Investigating whether and how these issues emerge in the science communication process of the SKA is thus a key empirical and analytical question.

The political-symbolic and cultural aspects of astronomy also raise interesting discourses for empirical investigation and analysis. The sharp increase in government support for astronomy (Gottschalk, 2005) raises the discourses of African scientific and technological achievement, national prestige, and projections of an image of modernity to the world. It also raises the question of whether, given this increased public support and rapidly escalating expenditure, scientists who rely on public funds are responsive to the public through their engagement with the media.

2.6.4. Conceptual overview

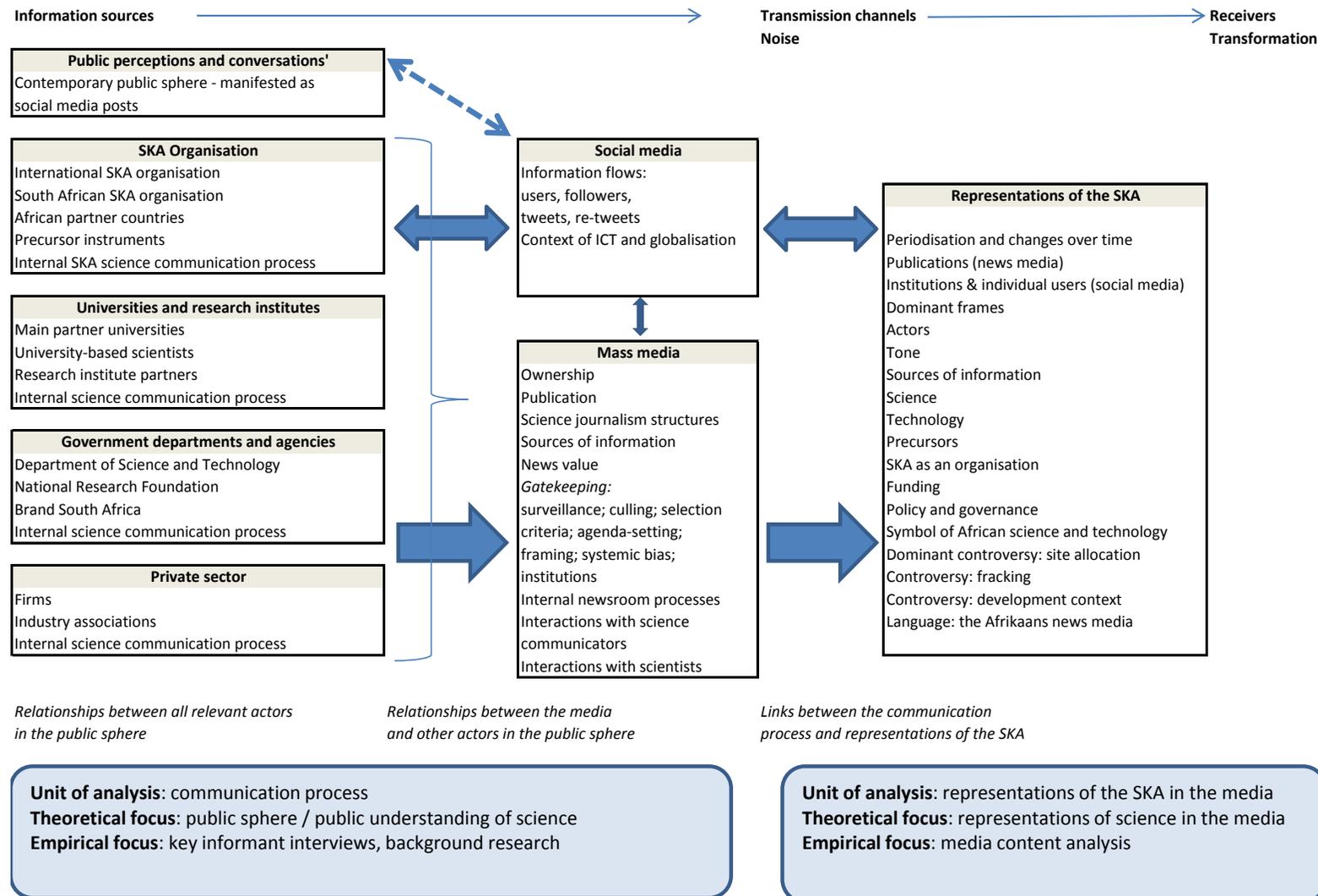
Within the rubric of the public sphere, the conceptual framework of an actor-network model has been used to better understand the science communication processes that lie behind representations of the SKA in the media. The framework has two principal components. Firstly, it looks at the actors relevant to the positioning of the SKA in the public sphere. The central actors are the SKA itself, as well as the mass media. Other important actors include universities and the public sector (government departments and agencies). In principle, private sector actors, such as astronomy organisations, international intermediaries, and firms in the SKA value chain, also play a role. However, early on in the fieldwork process it was established that this role is minimal, and that communication from these actors plays at most a minor role in the communication of the SKA. As such, in order to retain focus on the most important actors, private sector actors have not been included in the analysis.

The second principal component is the relationships between these actors. It is in understanding these relationships that the overall network, and the processes it contains, can be modelled in line with the conceptual framework. Figure 3 illustrates, in abstract, the main groups of actors and their relationships. Each of the lines connecting the actors (and they are all connected to each other, to a greater or lesser extent, in the communication process) represents a relationship that is relevant to understanding the overall communication system. In this conceptualisation, the media are positioned as a conduit for messages from other actors to reach the broader public. This conceptualisation allows for the development of a functional model of this communication process. This includes a triangulation of data describing relationships from multiple points of view – for example comparing the SKA’s point of view about its relationship with journalists to the journalists’ point of view of their relationship with the SKA.

Figure 3 provides an approximate graphical illustration of the conceptual framework outlined above. This indicates the two broad domains of research. Firstly, research into the science communication process, which has a theoretical focus on the factors that shape representations of science within a notional public sphere, in the theoretical context of the public understanding of science and science communication. The empirical focus here is on key informant interviews and background research into the main actors within the public sphere as relevant to the mass communication of representations of the SKA. The second main domain of research is the analysis of the outputs of the science communication process, namely the representations of the SKA in the media. Here the unit of analysis is media outputs, and the dominant theoretical framework is that of science communication. Empirically, this draws on a media content analysis of both news media and social media outputs. Figure 3 also illustrates the stages of information transmission that will be investigated, including sources of information, the transmission of information through various channels, and the processes of receiving and interpreting information. This provides an abstract lens through which to view the science communication process.

Finally, at the highest level of abstraction, the analysis may suggest connections between the science communication process and the representations of the SKA in the media. These are explored in the concluding chapter, which returns to the key concepts and theoretical lenses of the conceptual framework to examine the communications structures, processes, and outputs from a broader, systemic point of view.

Figure 3: Conceptual map of the case study of representations of the SKA in the media



Chapter 3: Methodology

3.1. Overview

A combination of desktop research, key informant interviews, and media content analysis have formed the basis of many studies of representations of science in the media, including broad overviews (Nelkin, 1995), sectoral analyses (Nisbet and Lewenstein, 2002; Bauer, 2005; Bonfadelli, 2005; Gastrow, 2010), studies focused on scientific controversies (Weingart *et al.*, 2000), studies focused on representations of astronomy in the media (Madsen, 2001; Madsen and West, 2001), and studies of representations of science in Africa (Lugalambi, 2011). In all cases, the fundamental methodological structure has been similar. Desktop research has been used to gain contextual knowledge about actors relevant to the science communication process and their inter-relationships. Key informant interviews have also focused on contextual knowledge, as well as aspects of the science communication process and the construction of media representations. Media content analysis has focused on identifying salient features and trends in media representations, and correlating these findings with major political, economic, social and scientific actors and events in order to construct a narrative or model of the relationship between these domains and media representations.

The methodology for this study focuses this approach on the SKA, and at the same time aims to operationalize the conceptual framework, the basic architecture of which is outlined in Figure 3. As indicated, there are two broad operational aspects, with distinct units of analysis, theoretical foci, and empirical foci, examining firstly the process behind media representations of the SKA, and secondly examining the outputs of that process by examining the nature of the representations themselves.

Research into the process that takes place ‘behind’ representations of the SKA in the media, with a view towards understanding how these representations are constructed within the social institutions that make up the media, has a theoretical focus on the public sphere heuristic and the public understanding of science, including science communication. This theoretical scope is brought together in an actor-network framework. Research into the processes through which these actors, situated in relationships with each other, undertake science communication and science journalism is the focus of the first two research chapters. This provides an empirical and theoretical context within which to situate the subsequent

chapters that focus on analysing representations. By clarifying the process behind the representations, and later comparing these to the results of media content analysis, a synthetic analysis can aim to provide insight into how, and why, the SKA is socially constructed in the public sphere. Across all the research chapters, a focus is maintained on issues of contestation, conflict, and controversy. These issues are drawn from all the data sources and analysed within the broader context of the science communication process and outputs.

Chapter 4 provides a history and periodization of the SKA. The main data source for this chapter was desktop research into the SKA, including many online resources such as the SKA websites, as well as written sources such as Wild (2012). These data sources were supplemented by additional detail emerging from the key informant interviews as well as the media content analysis, both of which were rich sources of contextual information. This chapter provides details about the main SKA actors and their relationships, which are used to frame the analyses in the research chapters. For example, by highlighting the main events that have characterised the growth of the SKA over time, it is possible to include these in the analyses of media processes and media outputs. Chapter 4 thus provides a vital background for the subsequent chapters.

Chapter 5 focuses on science communication, which, for analytical purposes, is defined as the communication activities that fall outside of science journalism, which is treated separately. This looks closely at the communication objectives, structures, processes, audiences, channels, and messages that characterise each of the main sets of actors, as well as the relationships and information flows that connect them and characterise their positioning in the public sphere. This analysis draws on key informant interviews with senior staff at each of the actors, which have been transcribed and analysed using Atlas.ti qualitative analysis software.

Chapter 6 focuses on science journalism, which provides a critical link between science communicators (based outside the media) and messages that enter mass media. This examines in more detail the context of science journalism in South Africa, as well the internal processes that govern the production of science news, such as gatekeeping, framing, selection, and the roles of institutions. It also looks at the relationships that science journalists maintain with science communicators, including a focus on the central relationship between journalists and scientists.

In chapters 7 and 8 the focus shifts onto analysing media representations of the SKA, in other words onto the *outputs* of the science communication process. The theoretical focus here is drawn from the literature on representations of science in the media, although a view is maintained of the context in the public sphere and of the overarching actor-network framework. The empirical basis of this research is the analysis of media content about the SKA that appeared during the twelve months centred around the announcement of South Africa as one of the SKA infrastructure sites (September 2011 – August 2012).

Chapter 7 focuses on representations of the SKA in the news media. This draws on a nationally representative sample of 203 news articles about the SKA in the English news media. By drawing on the literature review, key informant interviews, and a pilot coding exercise, a dynamic coding schema has been applied to these data in order to develop an in-depth profile of these representations, providing further insight into the manner in which these messages have been constructed by the news media, with input from science communicators. Coding and preliminary analysis were conducted using Atlas.ti qualitative analysis software. In addition, a sample of 71 articles has been drawn from a key Afrikaans language publication, *Die Burger*, to explore and compare the main features of how the SKA has been represented in the Afrikaans news media.

Chapter 8 turns attention to the online social media. This draws on a nationally representative sample of 1588 Twitter posts. This again draws on the common coding schema developed for Chapter 7 and Chapter 8, allowing for comparability. The analysis of the social media provides an important source of information about how the SKA is positioned in the public sphere, specifically with insight into the manner in which ‘attitudes and conversations’ of the public have influenced the construction of representations of the SKA.

Chapter 9, the conclusion, draws on both the process and the outputs operationalizations of the conceptual framework, and hence on both the key informant interviews data and the media content analysis data. This brings together the research findings of the study to reflect on the main theoretical components of the study, and take a broader view of their implications within the conceptual framework of the study, and thus develop an empirically and theoretically informed understanding of how representations of the SKA are constructed in the South African media.

Thus, from a methodological point of view, the main research activities are:

- Drawing on the literature review and conceptual framework to develop the methodology;
- Desktop research;
- Key informant interviews;
- Media content analysis;
- Analysis, synthesis, and modelling.

These main activities are described in more detail in the sections below.

3.2. Conceptual framework as a basis for a methodological framework

The literature review and conceptual framework identify the main variables and conceptual constructs that inform the design of empirical research instruments – including both the key informant interviews and media content analysis. By abstracting from the literature review and conceptual framework, these variables and constructs are summarized below.

Firstly, as suggested by Croteau and Hoynes (2003) and Bauer (2002), the analysis of the science communication process is focused on ‘social relations’, including internal relationships within the media, the media’s relationships with audiences, relations between the media and other social structures in society, which include but are not limited to, government department and agencies, the SKA organization itself and its components, journalists, editors, academics, scientists, public relations actors, and firms. Within this construct, questions about the ‘public sphere’ include variables examining the characteristics, motivations, actions, influences, and inter-relationships among these actors, including public relations efforts by the SKA and other actors, and the influence of public opinion on mass media production, for example through the influence of perceived news value. Questions about ‘internal relations’ within the media include aspects of governance, culture, and procedure.

Overall, these relationships are framed in a loose actor-network conceptualization, in which the various societal actors relevant to the SKA communication process are positioned in a

notional interactive space. This conceptualization has facilitated both instrument design and the modelling of the resultant data. This notional space also includes variables from information theory, such as information sources, channels of transmission, information receivers, information transformation at a destination, and noise or interference during the process.

The mass communication literature highlights several other relevant variables and constructs. The critical approach to media studies raises questions related to the framing of representations of 'Africa', and the issue of the SKA as a socio-cultural symbol of science in an African context. Another set of questions is related to normative aspects, based on the social responsibility theory of the press – for example the debate about public expenditure on the SKA. Finally, a further set of questions emanate from the literature examining internal processes of mass communication: the gatekeeping literature identifies issues of surveillance, culling, selection criteria, news value, agenda-setting, framing, systemic bias within the media, and the roles of institutions in these processes. The systemic approach to understanding the functioning of the media also includes a reflection on the nature of and interaction between structure and agency in the communication system (Fourie, 2008: 114).

The science communication literature identifies further variables, including a focus on the relationship between scientists and journalists (within the overall actor-network space). One of the key areas of investigation in the science communication literature is that of scientific controversy. Interviews and media content analysis have highlighted some controversies related to the SKA. Data drawn from the media content analysis can shed light on these controversies and how they are represented in the media. Key informant interviews also included reference to these controversies, and offer insights in terms of the science communication process and how controversies are nested therein.

Finally, the African and South African context raises particular questions. The historical domination of the South African media by a small set of actors merits focused investigation of the roles of government and large media corporations. Historical differentiation based on language and ethnicity motivates for questions in these areas, particularly looking at the distinct roles of the English and Afrikaans press. The limited body of research that examines representations of science in Africa and South Africa also raises some relevant questions. Lugalumbi *et al.* (2011) and Clayton and Joubert (2012) highlight the challenges facing

science journalism in Africa, including weak relationships between journalists and scientists, and low levels of institutional support. Previous research on representations of science in the South African media reaches similar conclusions about the South African context (Claassen, 2011a). Methodology design therefore aims to uncover how these contextual aspects have affected the construction of representations of the SKA.

In many cases a particular variable has been included in both interview and content analysis instruments to gather salient data from both sources – thus making it possible to compare results from each of these data sources and draw inferences from this. Thus many variables inform the construction of a code (for content analysis) and a question (for key informant interview questionnaires).

3.3. Desktop research

The aim of desktop research was to source contextual information to support an analysis of the science communication process and outputs. This information included:

- The history and periodization of the SKA project, highlighting key events, issues, and controversies;
- Technical details of the SKA project, and
- Background information about key actors and their inter-relationships, including but not limited to those indicated in Figure 3:

This desktop research was used in three main fashions. Firstly, it informed the design of methodologies for key informant interviews and content analysis. Secondly, the most relevant details were brought together in Chapter 4 to contextualise the SKA as a case study. Thirdly, salient information has informed the subsequent research chapters.

3.4. Key informant interviews

3.4.1. Survey questionnaire development

Customised semi-structured questionnaires were developed for 1) journalists and science communicators, and 2) scientists and other actors. Interview schedules were semi-structured.

The interview methodology used the interview questionnaires as a guideline to direct a discussion, rather than as a list of questions to be answered. In practice, each interview was a distinct engagement that produced a unique discussion about each participant's role in and view of the science communication process and outputs relevant to the SKA. This rendered data that is detailed and relevant, and allowed for exploration and the discussion of ideas. The instruments are presented in Appendix A and Appendix B.

The main questions for journalists and science communicators included questions about:

- Organisational profile;
- The internal science communication process;
- Role of science actors;
- Role of government actors;
- Relationships with scientists;
- Role of other actors, and
- Open ended question about issues that are relevant to the science communication of the SKA.

The main questions for scientists and other actors included questions about:

- Scientists' role in the communication process;
- Relationships with journalists;
- Roles of other actors, and
- Open ended question about issues that are relevant to the science communication of the SKA.

These questionnaires formed the basis for all key informant interviews. In some cases, where respondents were unwilling to meet in person, they responded to these questionnaires in writing, generally providing lower resolution data than that provided in interviews.

During the fieldwork process, one additional instrument was developed. It was found that written responses by science journalists did not include sufficient detail on their sources of information to allow for a meaningful comparison to the rich data that emerged from interviews. As such journalists who responded in writing were requested to complete an additional questionnaire – a table requesting more detailed data about their sources of

information (see Appendix C). Together with the data emerging from interviews, this provided a rich source of information that was critical to the analysis in Chapter 6.

3.4.2. Interviews

The identification of possible key informants drew in the first instance on desktop research, which identified the key actors, and in many cases the key individuals positioned within those actors. However the process was also dynamic and purposive – as interviews were carried out, further key informants were identified and included in the fieldwork. Interview scheduling began in September 2013, but continued through this ongoing process until April 2014.

The process of scheduling interviews with key informants was challenging. Senior managers and scientists at the SKA, university academics, and senior management within other actors all face time constraints, and the interviews were dependent on their willingness to participate. Some potential informants declined to participate. However, the large majority agreed to participate, and key informants were ultimately accessed within all the main actors.

One advantage that was leveraged was an overlap with a research project for the South African Department of Higher Education and Training (DHET) (Gastrow, 2014), which also required interviews with key informants relevant to the SKA. Official support by the Department and by the Human Sciences Research Council (HSRC) provided access to some informants that might otherwise have been unwilling to participate. As such, some informants were interviewed for both the DHET project and for this study. This in many cases was beneficial, as it allowed time for issues to be discussed in depth and to develop a rapport with participants.

Interviews were semi-structured and conducted in person. Interviews were confidential and anonymous and adhered to institutional research ethics requirements. All interview participants signed confidentiality agreements and consent forms (see Appendix G). All the interviews were recorded in digital audio, and transcribed verbatim by a research assistant. The quotes used in the analysis sometimes paraphrase the verbatim transcripts in order to make them more legible – for example removing repetition or non-relevant utterances (um, ah, ja-nee, etc.).

In addition to interviews, some respondents provided written responses. The written responses were to the same fieldwork questionnaire as the interviews, and are therefore comparable. Table 5 indicates where the responses were in written form and where they were in interview form. However, the most important respondents were all interviewed in person. Written responses were only used in cases where scheduling was difficult and where the respondent was not a critical one. For example, all the key dedicated science journalists were interviewed, some for up to ninety minutes. However, other science journalists who are not dedicated to science journalism (for example, science could be one area they cover amongst others) and who had not played a central role in coverage of the SKA, submitted written responses.

As is often the case in fieldwork, the utility of the interviews was variable. Some of the interviews, for example with international intermediaries, did not provide very much useful data, and do not feature strongly in the analysis. Other interviews lasted over an hour, in some cases approaching two hours, and yielded rich sources of data. As might be expected, the more substantial interviews feature more prominently in the analysis.

The overall size of the sample was constrained by the nature of a PhD study, which is of necessity limited in scale. The methodology could be employed to increase the scale of the study in the context of a project team. In this case, the number of fieldwork interviews could be increased and the parameters for the media content analysis could be widened in order to increase the volume of data available for analysis. This would provide higher-resolution data as well as increased representivity of the sample.

3.4.3. Sample

An overview of the complete final sample of key informants is provided in Table 5. Additional detail about the sample of science journalists is provided in Table 6 and in Appendix E. This included interviews with or written responses from:

- 1 senior manager at a firm;
- 2 senior managers from government actors (the DST and the NRF);

- 3 senior managers from international intermediaries (the British High Commission, the IAU/OAD, and the UK Science and Technology Facilities Council);
- 7 science journalists;
- 1 scientist from a science council;
- 1 manager/scientist from a science facility;
- 1 science communicator from a science facility;
- 2 science communicators from the SKA (South Africa);
- 1 science communicator for the SKA (international);
- 4 senior managers for the SKA (South Africa), of which 2 are also scientists, and
- 8 SKA-related academics from 5 universities (UCT, Rhodes, US, UKZN, UWC).

The sample of seven science journalists includes:

- **Beat:**
 - 5 dedicated science journalists, and
 - 2 science correspondents who also cover other beats.
- **Publication type:**
 - 4 daily popular newspapers;
 - 1 weekly opinion-leader, and
 - 2 freelance journalists.
- **Region:**
 - 2 Western Cape newspapers;
 - 2 Gauteng newspapers;
 - 1 national newspaper, and
 - 2 national freelancers.
- **Language:**
 - 5 English language journalists, and
 - 2 Afrikaans language journalists.

Table 5: Fieldwork interview summary

Position	Code	Organisation type	Organisation	Data source
Manager	A	Firm	SKA innovation partner	Interview

Manager	A	Government agency	NRF	Interview
Manager	B	Government agency	DST	Interview
Manager	A	International intermediary	British High Commission	Interview
Manager	B	International intermediary	International Astronomical Union – Office of Astronomy for Development	Interview
Manager	C	International intermediary	Science and Technology Facilities Council (UK)	Interview
Science journalist	A	News media	Afrikaans regional daily	Interview
Science Journalist	B	News media	Freelance	Interview
Science Journalist	C	News media	English national weekly	Interview
Science and environment correspondent	D	News media	English regional daily	Written response
Science, technology and crime correspondent	E	News media	Afrikaans regional daily	Written response
Science journalist	F	News media	Afrikaans regional daily	Written response
Science journalist	G	News media	Freelance	Interview
Science communicator	A	Science communicator	Consultant	Interview
Science communicator	B	Science communicator	Freelance	Interview
Researcher	A	Science Council	CSIR	Interview
Manager / scientist	A	Science Facility	HartRAO	Written response

Science communicator	B	Science Facility	HartRAO	Interview
Manager / scientist	A	SKA	MeerKAT	Interview
Manager	B	SKA	SKA business development	Interview
Manager	C	SKA	SKA human capital development and communication	Interview
Manager / scientist	D	SKA	SKA science and innovation manager	Interview
Science communicator	A	SKA (international)	SKA (HQ in UK)	Interview
Academic	A*	University	UKZN	Interview
Academic	A*	University	UKZN	Interview
Academic	A	University	UCT	Interview
Academic	B	University	UCT	Interview
Academic	A	University	UWC	Interview
Academic	A	University, SKA	Rhodes University, SKA	Interview
Academic	B	University, SKA	Rhodes University, SKA	Interview
Academic	A	University	Stellenbosch	Interview

*Note: two academics from UKZN were interviewed together, and the transcript does not differentiate between them. They therefore share a fieldwork code.

Table 6: Science journalist sample summary

Code	Position	Publication type	Region	Language
A	Science journalist	Daily popular	Western Cape	Afrikaans
B	Science Journalist	Freelance	National	English
C	Science Journalist	Weekly opinion-leader	National	English
D	Science and environment correspondent	Daily popular	Western Cape	English
E	Science, technology and crime correspondent	Daily popular	Gauteng	Afrikaans
F	Science journalist	Daily popular	Gauteng	English
G	Science journalist	Freelance	National	English

The SKA

Access to senior SKA management was facilitated by the fieldwork overlap with research for the DHET. The sample included senior managers responsible for overall project management, science and technology management, the MeerKAT, business development, communications, and human capital development. Two of the managers were also scientists, and were essentially responsible for the management of science activities. In addition, two of the university academics in the sample also held parallel science posts at the SKA.

Universities and research institutes

Universities and research institutions are important partners to the SKA, and play a significant role in the communication of the project. SKA scientists based at universities, including South African Research Chairs Initiative (SARChI) chairs and principal investigators on MeerKAT science projects, were included in the key informant interviews. These key informants provided a detailed description of the science communication process as experienced by scientists, as well as the formalised and informal communication processes

and practices inside each university. Each institution plays a distinct role in the SKA project, and each has a distinctive internal communication process that mediates between the university and the media.

There were two primary questions that guided discussion with university-based scientists (through the structure of the interview questionnaire). Firstly, about the nature and structure of the university's internal communication process through which scientists within the university can formally engage with the media. Secondly, about the nature of the relationship that scientists have with journalists. A science communicator and a senior manager at the Hartebeesthoek Radio Astronomy Observatory (HartRAO) were also interviewed in order to establish similar parameters for communication within this key research partner of the SKA. However, the communication activity of HartRAO with respect to the SKA was established to be minimal, and these interviews have not played a significant role in the analysis.

Government actors

Top managers from the DST and NRF were interviewed. These were established as the main public sector actors in terms of communication about the SKA. The questions are directed primarily at the science communication process, as related to the SKA, within each of these institutions, and within the public sector more broadly, and at their relationships with journalists and the media.

Science journalists

The contours of this sample require some elaboration. Firstly, the population of science journalists in South Africa is small. Most South African newspapers and other media channels do not have dedicated science reporters (Claassen, 2011b). A purposive search revealed that only a handful of publications employed dedicated science reporters, including the *Mail & Guardian*, *Business Day*, and *Die Burger*. The sub-set of science journalists who cover the SKA is even smaller, as most science journalists have a topical focus, such as health or environmental issues. One of the science journalists interviewed, who is also a member of the Board of the South African Science Journalists' Association, indicated that the number of full-time science journalists is indeed very small - 'about five in the country'

(interview: science journalist G). The SKA's main science communicator indicated that she has worked with only 12 or 13 journalists reporting on the SKA.

The sample of journalists thus covers most of the dedicated science journalists in the country, and also about half of the total population of journalists that engaged with the SKA's science communicators. As such the sample is broadly representative. Moreover, the journalists in the sample were included through a purposive process that sought to identify the most prominent, prolific, and influential journalists, so the sample has further validity as a result. For example, the names of the top science journalists were sourced from preliminary results of the media content analysis, from the advice of the SKA's science communicators, and from peers (other science journalists).

Marginal actors

Initial key informant interviews in some cases found that the informant, and his/her institution, did not play a significant role in the science communication of the SKA. The interviews were exploratory – conducted in tandem with desktop research into the SKA and the set of institutions related to it that might play a role in its communication process. Some of these interviews found that particular institutions were highly active in communication (for example universities, the DST, and the NRF) while others were hardly active at all (the British High Commission, HartRAO, the OAD). Some actors that play a critical role in the scientific and technological aspects of the SKA, such as HartRAO, and firms, play a much more minor role in its communication. In these cases the data from these interviews has not played an overt role in the analysis, other than to establish a clearer division between actors in the communication arena and non-actors who are outside the communication system.

3.4.4. Qualitative analysis

The analysis of key informant interview results firstly focussed on the profile of responses to individual questions among participants, with the aim of providing a descriptive profile related to each question – i.e. sources of information, relationships with other actors, the role of scientists, etc. Secondly, the analysis sought to establish patterns, trends, and relationships among these findings, with a few to forming a coherent model of the science communication process within the conceptual framework of the study.

This employed a qualitative data analysis approach (e.g. Chenail, 2012; Schiellerup, 2008; Urquhart, C. 2013), including close textual reading of each transcript, drawing out data that was relevant to each component of the research question. This included issues of the roles of actors, sources of information, gatekeeping, news value, the internal communication process, the external communication process, and issues related to controversies, etc. This textual reading was conducted using Atlas.Ti (version 7) qualitative analysis software. This enabled high-resolution coding of relevant text.

The development of a coding system used both ‘top-down’ (deductive) and ‘bottom-up’ (inductive) methodologies. Top-down coding was developed by drawing on the theoretical and conceptual frameworks, developing codes for identifying qualitative data relevant to each of the key concepts and research questions developed in these frameworks. ‘Bottom-up’ codes were developed throughout the analysis. This entailed developing new codes where relevant qualitative data contributed novel aspects or ideas to the analysis. These codes were then inductively grouped into families and integrated with the top-down coding system to develop the final set of codes that were used for qualitative analysis, as listed in Appendix F.

Once coding was complete, Atlas.Ti software was used to bring relevant qualitative data together to address the key variables and research question. The initial primary analysis used a simple method of drawing out all the quotes assigned to a specific variable, placed within the overall analytical framework. Secondary analysis used more complex qualitative techniques to establish the salient features of the science communication process and to situate them within the overarching conceptual framework of the study.

3.5. Media content analysis

Media content analysis involves the gathering of media outputs within a specified sampling frame, and the coding, according to a defined set of variables, of the contents of these outputs. This renders a database that can be used for quantitative and qualitative analysis (Berger, 2013; McQuail, 2005:364-367). This methodology is aimed at unveiling manifest contents of media outputs. In its common usage, content analysis provides insight into how a subject is framed, and what the key themes, actors, roles, tones, and controversies are. In this study, additional coding is focused on answering the main research questions using the

variables and constructs highlighted in the conceptual framework to model the science communication process and its media outputs.

The refinement of this methodology draws on previous research that used media content analysis to study representations of science in the media. Each of these studies presented detailed sampling frames, data gathering methods, coding schemes, and analysis methods. Examples here include Nelkin (1995), Weingart *et al.* (2000), Madsen (2001), Madsen and West (2000), Nisbet and Lewenstein (2002), Bauer (2005), Bonfadelli (2005), Gastrow (2010), and Lugalambi (2011). Drawing on these examples, the characteristics of the media content database, the coding methodology, and the analysis methods are described in more detail below.

3.5.1. Media content database

The development of a media content database had to take into account the following considerations:

- Feasibility/availability of data;
- Methodological consistency;
- Representivity;
- Covering key events in the timeline;
- Language;
- Region, and
- Type of publication.

The considerations of feasibility necessitated constrained time parameters for the dataset. Time parameters also needed to include coverage of key events. The desktop research, media content analysis pilot study, and the key informant interviews had all indicated that the allocation of the infrastructure site to South Africa and Australia in May 2012 was the most significant event for the SKA in South Africa, particularly in the media. This was placed near the chronological centre of the analysis. On the basis of the size of full databases obtained from SAASTA, the time parameter was established to cover one year in the history of the SKA, thus covering September 2011 to August 2012. This rendered a sample that was small enough to feasibly analyse within a PhD study, while also providing enough data to reach

valid and meaningful conclusions. Given the key role played by the Afrikaans media, a decision was made to include the Afrikaans media in the analysis. As such, data drawn from *Die Burger* was included to the study.

The main features of these databases are presented in Table 7, and the characteristics of each of these data sources are explored in more detail below.

Table 7: news media content analysis data overview

Database	Type	Size*	Geographical focus	Language	Representivity
SAASTA/Fuseware	Most mainstream SA newspapers	244 (203)	national	English	Representative national sample based on web search algorithms
Die Burger	Regional daily	78 (71)	Western Cape, Eastern Cape, Northern Cape	Afrikaans	Full population
SAASTA/Fuseware	South African Twitter posts	1588	national	English	Full population (of posts from SA domains)

* The full databases were reduced to the final, smaller versions by removing non-relevant articles and duplicates. The final size of each data set is indicated in brackets.

3.5.1.1. The SAASTA/Fuseware database

The core sample is a media database provided by the South African Agency for Science and Technology Advancement (SAASTA), a unit of the National Research Foundation (NRF). In an effort to track media representations of astronomy in South Africa, these data were collected by Fuseware, a specialist media analysis consulting firm.

Fuseware employed an algorithm-based methodology to search online for news and social media coverage of the SKA. Data were collected by searching for specific keywords and phrase combinations across their data sources. These online data were collected using a diverse range of proprietary methods that used a combination of accessing social media Application Program Interfaces (APIs), public XML feeds, scraping public websites and accessing data from data partners. Complex Boolean queries were used, such as all articles mentioning the word “kat”, as well as “telescope”, but excluding “ska music”. These Boolean queries allowed for effective filtering of the data, but in some cases may have filtered out legitimate data if it matched the Boolean filter. There is a degree of ‘fuzziness’ in online data due to its sheer volume and non-structured nature – manual methods of filtering each mention individually are not viable, hence automated collection and filtering is needed. Automated filtering may at times have filtered out relevant data, but filter keywords were chosen to minimize any likelihood of this happening.

Fuseware’s methods of access covered the majority of online news sources, scouring billions of public records. The types of media that were monitored included:

- Social Media: the social media data search focussed on the Twitter platform.
- News: All major local online news publications (approximately 50 publications in total), including but not limited to News24, M&G, Moneyweb, iafrica.com and Fin24.

The search terms used by to draw data from these sources included:

- SKA;
- square kilometre array;
- square kilometer array;
- MeerKAT;
- KAT-7, and
- radio astronomy.

It is important to note that Fuseware’s proprietary filtering algorithms attempted to exclude non-article based pages (such as the home pages of websites that may match the keywords, or category pages such as technology article listings). A Google search will typically include these, so directly searching through Google for keywords may produce more results, but

many of these results will not be relevant to this study – i.e. not related to news media or social media outputs.

Fuseware news media data

Mainstream news media data was gathered by searching South African online news sites for article content matching any of the keywords. This included approximately 50 South African news sources, which covers almost the entire news market in South Africa (News24.com makes up a majority stake in its own right). A Boolean search was employed for the keywords and any articles matching these keywords were extracted and added to the database. The sites used for the mainstream news media search included:

- www.news24.com
- www.polity.org.za
- www.iol.co.za
- www.mg.co.za
- www.sabcnews.com
- www.timeslive.co.za
- www.dailymaverick.co.za
- www.iafrica.com
- www.citypress.co.za
- www.sowetanlive.co.za
- www.moneyweb.co.za
- www.fin24.com
- www.enca.com
- www.citizen.co.za
- www.bdlive.co.za
- www.engineeringnews.co.za
- www.ewn.co.za
- www.itweb.co.za
- www.mweb.co.za
- www.pretorianews.co.za
- www.miningweekly.com
- www.dispatch.co.za

- www.financialmail.co.za
- www.channel24.co.za
- www.thestar.co.za
- www.thenewage.co.za
- www.sabreakingnews.co.za
- www.grocotts.co.za
- www.beeld.com
- www.noseweek.co.za
- www.rapport.co.za
- www.dailysun.co.za
- www.witness.co.za
- www.volksblad.com
- www.peherald.com
- www.themercury.co.za
- www.capeargus.co.za
- www.mybroadband.co.za
- www.women24.com
- www.dieburger.com
- www.memeburn.com
- www.sake24.com

One limitation to the Fuseware dataset was that the full text for news articles was not provided – only the URL. As such it was necessary to manually download all the news media content and convert this to text files for use by the Atlas.ti qualitative analysis software.

Fuseware Twitter data

For Twitter data a keyword-based approach was also used. All tweets mentioning any of the keywords in the search were collected. The tweets were limited to South Africa – the location of users posting tweets, and the geotag of tweets, were taken into account to verify locations in South Africa. According to Fuseware, this methodology has an accuracy of approximately 95%. This did however form a limitation, as some relevant actors were not using Twitter accounts registered in the South African domain.

Fuseware metadata included several additional fields for describing Twitter posts, including:

- Publication date - The date and time the post was published;
- Followers - The number of other users that subscribed to follow the source user, and
- Re-tweets – the number of times an original post was re-posted by other (South African) users.

3.5.1.2. *Die Burger* database

The sample of *Die Burger* provides a critical Afrikaans-language sample, making it possible to compare and contrast English and Afrikaans coverage of the SKA. As one of the main publications reporting on the SKA in Afrikaans, partially due to its readership in the Western Cape and Northern Cape, *Die Burger* is the ideal Afrikaans-language publication from which to draw media content related to the SKA. The method of data collection involved a manual search of *Die Burger*'s online archives, using date parameters and the search terms 'SKA', 'square kilometre array' (Afrikaans media sometimes use the English term here), 'MeerKAT', 'KAT-7', and 'radioteleskoop' (radio telescope). This search rendered 78 articles. After a process of reading, initial coding, and assessment, seven of these articles were found not to be relevant to the SKA, reducing the sample to 71 articles. The full list of articles, indicating the title, date, and unique Atlas.ti coding number, is provided in Appendix J.

3.5.1.3. Data constraints

The representivity of the news media data is constrained in one respect: it is partially drawn from the online archives of news print media that also make archives available online. Not all the content of print versions is included in the online archives, and the sample is thus representative of the news media that makes it from print into the archives. There is also loss of data such as layout, proximity to advertising, page position, etc., that characterises print versions. However, none of these issues result in misalignments that could compromise the value of the data as a broadly representative reflection of how the news media have represented the SKA.

This relatively small sample represents news coverage – a knowledge-intensive and valuable form of mass communication about the SKA. In terms of the overall presence of the SKA in the media, news coverage plays a quantitatively small but systemically important role, representing a critical and influential channel for mass communication. On 09/07/2014, a simple Google search for ‘square kilometre array’ returned 324,000 results. The websites of the SKA alone contain more information than the entire news sample. However, in the study of mass communication, the news media, whether online, print, broadcast, or radio, remains an opinion-leading channel for communication, setting the broader news agenda for other channels, such as the online media (Peters *et al.*, 2014), and thus playing a significant part in forming public opinion and support in the public sphere.

3.5.2. Coding

The generation of the coding framework used both deductive and inductive processes. Some codes were generated deductively from the literature review and conceptual framework. Other codes were generated inductively in a grounded manner using a pilot study. In this pilot, as the media outputs were coded, salient passages were coded, and these codes grouped into themes (families of codes). These codes and themes were then added to the overall coding framework. Thus, the final set of codes is a combination of deductive and inductive coding. Also, the development of the coding system across English news media, Afrikaans news media, and the social media samples had both ‘vertical’ and ‘horizontal’ aspects. For example, codes that were developed through a grounded process drawing on the English news media sample were then applied to the other samples, and vice versa. In this way, a coherent coding framework was developed that has allowed comparative analysis across these datasets.

Once the coding framework was established, a combination of automated and non-automated coding was employed. For certain codes, a comprehensive auto-coding function was used to flag every instance of a particular string of text. This was only applied to codes without any interpretive content. For example, basic terms such as ‘KAT-7’ and ‘MeerKAT’ were used to identify the articles in the overall sample frame that mentioned these terms. Other automated coding was conducted to identify particular actors (e.g. ‘Fanaroff’, ‘Pandor’, ‘Jonas’, etc.). Automated coding was particularly useful for the analysis of the Afrikaans news media, where it was helpful in overcoming language constraints.

However, the majority of the coding for the English news media and the social media samples was non-automated, as most of the codes required a degree of interpretation. For example, codes for actor, relationship, benefits, challenges, controversies, science topics, technology topics, symbolic issues, etc., all required interpretation. In these cases the articles were coded manually.

The development of a coding framework for the analysis of the media content database drew on several sources for guidance, including the literature on analysing representations of science in the media, the results of key informant interviews, and a brief pilot exercise that provided relevant lessons about the application of content analysis methodologies to the SKA.

The basic structure and coding framework drew from the literature on the study of representations of science in the media, which provides some guidelines for the construction of appropriate search terms and parameters and the associated analytical methods. These studies include Nelkin (1995), Nisbet and Lewenstein (2002), Bauer (2005), Bonfadelli (2005), Gastrow (2010), Madsen (2001), Madsen and West (2001), Lugalambi (2011), and Weingart *et al.*, (2000). A composite of variables that have previously been used in these studies to structure media content analysis coding schemes include:

- Identification: Country, newspaper, date, title, author;
- General characteristics: source (own story, wire-service cable, syndicated article), main subject, type of article (short news, article, interview, other);
- Scientific subjects: research questions, scientific implications;
- Technology subjects: receiver dishes, receiver arrays, data transfer, supercomputers, etc;
- Dominant frame: the way media outputs are ‘framed’ refers to latent content that provides a discursive framework or set of assumptions that frame the discourse. Each article is usually coded with one frame. In the case of the SKA, examples of frames could be ‘economic implications’, ‘international rivalry’, or ‘scientific progress’;
- Tone: mention risks, mention benefits, report on a controversy;

- Themes: themes present in an article can refer to a particular aspect of science or technology, or a particular attendant social, political or economic theme. Each article can usefully be coded with up to three key themes;
- Actors: mention of actors from industry, government, education, science, or non-government spheres. Coding can usefully identify up to two of the main actors mentioned in an article;
- Science-related text elements: results/findings/facts, research methods, theories and assumptions, experiments, social issues (e.g. controversy, peer review systems, competition among scientists, social pressures);
- Nationality issues: nationality of scientists, nationality of the newspaper, issues of international competition;
- Elements of scientific accuracy: is a scientist identified? Is a scientist quoted? Are scientific instruments identified? Is the scientific method explained? Is previous research cited? Does the text contain qualifiers (i.e. ‘this suggests that...’ rather than ‘this proves...’), are theories and facts conflated? Is there reference to actual observations?, and
- Open-ended data entry points for general notes and observations.

This provided the core set of variables for media content analysis. The conceptual framework for this study provides an organising principle for operationalizing these, providing guidance for organising salient variables to serve as data points to reflect properties of actors, relationships, and information flows.

The analysis of key informant interviews provided salient information about the news value of the SKA, as well as information about the key issues, controversies, actors, relationships, and periodicity of the SKA. This information was used to inform the development of variables for media content analysis. Another source of information was a pilot exercise conducted using a separate but cognate data source, which was used to generate basic descriptive statistics and initial interrogation in order to provide another lens on the landscape of representations of the SKA in the media. This pilot used a dataset provided by SAASTA that had employed a media content analysis service provider (Media Clip) to monitor South African media coverage of the SKA from August 2011 to March 2012. They provided a high-quality dataset for print, broadcast, and online media, including the full text of all articles.

However, because SAASTA did not renew the Media Clip contract, their data range stops at the end of March 2012 and therefore doesn't cover the core period surrounding the site allocation in May 2012. This data set was therefore not suitable for use in this study. However, it provided an excellent data set for the pilot exercise.

Media Clip provided a comprehensive database with a larger sample than the subsequent Fuseware database. This is due to a methodology that is not algorithm based, but rather based on a purposive search through South African publications to extract SKA-related content. The Media Clip database for September 2011 contained 25 news media articles. These were coded using a preliminary version of the coding scheme in order to test for suitability and practicality. Descriptive statistics from the pilot exercise served to illustrate the basic contours of the data, making it possible to shape the coding scheme to be more responsive to the data. For example, by examining the most commonly coded variables, it was possible to establish which codes were likely to play a central role in the analysis and which might not be useful. Table 8 below shows the results of this coding exercise, listing the most commonly coded variables.

This provided useful guidelines for establishing a coding framework and coding practice for the full media content analysis database. Table 8 lists the variables which were coded four or more times in the pilot database, representing the top 38 code families out of 73, or 440 individual codes out of 612. The pilot study suggested that the site bid would be an important theme, particularly as framed in contestation with Australia. The precursor instruments (KAT-7 and MeerKAT) also received significant coverage. Other codes received lower levels of coverage, for example policy issues. The pilot exercise also illustrated the utility of grouping related codes to allow for several levels of analysis, and provided guidelines for a logic to underpin these groupings. For example, 'precursor' codes included those for the KAT-7 and the MeerKAT, 'benefits' codes included 'SA science capabilities', and 'job creation', etc.

Table 8: Code frequency count for media content analysis pilot exercise

	Total
Site bid	64
Precursor instruments (MeerKAT + KAT-7)	38

Site bid + competition with Australia	32
Benefits	28
MeerKAT	24
KAT-7	20
Technology	20
Bernie Fanaroff	18
Africa	12
African partner countries	12
Benefits (SA scientific capabilities)	12
Local development	12
Costs	10
Science	10
Symbol	10
Benefits: showcase SA capabilities	8
Carnarvon	8
Technology: receiver array	8
Naledi Pandor	6
Benefits: job creation	6
Challenges	6
Controversy	6
Science: research questions	6
Site bid: possibility of sharing site	6
Technology: receivers	6
DST	4
Justin Jonas	4
Astronomy Geographic Advantage Act	4
Benefits: attract people to science and engineering careers	4
Challenges: infrastructure	4
Comparison to SALT	4
Controversy: bid security in SA	4
Controversy: fracking	4
Policy	4

Science: general telescope capabilities	4
Symbol: affirmation of SA science and engineering capabilities	4
Symbol: external views of SA capabilities	4
Technology: data processing	4
Sub-total for listed variables	440
TOTAL FOR PILOT DATABASE	612

The coding system emerged from these three sources, together with a grounded process drawing on all three data sources, in an organic and iterative fashion. The Atlas.ti qualitative data analysis software system makes it possible to continuously add, change, and merge codes throughout the coding process. Thus, main variables drawn from these three sources provided a starting point for an emergent process that guided the evolution of a final set of coding variables that reflected the precedents set in the literature, responded to the analysis of key informant interviews, and was informed by the pilot exercise. During the coding process, codes that were found to be irrelevant, impractical, or imprecisely expressed were modified, removed, or merged, thus iteratively producing the final set of variables for media content analysis presented in Appendix D, amounting to 295 individual codes divided into eighteen main families, together with the identification data of title, date, and publication.

3.5.2.1. Coding system for the Afrikaans language sample

The coding and analysis of the Afrikaans sample was restricted to variables that were non-interpretive, as an interpretive qualitative analysis would require collaboration with a first-language Afrikaans speaker. As such, all interpretive coding variables, such as dominant frames, symbolism in the public sphere, etc., were not coded for. Instead, a non-interpretive coding scheme was developed that relied on the identification of occurrences of specific search terms in the text using Atlas.ti qualitative analysis software. This made it possible to develop a profile of representations of the SKA in the Afrikaans media without introducing the possibility of distortion through incorrect interpretation. In many cases, the translation of coding search terms was not required, for example in the names of key actors, such as ‘Fanaroff’ or ‘Pandor’. In other cases, where applicable, search terms were translated, for example ‘Australië’ for Australia or ‘kosmologie’ for cosmology. The list of codes, as well as the translated search terms, where relevant, are presented in Appendix I.

In order to proceed with a comparative analysis using the data rendered by this coding system, a comparable coding system had to be developed for the English language sample. The primary coding system for this sample was largely interpretive, so a non-interpretive coding system was developed in order to provide data that was directly comparable to the Afrikaans dataset. To this end, all interpretive codes were discarded, and the English language sample was re-coded using the same non-interpretive codes that were applied to the Afrikaans sample. For example, instead of assessing sources of information by coding for quoted actors (as was undertaken for the primary English-language analysis), this was coded for using text references to actors as a proxy, in order to provide a comparable dataset to the Afrikaans sample. In another example, instead of coding for issues related to the development context through interpretive analysis, text references to the local towns, Carnarvon and Williston, were used as proxies in both the English and Afrikaans sample for references to the local context. Through this process, comparable datasets were developed for the Afrikaans and English language samples.

Coding was undertaken using search terms through the automated coding function of the Atlas.ti software. This involved the automatic flagging of all matches to each search term as a first step. Thereafter, all codes were manually checked in order to avoid any instances of false coding. This process has rendered a complete and highly reliable data set representing the use of all the search terms across the sample.

3.5.2.2. Coding system for the social media sample

The SAASTA Fuseware media database includes comprehensive data on South African Twitter feed that mentions the SKA, MeerKAT, KAT-7 or radio astronomy. The data includes the author, text content, URL, date of publication, and the number of followers of the particular Twitter account. The database makes it possible to search for specific terms within the entire set of Twitter feeds. Due to the short length of tweets (140 characters), the database includes the full text of each tweet.

The Fuseware database, originally made available in an Excel format, was imported into the Atlas.ti qualitative analysis software, which was used for coding and preliminary analysis. This required some adaptation of the coding practice. While the profiles of the English and

Afrikaans news media samples were broadly comparable, due to the different structure of the Twitter data there is a lack of direct comparability in some areas. For example, comparing the proportion of outputs that reference specific variables or codes is not appropriate. Since Twitter posts are only 140 characters long, each of them can only include a limited number of codes, while each news article included an average of 17 quotations referring to specific codes (3514 total quotes from 203 articles). Thus, in general, codes are less frequently distributed throughout the social media sample. This does not however mean that the sample is less rich or less informative. Due to the large number of Twitter posts in the sample (1588), the total number of quotations referring to specific codes (17925) is even greater than the news media sample.

The coding process was in some respects similar to that employed for the news media. The overall coding schema was applied to the social media database in two main rounds. The first round entailed automated searches for specific texts strings that could unambiguously identify specific codes, for example names of actors (e.g. Pandor, Fanaroff) or specific science and technology terms (interferometry, dark matter). The second round entailed a manual coding exercise, where all the automatically assigned codes were verified, and the text of each Twitter post also read and coded for interpretive variables, such as reference to the site bid or to specific controversies. Together, these two rounds have created a highly detailed and complete media content database for analysis.

Of course, the Twitter sample is not nationally representative of the views of the entire South African population – it includes only those individuals and organisations that have Twitter accounts and have used these accounts to post messages about the SKA. Nonetheless, this remains the best current source of data about representations of the SKA in the social media.

3.5.3. Media content analysis

Atlas software provides functionality in terms of generating descriptive and analytical statistics from the coding data. Drawing on both Atlas results and own calculations, the analysis of data rendered by the coding firstly examined the summary findings of the distribution of individual variables – i.e. the profile of frames, themes, actors, tone, science-related elements, social elements, etc. Each of these profiles provided analytically useful descriptions of representations of the SKA in the media. The second stage of the content

analysis was to search for patterns, trends, and relationships among these variables, and between these variables and the contextual information gathered from other components of the study. This analysis aimed to identify the salient features of media representations of the SKA and situate these in the context of the associated communication process.

A more rudimentary content analysis has been performed on the Afrikaans media database, largely to provide a comparison to some of the major patterns and trends found in the English database. The analysis of the Afrikaans medium database has been driven primarily by search functions, in which Afrikaans translations for English search terms can provide directly comparable results using the same search in each database. This provides a basic quantitative comparison at key data points. For example, an automated search for ‘shale gas’ in the English language database would be compared to a search for the translated term ‘skaliegas’ to provide a comparable result.

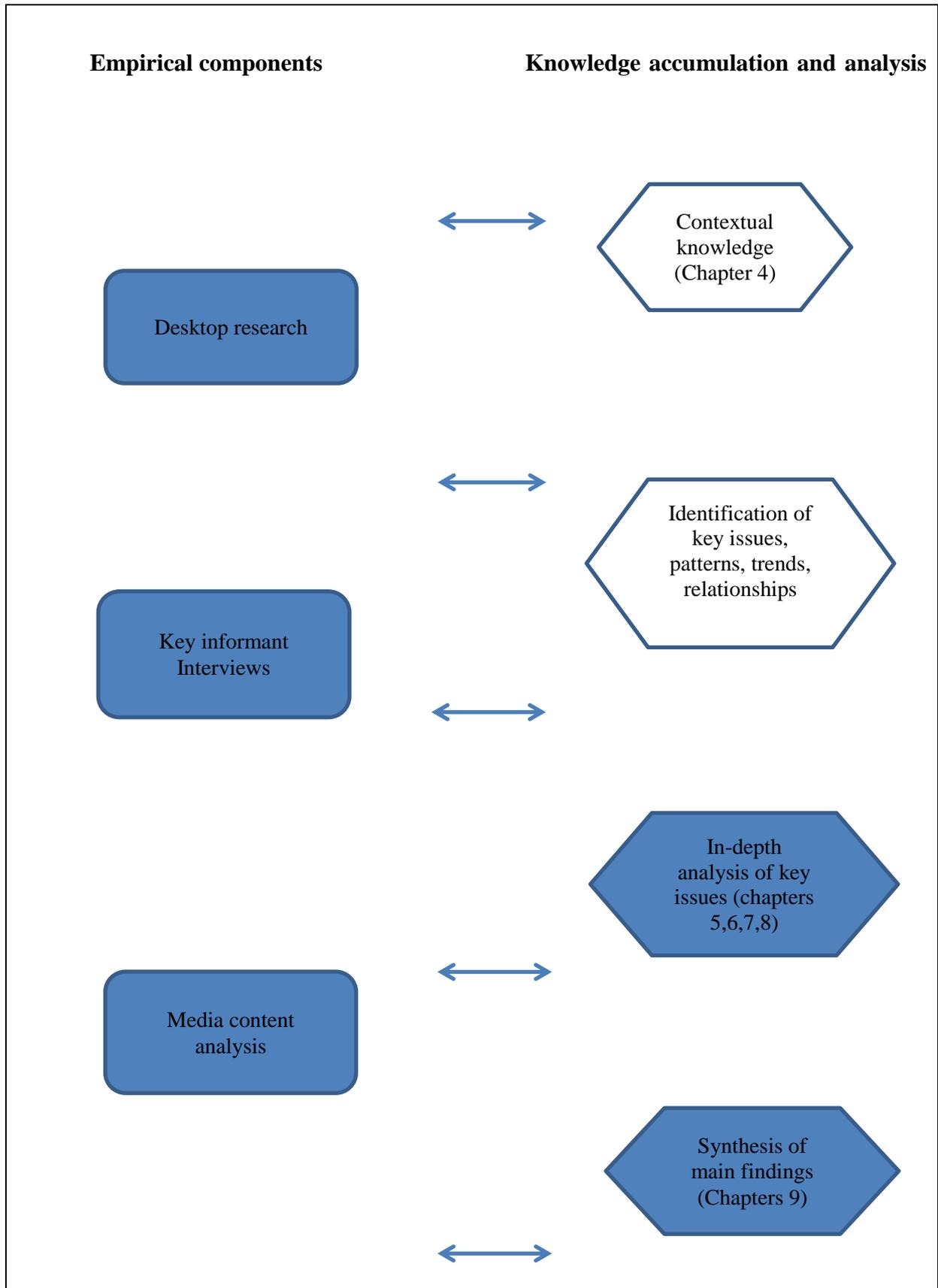
Coverage of Twitter posts included the text of the post itself, the name of the sender, and the number of followers of the sender. It is thus possible to calculate basic descriptive statistics about the reach of each message. It is also possible to run searches of the Twitter texts to find occurrences of specific key words (e.g. Pandor, Fanaroff, HartRAO, etc.). These could then be brought together in order to look at the distribution over time of this coverage.

One aspect of the analysis of social media that differed significantly from the analysis of news media was the investigation of information flows. By tracking users, followers, and re-tweets, it is possible to calculate the total number of followers that each actor and each message reaches. This provides an indication of the interactive nature of the social media as well as the effects of the ‘viral’ propagation of messages within the Twitter platform.

3.6. Concluding analysis: synthesis and modelling

Drawing together the findings from the literature review, desktop research, interviews, media content analysis, and research analyses of chapters 5, 6, 7, and 8, the concluding chapter returns to the overarching research question to reflect upon the SKA as a case study of mass communication and science communication. This includes a reflection on how the main relevant theoretical tools apply to the case of the SKA, and how this has filled a gap in the literature.

Figure 4: Overview of research methodology



Chapter 4: The Square Kilometre Array in context

4.1. The SKA in the public sphere: main actors and network structure

When seen as a ‘technology movement’ in the public sphere, as conceived by Bauer (2002), it is possible to delineate the key actors that have an impact on the SKA. The SKA organisation itself is central, comprised of headquarters in the United Kingdom, at Jodrell Bank, and an international consortium of member countries. In addition there are significant project offices in South Africa and Australia, as well as smaller nodes within each of the member countries. In terms of science communication, the centralised international science communication function is based at the headquarters in the UK, while the locally orientated communication functions for South Africa and Australia respectively are based in the relevant project office. A number of other actors also play a role in the public sphere, including government departments and agencies, universities and research institutes, science facilities, firms, intermediary organisations, the media, and the public. The main characteristics of these actors are briefly explored below, in the context of a brief overview of astronomy in South Africa.

4.2. Astronomy in South Africa

Astronomy has a long history in South Africa. Astronomy has long been part of indigenous knowledge systems in Africa, which has been explored extensively in the field of African palaeoanthropology (e.g. Snedegar, 1999, 2007; Holbrook, 2007; Chabalala, 2012). Astronomy played a role in the colonial project in South Africa as far back as 1685, when astronomical observations were made for navigational purposes (Paterson *et al.*, 2005; Wild, 2012; Gastrow, 2014). South Africa’s first observatory was established in 1820 in Cape Town. From the 1950s onwards South African involvement extended to satellite tracking in collaboration with international agencies, including NASA. This built upon South Africa’s comparative advantage in astronomy, which requires adequate infrastructure, and more importantly, low levels of light, dust, and radio frequency (RF) pollution. South Africa has retained its geographical advantage with respect to astronomy since that time. The drivers of astronomy are peculiar, in that observational capacity is more important in the Southern Hemisphere than it is in the North, as our galactic core and the plane of the Milky Way

galaxy are positioned in the Southern skies. Southern countries with suitable characteristics thus have an advantage in the global competition to host astronomical instruments.

This competitiveness led to ongoing investments in South African astronomy. The advent of democracy led to a further massive increase in astronomy support and investment, as proposed in the 1996 White Paper on Science and Technology (Department of Arts, Culture, Science and Technology, 1996) and the 2007 Ten-Year Innovation Plan (Department of Science and Technology, 2007) – two framework policy documents for science and technology for the post-Apartheid government. It is notable that in its first twelve years of rule the African National Congress (ANC) government spent more on astronomy than all governments combined between 1910–1993. It is postulated that this is due to its characteristics of reflecting modernity, international standing, and validation for African scientific and intellectual capabilities (Gottschalk, 2005).

Today these capabilities continue to play an important role in the global astronomy system. South Africa is host to the largest single-lens optical telescope in the Southern hemisphere – the Southern African Large Telescope (SALT). However, the Square Kilometre Array telescope is poised to become the flagship astronomy facility in South Africa. This giant radio telescope will become the largest science project ever undertaken in Africa, the world's most powerful telescope by several orders of magnitude, and also one of the largest science installations of any type in the world.

4.3. The Square Kilometre Array

There is a high level of information about the SKA available in the public domain. Information from these sources has been drawn upon to present the following profile of the SKA and the main actors that are relevant to its position in the public sphere. Key sources included:

- Wild (2012) provides an account of the evolution of radio astronomy in South Africa leading up to the SKA bid and the development of the MeerKAT.
- Gastrow (2014) provides a detailed account of the astronomy sector in South Africa and of the SKA, including information about the SKA's main university partners, public sector partners, and private sector partners.

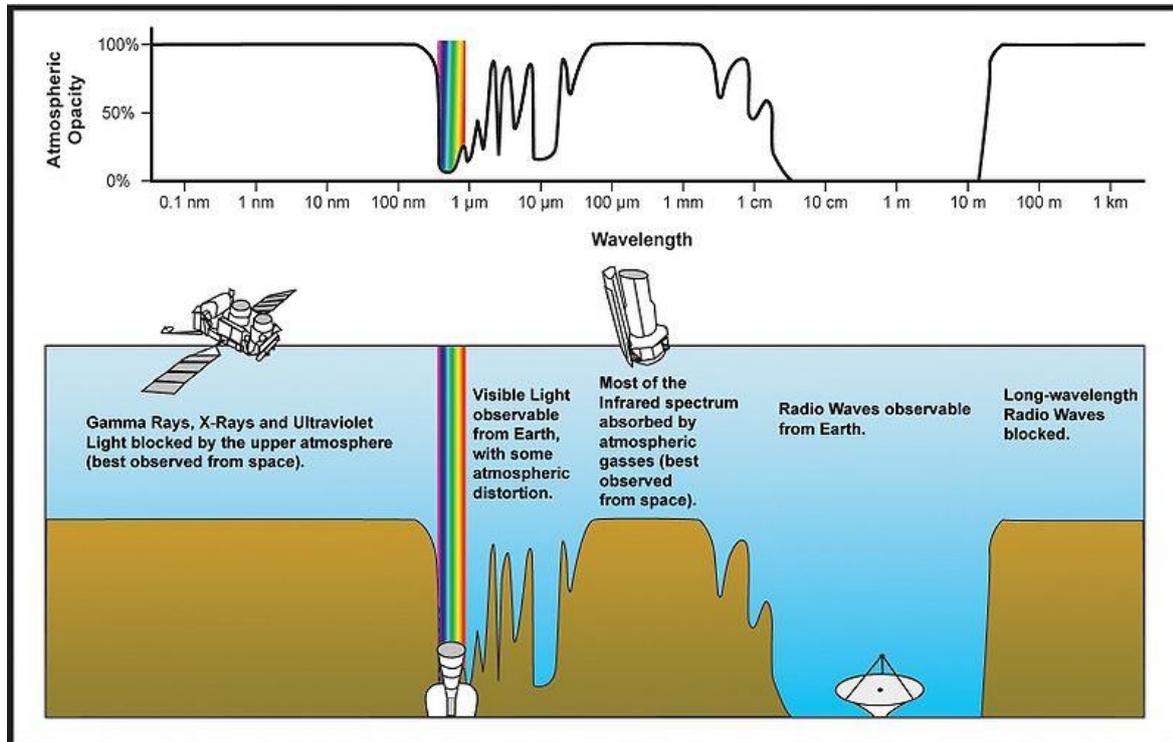
- The website of the SKA in South Africa (<http://www.ska.ac.za/>) provides a rich source of information. This includes an archive of 22 newsletters that have been published periodically since 2006. Each of these in turn includes approximately a dozen articles that provide information about key issues facing that SKA at that time. This entire archive was printed, read, and relevant information was extracted.
- The website of the SKA at the international level (<https://www.skatelescope.org/>) also provides a wealth of information, including substantial archives of newsletters and press coverage. These were also printed, read, and the relevant information extracted.
- The website of the Jodrell Bank Centre for Astrophysics (<http://www.jb.man.ac.uk/research/ska/>).
- The website of the 'The Conversation', a leading science blog, which has a dedicated section for the SKA (<http://theconversation.com/topics/square-kilometre-array>).

The Square Kilometre Array (SKA) will be a giant radio telescope comprised of thousands of dishes and receiver arrays spread over large tracts of the African and Australasian continents, all connected by dedicated high-bandwidth optical cable transferring data to be processed by the world's most powerful supercomputers. The projected cost for the SKA is approximately EU1,5 billion. Approximately 80% of the telescope is to be located in South Africa (although the final allocation has yet to be fully negotiated and is open to minor changes). However, the scope is global: the SKA will involve astronomers and engineers from more than 70 institutes in 20 countries.

The SKA will be a technical achievement at the frontier of global science. Terrestrial radio telescopes have an advantage over telescopes focussed on other electromagnetic frequencies as the Earth's atmosphere does not block radio waves (see Figure 5). The aim of the SKA is to design and build a radio telescope that is 50 times more sensitive and 10,000 times faster than the fastest existing telescopes. The rate at which data will be transferred from the network of dishes and arrays to the SKA supercomputer will far exceed the total flow of current global internet traffic. Technological specifications include: thousands of dishes and antennae arrays with a combined collecting area of about one square kilometre (1,000,000 square metres); a central computer with the processing power of about one hundred million PCs; enough optical fibre to wrap twice around the Earth; dishes that produce 10 times more data than the sum of global internet traffic; aperture arrays that produce more than 100 times

the global internet traffic; and many other specifications far in advance of current technologies.

Figure 5: Atmospheric opacity for a range of electromagnetic radiation wavelengths



http://en.wikipedia.org/wiki/File:Atmospheric_electromagnetic_opacity.svg based on
http://earthobservatory.nasa.gov/Features/RemoteSensing/remote_04.php

The purpose of this giant technical feat is to search for answers to questions at the frontiers of physics and cosmology, where scientists are seeking to identify and understand the fundamental laws and structures of the universe. Some of these questions are:

- *How do galaxies evolve and what is dark energy?* The expansion of the universe has been attributed to a mysterious dark energy. The SKA will investigate the expansion of the universe after the Big Bang by mapping the cosmic distribution of hydrogen. The map will track young galaxies and help identify the nature of dark energy.
- *Are we alone?* The SKA will be able to detect very weak extra-terrestrial signals and will search for complex molecules, the building blocks of life, in space.
- *How were the first black holes and stars formed?* The SKA will look back to the Dark Ages, a time before the universe lit up, to discover how the earliest black holes and stars were formed.

- *What generates the giant magnetic fields in space?* The SKA will create three-dimensional maps of cosmic magnets to understand how they stabilise galaxies, influence the formation of stars and planets, and regulate solar and stellar activity.
- *Was Einstein right?* The SKA will investigate the nature of gravity and challenge the theory of general relativity.
- *Blue sky research:* More generally, the SKA will explore the unknown, with the long-term potential to make discoveries for which science has not yet formulated questions, let alone answers.

The idea of using an array of connected telescopes for the purpose of radio astronomy predates the SKA. The idea of interferometry was developed in 1907 by Martin Ryle, for which he was awarded the Nobel prize in physics. The idea of connecting multiple radio arrays or parabolic dishes to create a much larger ‘virtual’ radio telescope using interferometry was conceived in 1946. This technique works by superposing (interfering) the signal waves from the different telescopes on the principle that waves that coincide with the same phase will add to each other while two waves that have opposite phases will cancel each other out. This creates a combined telescope that is equivalent in resolution (though not in sensitivity) to a single antenna whose diameter is equal to the spacing of the antennas furthest apart in the array. This vastly increases the resolution of radio ‘images’. However, the communications and computing technologies required to apply this on a very large scale have only become available more recently – particularly the use of high-bandwidth data cables and powerful computers to transfer and process data from multiple arrays and dishes spaced over long distances.

A high quality image requires a large number of different separations between telescopes. This arrangement does have some smaller technological precedents. The Very Large Array (VLA) in the USA has 27 dishes. The largest existing array, LOFAR (the 'LOw Frequency ARray'), currently under construction in Europe, consists of approximately 20 000 small antennas in 48 stations distributed over an area several hundreds of kilometres in diameter. In preparation for the SKA, both South Africa and Australia have constructed test sites. The KAT-7 test site in South Africa consists of seven dishes each of 12 metre diameter with the capability of producing combined images using interferometry. The KAT-7 is a precursor to the larger MeerKAT project, which will consist of 64 linked dishes. In Australia the

pathfinder test site consists of 36 antennas each 12 metres in diameter, also linked using interferometry, referred to as the Australian Square Kilometre Array Pathfinder (ASKAP).

The SKA itself will be constructed on a far larger scale than any other telescope. The main components are receivers (antennae that receive radio signals) and dishes (larger structures that reflect radio signals onto an integrated receiver). The SKA will consist of over 3000 15 meter wide dishes, and thousands more receivers in its aperture arrays. The outer dish installations will be located 3000 km from the core site in South Africa, with the perimeter installations being based in Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia and Zambia. Thousands of aperture arrays will extend over Australia and New Zealand.

The large scale and technical complexity of the SKA necessitate a long time-frame for the project. The concept for the SKA originated in 1991. By 2003 a short list of suitable sites had been developed. Since 2008, and through 2014, the early design and costing of the system has been ongoing. In 2011 the SKA organisation was established as a legal entity to house an international consortium including Australia, Canada, China, Italy, the Netherlands, New Zealand, South Africa, Sweden, and the United Kingdom. Site selection took place in 2012, when the majority of the project was allocated to South Africa and its African partner countries, and the remainder to Australia and New Zealand. The design and pre-construction phase is due to continue until 2015. Construction is due to begin in 2016, with phase 1 to be completed in 2016 and phase 2 in 2023. This will produce full science operations for phase one by 2020 and for phase 2 by 2024. Thus the overall periodization of the SKA project could be seen as:

- 1991-2011: conceptualization, mobilization, consortium formation
- 2012-2024: design, construction, early operations
- 2024 onwards: full operation

4.4. The SKA in South Africa and African partner countries

The South African SKA Project Office was established in 2003, with South Africa's preliminary bid to host the project. During the bidding phase for the location of the SKA, precursor or 'pathfinder' radio telescopes were commissioned and built in South Africa, both

to test the technology and to illustrate to the international community that South Africa had the requisite capacity in the field. These ‘pathfinders’ have used the acronym KAT, signifying their purpose for a Karoo Array Telescope. The first of these was the KAT-XDM, a 15 metre antenna located at HartRAO. This was a testing ground for the subsequent precursor, the KAT-7, a set of seven linked satellite dishes. The third and largest precursor is a set of 64 dishes, known as the MeerKAT, which is currently under construction. Thus, when we refer to the ‘the SKA’ in South Africa, we are referring to the KAT-7, the MeerKAT, and the SKA South Africa project office, which provides a host to the MeerKAT and all the SKA activities based in South Africa.

Since its completion in 2010, the KAT-7 has been used in astronomy research, and these science outputs have had sufficient news value to appear in the news media and the social media. The KAT-7 is a precursor engineering test-bed for the larger 64-dish MeerKAT pathfinder. The MeerKAT will form 25% of the first phase of the SKA, and is also a pilot for the design of the antennae. The MeerKAT is entirely paid for by the South African government, as a form of ‘in kind’ contribution to the SKA. This was a calculated risk by the government, with several possible routes to a positive outcome. If the SKA bid had been unsuccessful, the MeerKAT would still have been the largest radio telescope in the Southern hemisphere for the next decade, allowing it to undertake ground-breaking science in its own right. As it stands, the KAT-7 and MeerKAT have provided evidence of South African capabilities in radio astronomy, and contributed to decision to locate most of the SKA in South Africa.

The site allocation process, through which the international SKA consortium has decided on the location of the telescope infrastructure, has been central to the evolution of the SKA in South Africa – shaping the development of the South African SKA project office, as well as the strategic moves behind the development of precursor instruments, technologies, human capital development, policy, funding, international relationships, and public awareness (Gastrow, 2014). The main events in this process are described below:

- 2003: Bids from South Africa, China, Argentina/Brazil, and Australia are considered by the SKA organisation as site candidates. This initiates the establishment of the SKA South Africa Project Office.

- 28 September 2006: South Africa and Australia are shortlisted as final contenders to host the SKA infrastructure
- 10 March 2012: the *Sydney Morning Herald* leaks information about a confidential report from the SKA’s Site Advisory Committee that, on balance, favours South Africa over Australia.
- 4 April 2012: The expected announcement of the site allocation is delayed. Rhetoric from the SKA hints that a split site solution was being considered.
- 25 May 2012: the SKA announces that the site location will be split between South Africa and Australia, with the largest share being located in South Africa. All of the Phase 2 dishes will be built in Africa. Australia will host the Phase 2 aperture array antennas.

Table 9: SKA split site allocation of infrastructure

SKA Phase 1 (about 10% of the total SKA)	
South Africa	Australia
South Africa's precursor array - the 64-dish MeerKAT telescope - will be integrated into Phase 1. An additional 190 mid-frequency dish-shaped antennas, each about 15 m high will be built.	Australia's 36-dish SKA Pathfinder (ASKAP) will be integrated into Phase 1. An additional 60 mid-frequency dish-shaped antennas, each about 15 m high, will be built, as well as a large number of small, low-frequency antennas - each about 1,5 m high.
SKA Phase 2	
South Africa & African partners	Australia
Telescope will extend to long baselines of 3 000 km or more	Telescope extends over a baseline of 200 km, or possibly longer
A total of about three thousand mid-frequency dishes, with the highest concentration in the Northern Cape, South Africa, but some dishes in Namibia,	Up to 10 times more of the low-frequency antennas – each about 1,5 m high

Botswana, Zambia, Mozambique, Kenya, Ghana, Madagascar and Mauritius. In addition, a large number of flat mid-frequency antennas, each about 60 m in diameter (number to be determined).	
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Source: <http://www.ska.ac.za/releases/20120530.php>

4.5. Public sector actors

Government departments and agencies play an important role in supporting the SKA, primarily as a source of funding and policy support, but also in terms of rhetorical support and mobilising awareness in the public sphere. The main actors are the Department of Science and Technology (DST) and the National Research Foundation (NRF). The main role of the DST is to formulate policy and strategy in relation to the SKA, and to manage international relationships. The DST channels funding for the SKA from the National Treasury to the NRF, which acts as the immediate managing agency for the project, and a funding conduit. Both the DST and the NRF have dedicated communication functions which are employed to position the SKA in the public sphere.

The priority enjoyed by astronomy is reflected in the budget allocations made by DST. Expenditure on astronomy, specifically that related to the SKA, has risen sharply over recent years, and is expected to increase further over the medium term, according to the Medium Term Expenditure Framework (National Treasury, 2013).

Table 10: DST expenditure 2009-2016

	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	MTEF
	Outcome			Revised estimate	Medium-term estimates			Average annual growth
R million								
National departments	3 507	3 360	3 691	4 067	4 616	4 716	5 565	11.0%
Public entities	7 712	9 291	10 021	11 030	11 679	12 678	13 361	6.6%
Total	11 220	12 651	13 713	15 096	16 294	17 394	18 926	7.8%
<i>Of which:</i>								
<i>Square Kilometre Array</i>	502	13	11	231	641	661	715	45.8%
<i>Human capital and science platforms</i>	1 119	1 244	1 408	1 434	1 707	1 858	2 346	17.8%
<i>Research and infrastructure</i>	449	485	531	603	738	792	1 036	19.8%

Source: National Treasury, 2013.

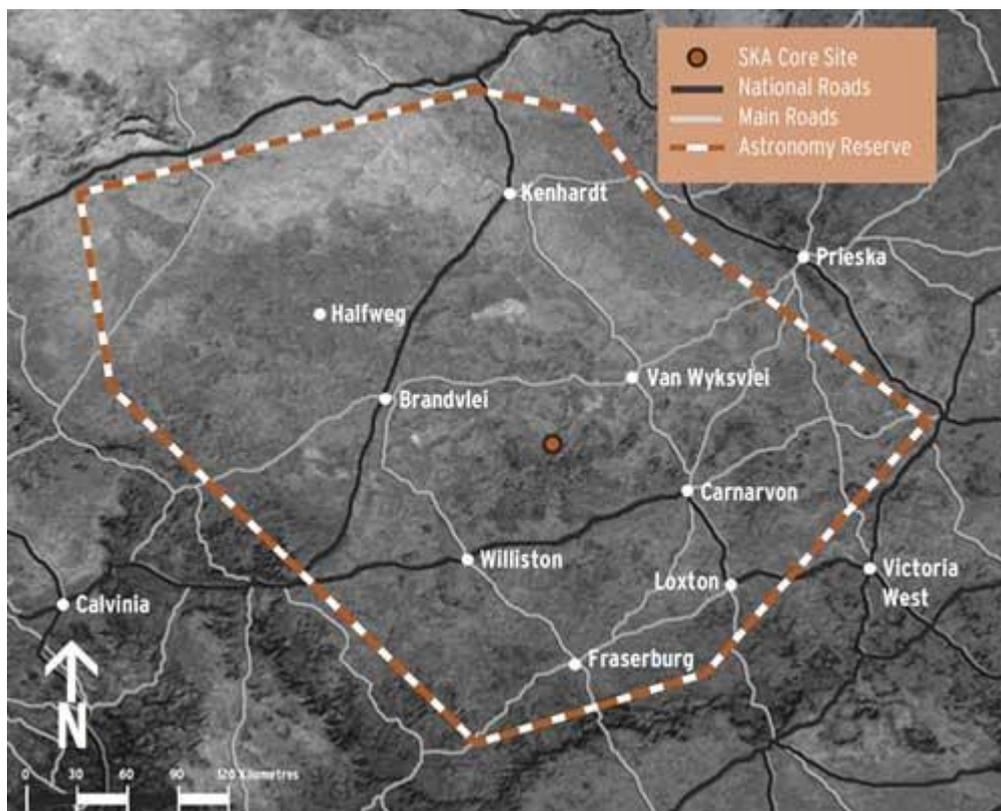
The NRF is mandated to promote and support research in all fields of humanities, the social and natural sciences, engineering and technology, and indigenous knowledge. The foundation provides research funding and research platforms through national facilities and science awareness activities. It also performs an agency function on behalf of the Department of Science and Technology, and is a service provider to several other government departments. The NRF funds and manages South Africa's public science facilities, which includes a funding and co-ordinating role in oversight of the national astronomy science facilities, including the South African Astronomical Observatory, an organising body for South Africa's optical astronomy facilities. The main science facility relevant to the SKA is the Hartebeestpoort Radio Astronomy Observatory (HartRAO). The NRF also funds the South African Research Chairs (SARChIs), which are designed to support world class research and teaching at universities across the country, and which include several Chairs dedicated to the SKA.

In 2013 the DST established an astronomy sub-agency within the NRF as an interim measure aimed at managing the growing field of astronomy in South Africa. Previously, there had been no single public institution overseeing the country's astronomy activities. This required the NRF to create the post of Deputy CEO: Astronomy, which is now part of the NRF corporate executive and the 'NRF anchor point' for liaison with actors in the astronomy sector, in particular the DST. The sub-agency makes use of the NRF's shared corporate services, such as finance, governance and human resources. Astronomy is the only scientific field – out of the approximately 200 disciplines managed by the NRF – that has such a position. This is a reflection of public support, political priority, and rapid growth in the scale and complexity of the astronomy sector in South Africa.

South Africa's democratic government has offered strong support for the astronomy sector. Astronomy and space science are seen as large scale, broad scope, new technology platforms that will be directly coordinated and led by DST as a priority area. The main form of policy support has been through the Astronomy Geographic Advantage Act (2007). The aim of the Act is to protect geographic areas which are suitable for astronomy from potentially adverse activities. Parts of the Northern Cape which are to contain the SALT, the MeerKAT and the SKA have been declared as core astronomy advantage areas (see Figure 6). Restricted

activities in this area includes prospecting and mining activities, harmful industrial process, the construction and development of new business or residential premises or recreational facilities, the operation, construction or expansion of facilities for the generation, transmission or distribution of electricity, or any other activity which might detrimentally impact on astronomy and related scientific endeavours. This includes a restriction of any activity which may cause light pollution or interfere with the radio frequency in these areas. These restrictions could severely limit shale gas fracking within astronomy advantage areas.

Figure 6: Core Astronomy Advantage Area



Source: <http://eepublishers.co.za/article/hans-05-how-will-the-ska-affect-people-in-the-astronomy-advantage-area.html>

Another form of policy support has been the granting of a Value Added Tax (VAT) exception for the SKA in South Africa, which was announced by the Minister of Finance on the 22nd of February 2012 in the Minister's annual budget speech.

Beyond the explicit legislation, the tacit political support for the SKA should not be underestimated. From the early stages of its conception, the SKA bid was seen as a flagship national project with enormous potential, not just for science, technology, skills, and

economic development, but also as a national symbol of world class scientific and technological achievement (Gottschalk, 2005).

Public sector partnerships relevant to the SKA extend beyond South Africa, and in some cases these have featured in the communications process and outputs. Two key partnerships exist with European and American actors. The African-European Radio Astronomy Platform (AERAP) is a stakeholder forum of industry, academia and the public sector established to define and implement priorities for radio astronomy cooperation between Africa and Europe. The AERAP platform has been instrumental in raising the profile of African radio astronomy in the EU, and has contributed to the inclusion of this focus area in the EU Horizons 2020 funding programme. In 2008 the South African SKA Project Office signed a formal collaboration agreement with the USA National Radio Astronomy Observatory (NRAO) with the shared goal of collaborating and cooperating to develop radio astronomy projects. The NRAO has sent astronomers and engineers to help with the commissioning of the KAT-7 and MeerKAT telescopes and NRAO scientists and engineers have participated in the MeerKAT design process.

4.6. Universities and research institutes

Detailed information about the role of universities in the SKA is included in Bharuth-Ram (2011), Paterson *et al.* (2005), Wild (2012) and Gastrow (2014). Most of South Africa's universities play a role in the SKA. Of all the universities in South Africa, the University of Cape Town (UCT) has the longest history in astronomy. UCT is one of only two universities in South Africa offering undergraduate programmes in astrophysics; the other is UNISA, which, according to fieldwork and desktop research, plays no notable role in the SKA. The UCT astronomy department has over time developed close ties with the SKA. This has maintained UCT's leadership in astronomy among South African universities and also established an institutional foundation for taking a leading role in radio astronomy. The relationship between UCT and the SKA is supported by their close geographical proximity - the SKA headquarters in South Africa were established within a five kilometre radius of both UCT and the South African Astronomical Observatory (SAAO). These organisations therefore form a tight-knit and effective geographical and organisational cluster that represents a core network within the broader astronomy system.

Another key actor is Rhodes University, which has historically maintained a close relationship with HartRAO, and has thus developed unique capabilities in the area of radio astronomy. HartRAO has formed a training ground and science facility for astronomy students and researchers, while at the same time drawing on Rhodes graduates as an employer. The University of Stellenbosch is an important partner in the domain of engineering. This follows a historical trajectory of engineering excellence, characterised by close relationships with firms, the military, the space science sector, and the engineering professional body. This has positioned the university to play a leading role in technology development in collaboration with the SKA and technology-oriented firms in its value chain.

Astronomy at universities outside the traditional institutions of UCT and Rhodes University has grown rapidly over the last few years, with escalating staff numbers in the areas relevant to astronomy, as well as escalating numbers of postgraduate students and postdoctoral fellows. Several universities are currently establishing undergraduate programmes in astronomy (based in other departments, mostly in physics), including the University of the Witwatersrand (Wits), the University of KwaZulu-Natal (UKZN), and the University of the Western Cape (UWC). This has partially been a result of the influx of funding, as well as the attraction that a large project such as the SKA offers to prospective students and academics.

Overall, the distinct roles of the main university partners can be described as:

- UCT: the main partner university for the SKA in terms of astronomy
- University of Stellenbosch: the main partner university for the SKA in terms of engineering
- UWC: a leader among previously disadvantaged universities, and recent entry into the astronomy domain, supported by an influx of public funding
- Wits: a locus for SKA-related activity in the Gauteng region has experienced rapid growth in astronomy and SKA-related teaching and research
- Rhodes University: historically the leading university in radio astronomy, a key astronomy partner for the SKA
- UKZN: a critical mass of research excellence has evolved in the area of cosmology. As a leader in terms of transformation the university has received increased public funding for astronomy.

- DUT: the only university of technology with a formalised partnership with the SKA, this plays a small but systemically important role.

(source: Gastrow, 2014)

4.7. The Hartebeesthoek Radio Astronomy Observatory (HartRAO)

The HartRAO observatory was originally built in 1961 by NASA as a Deep Space Station to monitor the Southern skies, including communication with space craft, for example lunar missions. Until the construction of the KAT-7, HartRAO was the only major radio astronomy observatory in Africa. It undertakes research and training in radio astronomy, and is arrayed through interferometry with telescopes on other continents, forming a set of ‘super’ telescopes. HartRAO contributed to the bid to host the SKA in Africa, including contributions to the establishment of design and engineering requirements, and participation in the development and construction of the KAT-7 and MeerKAT.

4.8. Private sector: astronomy organisations

The main private sector organisations relevant to the SKA are the International Astronomical Union (IAU), and the Office of Astronomy for Development (OAD). The IAU is an international co-ordination body for astronomy, with a membership body of professional astronomers (<http://www.iau.org/about/>). Activities include hosting international symposia and hosting discussions about large-scale facilities such as the SKA. The IAU also works to promote astronomical education and research in developing countries. The OAD operates under the auspices of the IAU. Its headquarters have been located in at the South African Astronomical Observatory (SAAO) in Cape Town, in recognition of the role astronomy can play for development in Africa. This office coordinates between the IAU and South Africa's NRF with a focus on the use of astronomy as a tool for education and development.

4.9. Private sector: firms

The knowledge and technology requirements of the astronomy sector, and the SKA in particular, are too large to be met without firms in the private sector. Numerous firms are involved at various levels, primarily in research and technology development, as well as manufacturing. The SKA has a large value chain, and many firms, arranged into hierarchical

functional consortia, are involved in co-designing the instrument, and in the manufacture of the instrument. A good example of this is the ROACH board, a collaboration between SKA engineers, scientists from the University of Cape Town, and Tellumat, a South African electronics firm that will assemble the product locally. Examples of other firms in the SKA value chain include:

- MMS and BAE Land Systems, which have built the composite dishes;
- Optic 1, which built the power and optical fibre cables to the site;
- MESA Solutions, a Stellenbosch-based technology firm working on electromagnetic compatibility;
- IBM, which is working with the SKA towards developing a next-generation big data analytics platform;
- Aurecon, a multinational company with offices throughout sub-Saharan Africa, has been involved in planning and executing the infrastructure for the MeerKAT telescope;
- Neotel has partnered with the CSIR to install a data transfer network to the SALT and SKA sites.

Chapter 5: Science communication

5.1. Introduction: science communication in the context of the SKA

In the context of the study of the communication processes behind representations of the SKA in the media, the focus on ‘science communication’ in this chapter refers, for analytical purposes, specifically to communication related to the SKA that occurs outside of the mass media. The role of the mass media, and of science journalism in particular, is explored in chapter 6, and its findings are synthesised with those of this chapter in chapter 9. The analysis of science communication, thus defined, includes the communication activities of the SKA organisation itself, as well as the other main actors relevant to the science communication of the SKA, in this case the universities where many of the SKA’s scientists and engineers are based, as well as the government departments and agencies who fund and oversee the SKA in South Africa. There are some peripheral actors that play a minor role in the science communication of the SKA, including firms in the SKA’s value chain and innovation network, and affiliated science facilities and research institutes. However, both desktop research and interviews indicated that the role of these actors is minor, and they are not included in this analysis in order to provide more focus on the primary actors.

This scope provides insights into some of the main questions emerging from the literature review and conceptual framework. The analysis provides insight into how key actors strategically and operationally position the SKA within the public sphere, and outlines the manner in which science communication strategies respond to the imperatives that the various actors face within this sphere. This includes their response to their social and political context, as well as insight into the relationships between the primary actors in the framework of an actor-network model of science communication. This analysis covers two broad areas. Firstly, there is internal science communication within each actor, looking at strategies, structures, processes, internal information flows, and gatekeeping. Secondly, there is external science communication, looking at channels and messages produced by each actor for defined audiences, and the nature of their relationships with other actors, including journalists. Together these aspects help to build a model of how science communication is framed as a set of processes, both formal and informal, through which a network of actors position the SKA in the public sphere (see Figure 7).

This chapter is structured as follows: firstly, science communication within the SKA organisation will be examined. This includes science communication within the global SKA organisation, science communication within the South African SKA project office, and the nature of relationships with journalists and public sector actors. The second section looks at science communication at universities, focussing firstly on the internal science communication processes and structures, and secondly at the relationships between journalists and scientists. The third section focuses on science communication within public sector actors, including the DST and the NRF, again looking at both the internal science communication process and the external aspects such as their relationships with the SKA and their channels and messages for communication. The final section brings these findings together to model the science communication process behind representations of the SKA in the media within the conceptual framework derived from the mass communication literature, the science communication literature, and the notion of the public sphere.

The relationship between scientists and journalists is of central concern for this chapter. Bucchi (2004: 108-109) identified the attitude or position of scientists as the ‘diffusionist’ conception, which positions the media as a ‘dirty mirror’ held up to science, that has a limited ability to accurately reflect scientific facts and methods. As pointed out by the British Royal Society (Royal Society, 1985), a lack of communication between scientists and journalists can undermine the quality of science news. Claassen (2011a) reached similar conclusions in the South African context, and Lugalambi *et al.* (2012) and Clayton and Joubert (2012) in the African context. Thus, for each of the main science communicators, the nature of relationships with journalists is investigated, particularly the relationships between scientists and journalists, including both scientists based within the SKA and partner scientists based at universities.

In line with the overarching methodology of this study, both top-down and bottom-up methods were used to identify salient dimensions to structure the analysis of data describing science communication. Data relevant to science communication was drawn from the interview transcripts of respondents from the SKA, the DST, the NRF, and university-based scientists working on the SKA. Each key dimension is reflected the data through several modes, or indicators. These elements are presented in outline in Table 11.

Table 11: Key dimensions and indicators for science communication

Dimensions	Indicators
Objectives	Strategic imperatives at the institutional level Strategic orientation of each actor vis-à-vis the public sphere Formal and informal strategies Tacit and codified strategies
Structure & Process	Structure of internal science communication functions Processes for science communication Gatekeeping
Audiences	Identification of stakeholders and constituents Differentiation of strategies, channels, and messages for different audiences
Channels	Operational means of delivering messages Differentiation for specific audiences and messages according to institutional strategies and imperatives
Messages	Message construction in relation to science communication strategies Differentiation for specific audiences and channels
Relationships	Relationships maintained with other actors in the public sphere Particular emphasis on the relationship with journalists and the mass media
Controversies	Site allocation; fracking; development context

5.2. Science communication in the SKA

5.2.1. Science communication at the global level of the SKA

The science communication process within the international SKA organisation has been developed relatively recently. Until 2011, the SKA took the form of a project office rather than a fully-fledged organisation, and as such did not have a significant internal communications function. The SKA organisation, as presently constituted, came into being in December 2011. From that point the project evolved rapidly, moving towards the site allocation in May 2012. At that time, a dedicated Communications and Outreach Manager was appointed to develop a communications strategy and to co-ordinate the communications activities across all the partner institutions and partner countries. Within the SKA, at the

international level, communication and outreach activities fall under the same functional area, and overlap to some extent. Communication includes public relations, while outreach refers more specifically to community-based activities that involve the public, as well as media events such as press briefings and launches.

The first step in this process was to gather staff involved in communications and outreach from all the international partner organisations and institutions and create a forum for them to interact and work together to inform the strategies and structures for the SKA's communication process. A working group was established, the 'Communications and Outreach Working Group', with one representative from each region, including Africa, North America, Asia, and Europe. The SKA Communications and Outreach Manager is the chair of this group. The initial purpose of this working group was to inform the development of a global communications strategy and to have each region endorse this strategy. This working group has become the top level of the communications function within the SKA. The strategy established the main on-going role for the working group to be the coordination, management, planning and control of the SKA-related communications and outreach activities. The group convenes monthly teleconferences and face-to-face meetings at least annually and more often if necessary.

At the second level is a broader group, that includes at least one representative from each of the member countries. This has been called the 'Communications and Outreach Network'. This network meets less regularly than the Working Group – approximately every three months by Skype and annually in person. Members of the Network act as liaisons between the central SKA organisation and the SKA operations and partner institutions in their own countries. Rather than strategy formulation, the task of the Network is to implement this strategy, and the network therefore has a more practical orientation.

The SKA communications strategy, as approved by the SKA board, is not available in the public domain, nor is it classified. Rather, it is an operational document, and SKA management kindly made some details from this strategy available for research purposes (although not for distribution to the public). The main and overarching objective of the strategy is to grow financial, political and public support for the international SKA project by communicating its value to stakeholders and the general public. This point clearly towards a strategy for positioning the SKA in the public sphere, as conceived by Habermas (1989), and

as conceived by Bauer (2002) in relation to a ‘science or technology movement’ within the public sphere. The strategy explicitly aims to bolster support in the public sphere by selectively providing messages through the mass media.

By ‘value’ the strategy refers to the science and technology aspects of the project as well as other elements, such as local development, capacity building, educational initiatives, and the preservation of local heritage and environment. In a broader sense, the SKA aims to position itself in the public imagination as one of the top scientific and technological global projects of the twenty-first century – a favourable way in which to frame a ‘technology movement’. The scope of the strategy is large. Due to the demographic composition of the member countries, which include India and China, the SKA partner countries together account for 40% of the world’s population – and the strategy aims to reach this population. Thus, the SKA faces many ‘publics’, which, as is evident, calls for a targeted and selective strategy for engaging in these multiple, nested, and overlapping public spheres. The populations of partner countries, as tax payers and citizens, are the funders of the SKA, and the organisation needs to be positioned as a deserving beneficiary of public funding.

To achieve these public sphere objectives, the strategy outlines five key priorities:

- 1) Ensure that stakeholders and the public understand the SKA to be a single coherent project;
- 2) Increase communications activity in non-host countries;
- 3) Ensure that all stakeholders are engaged with the project at the national and international level;
- 4) Communicate the value of the SKA project to all its stakeholders; including the public, and
- 5) Support SKA top managers to attract new member nations to the organisation and enrol non-traditional funding sources.

(SKA Communications Strategic Plan 2013-2017)

The strategy, based on these priorities, identifies the main messages for each audience, and identifies the roles and media channels to reach the required audiences at the global, international, national, and regional levels. There are seven high-level communication channels, which also form the seven operational components of the SKA Communication and Public Outreach Programme: 1) branding; 2) online outreach; 3) networking; 4) media; 5)

material and publications; 6) events and conferences; 7) public and local affairs (SKA Communications Strategic Plan 2013-2017).

The key audiences are defined at a high level by geographical scope, rendering distinct strategies for local, national and international audiences. This provides operational guidelines, as geographical location largely determines who will do most of the communicating with each audience. ‘Local’ refers to audiences close to the infrastructure or SKA headquarters, including local publics, national and local politicians, the science and engineering communities. ‘National’ refers to specific audiences within member countries, as well as targeted audiences within non-member countries, where important SKA stakeholders need to be communicated with, including scientists, government agencies and businesses. ‘International’ refers to broader groups which cross national borders, for example the broader international astronomy community. For each of these categories, the strategy identifies specific audiences and delegates responsibility for communication.

Within this context, the mandate and tasks of the communication function of the SKA South Africa project office are clarified: they are the primary communicators to local audiences; they co-operate with the international SKA organisation in communicating to national audiences, but are not responsible for communicating to international audiences. In other words, the public sphere faced by the SKA South Africa is largely a national one. The main audiences that are covered by this mandate are indicated in Table 12.

Table 12: SKA communication audiences and responsibilities

	Audiences	Responsibility
Local	<ul style="list-style-type: none"> • Local groups, businesses, native title claimants, schools, councils, etc. • National-level business/industry groups • Mining organisations, pressure groups, etc. • State and National Governments • National and local media 	Host country (including African partner countries)

	<ul style="list-style-type: none"> • Education community • Scientists and universities • The general public 	
National	<ul style="list-style-type: none"> • National Governments • Funding agencies • Science organisations • Universities • Science outreach organisations • Media 	SKA Organisation and Member country
International	<ul style="list-style-type: none"> • The international science and engineering community • The general public (world-wide) • International media • International business/industry • Non-member Governments 	SKA Organisation

Source: SKA Communication Strategic Plan 2014-2017

At a higher level of resolution, the strategy identifies specific messages and channels appropriate for each audience or stakeholder group, as indicated in Table 13. Management interviews highlighted the importance that building support amongst this array of stakeholders has for the SKA project, again explicitly positioning the SKA within the public sphere as a ‘science and technology movement’ (Appendix Q.1).

Table 13: SKA communication audiences, messages, and channels

Stakeholder Group	Message types	Channel
Science and engineering community	<p>Address when and how SKA will deliver science</p> <p>Convey what the SKA will do and how it will impact their science</p> <p>Address technical challenges of</p>	<p>Talks</p> <p>Journal articles</p> <p>Technical / computing articles</p> <p>Newsletters (including SKA eNews)</p> <p>Science Working Groups</p>

	the SKA construction	Conferences/seminars: (i) Booths (ii) Talks (iii) SKA literature*
Media	Detail facts, figures, timescale, key science projects, main technological breakthroughs and spin-offs, non-science benefits, cost and funding	SKA literature* Visuals on SKA websites Press releases Video newsreels Press visits to the sites Individual contacts Conferences
Educational community	Raise awareness of SKA among students and research institutes Address curriculum requirements of the many countries participating in the SKA	<i>Informal education:</i> SKA literature* Exhibitions <i>Formal education:</i> Connect with dedicated programmes such as Universe Awareness, Cool Cosmos initiative, Science in School, Galileo Teachers Training Program, etc... University magazines Summer schools Workshops
Governments (locals and nationals)	Identify how SKA fits into funding themes Address potential non-science benefits Address what the economic impact of the SKA is Benefit of international collaborations Connection to national	Special events Presentations SKA literature* Non-science /economy/societal benefits material Visits to the sites

	priorities	
General Public	Inspire, engage, raise general awareness on the SKA (includes key science drivers, technological breakthroughs, non-science benefits)	Background articles (magazines and newspapers) SKA literature* Online SKA platforms Social networking sites Exhibitions Conferences Outreach events SKA News Programme
International business/Industry	Address potential opportunities for collaborative design, procurement and IP exploitation	SKA literature* Industry Day / Workshops SKA Forum Newsletters (including SKA eNews) Annual report Regular contacts with specific groups (visits, meetings, events)
Local people in host countries and at telescope sites	Inspire, engage, raise general awareness on the SKA, focus on local heritage and link it as much as possible to SKA universe	Background articles (magazines and newspapers) SKA literature* Website (keywords) Exhibitions Comic series Social networking sites Outreach events Capacity building and educational programmes

* SKA literature includes SKA brochures, leaflets, posters, fact sheets, artist impressions/animations and newsletters / e-newsletters

(Source: SKA Communication Strategic Plan 2014-2017)

This strategy needs to cater for different conditions in each of the member countries. Communication and outreach functions are well-developed in South Africa and Australia, due to the sustained effort of competing to host the SKA. The SKA Communications and Outreach Office engages regularly with the South African SKA Project Office – particularly with the management responsible for communication, and with the science communication consultancy that conducted a large proportion of the project’s communication activities prior to 2014. However in other partner countries the functions are less developed. At the time of research, the SKA (international) Communications and Outreach office was in the process of gathering information about the status of communications and outreach in each of the member countries, in order to develop detailed plans for each country.

Relationships with journalists at the international level are well developed. The Communications and Outreach office, through its staff, has a large network of ‘first level’ contacts – people that are known personally. At this level, contacts can even be briefed on new developments before they are made public, indicating a high level of trust. In addition to this is a much larger network of ‘second level’ contacts that are more regularly accessed through mailing lists (Appendix Q.2.)

The information that is passed on to journalists is largely in the form of news releases. The strategy behind these news releases is to focus on ‘newsworthy’ messages that relate technological or scientific ‘milestones’. The concept of milestones is central to both the international and South African communications strategies. Focussing on milestones allows communicators to send out messages of concrete achievements, reduces the scope for subjectivity and inaccuracy, and renders an output of positive messages.

The internal process for generating news releases requires a high level of co-ordinating ability within the SKA organisation. The Communication and Outreach Manager maintains an online Google document and Google calendar that reflect all the identified upcoming media opportunities. This is shared internally within the SKA, across all the member countries, and represents a dynamic knowledge pool, in that all members can independently update the live documents. These documents are discussed with the international team via teleconference. On the agenda here are upcoming events and media opportunities, the scale and scope of the planned media event or outputs, which countries to include, and which

media channels and mailing lists to utilise. The Communication and Outreach Manager then takes action accordingly (Appendix Q.3.).

The online media, including the social media, play a central role in the communications function. The SKA international has a presence on Twitter and Facebook. At the time of research a Deputy Communication and Outreach Manager was being recruited, and one of the main objectives for this position will be to provide additional support to raise the profile of the SKA in the social media. The SKA international hosts a website, and one of the main functions of the social media, from a communications strategy point of view, is to direct people to this website (Appendix Q.4.).

The structure of communication flow in the social media is somewhat devolved. Country teams have direct access to the SKA international's Facebook page, and are able to freely post items to that space. The aim is to make the social media footprint more dynamic and responsive to changes around the world (Appendix Q.5.).

The impact of government actors on the communications process is not very great, but this varies from country to country. Each country team and partner institution is responsible for engaging with government at the national level, and the communication department in each country has a relationship with domestic government actors.

The role of the institutional partners, including firms, is more complex. There is reportedly no direct influence that the private sector has on the SKA's communication function. However, there is an internal communications interface between the central communications office and the ten consortia that constitute the SKA project – and the consortia include firms, universities, research institutes, and science facilities. The emerging protocol is for organisations that form part of the consortia to inform the central communications office, via the consortium leader, who acts as a first gatekeeper, before they communicate to the public about their progress, particularly in relation to the milestones that form the core of the communications strategy. The intention is for the communications office to ensure that their public statements about milestones are accurate and consistent with other outgoing messages.

Public communication from consortium members can include news releases, engagement with journalists, social media messages, and website updates. However, not all

communication channels are treated equally. The central communications office is most interested in the monitoring and gatekeeping of formal public statements - such as news releases. Minor social media posts, for example, are not treated in this way, as their impact is too low to justify the time required, and the communications office does not have the capacity to monitor every such message (Appendix Q.6.).

The structures of communication within the SKA international are responsive to the shifting communication needs of the project, and are thus inherently dynamic. At the time of research, the priority was to gain the support of the science community and industry. At a later stage, gaining the support of the general public will become increasingly important. These priorities inform the project's communication strategy and activities. This highlights that the SKA's efforts to position itself in the public sphere includes strategic choices informed by changes in the organisation's environment, and by predicted changes for the future. The public sphere is a dynamic space, with actors, interests, and relationships changing over time, necessitating such a strategic response (see Appendix Q.7.). Since the communications office within the SKA is relatively new, the capability to achieve these monitoring and gatekeeping functions was still being developed at the time of research. Communication for an organisation as large and globalised as the SKA is a challenge (see Appendix Q.8.).

5.2.2. Science communication within the SKA in South Africa

The SKA's management and science communicators report an intensive awareness of their position in the public sphere, and the need to support this through communication (Appendix Q.9.). This is a challenging imperative, as communication within the SKA in South Africa answers to multiple mandates. The SKA's communication needs to be aligned with the laws, protocols, and formal and informal requirements of the DST, the NRF, and the SKA international organisation. Moreover, the SKA's communication efforts needs to be targeted to strategically position itself amongst its many other stakeholders, including the local community around the infrastructure site and the broader South African public. The communication strategies and processes of the SKA in South Africa, like the international organisation, thus have as their primary objective the improved positioning of the project in the public sphere. This necessitates rigorous controls over outgoing information, including a gatekeeping function at the apex of the organisation (Appendix Q.10.).

Within the SKA South Africa project office, including the MeerKAT project office, professional science communicators have played a central role, particularly in the operational aspects. Southern Science, a science communication service provider and consultancy, has been a major contributor to the SKA's science communication activities. Southern Science was part of the SKA's communication function since its inception in 2002 until early 2014, following which an internal post was established within the SKA. However, during the time period that frames this study (September 2011 to August 2012), Southern Science were the primary science communicators for the SKA South Africa.

The main day-to-day activities of this function include interaction with journalists, staging media events (launches, press briefings), and responding to ad-hoc requests for interviews or editorials. Communication activities are framed by an engagement strategy. This, in line with the SKA international communications strategy, is centred on the notion of milestones, with the aim of using milestones as a touch-point to illustrate progress and achievement to stakeholders and to the general public. The strategy presents a timeline of upcoming milestones, each of which present an opportunity for interacting with the media and communicating with the public, with the aim of growing support for the SKA in the public sphere – driven by the need to demonstrate that public funds have been effectively utilized (Appendix Q.11.).

The communication strategy was informed by discussion at the steering committee level of the SKA (South Africa) and at a Board level, to decide what the key messages should be and how these messages should be brought to stakeholders and the public. On this basis the communications strategy was written, approved by the board, and circulated through the organisation. It is currently in the implementation phase. The strategy is not a formally instituted document – it is a practical guide that has been circulated to SKA staff. However, interviews found that not all SKA staff were aware of this guide, suggesting that the strategy is also in part a non-codified set of practices premised on tacit knowledge that is cultivated within the organisation.

The communications strategy outlines a process for engaging with the media, including the identification of several gatekeeping functions. Firstly, the main entry point for media enquiries was, during the period being researched, was the external communications consultant. From that point, the enquiry would be directed to the appropriate person. The

communications strategy contains guidelines about which members of staff are the appropriate media contact point for various topics. The strategy, in general, calls for members of staff to restrict their public comments to their fields of expertise – for example, engineers may comment on engineering issues, scientists on science issues. The aim of this policy is to prevent inaccuracies or personal opinions from entering the media – the focus is on objective and accurate information about SKA milestones (Appendix Q.12.).

Senior management play a central role in communication. They are best positioned to oversee outgoing messages about strategic or politically sensitive issues. For example, questions about the site allocation or the allocation of public funds require strategically informed and considered answers, which senior management are in the best position to formulate. Moreover, all messages officially endorsed by the organisation – for example, newsletters and press briefings - require clearance from the project director (Bernie Fanaroff) or associate director (Justin Jonas). The top management therefore form a narrow gate by which formally endorsed messages can enter the public domain – a structure necessitated by the complex nature of the SKA project and its sensitive position in the public sphere. This again highlights that the SKA's efforts to position itself in the public sphere are complex and represent high stakes for the organisation (Appendix Q.13.).

The SKA uses several channels to send messages out to the public:

- Social media: regular updates are posted on Twitter and Facebook. The SKA South Africa website also duplicates any updates from Facebook and Twitter. This is an effective way of engaging with the public and with stakeholders, as the SKA has a large following on the social media, as well as specific influential followers, such as the Minister of Science and Technology, who in turn attract followers to these sites (see Chapter 8).
- News media: Firstly, the SKA issues editorials and news releases co-inciding with events and milestones. Secondly, there are ongoing ad-hoc interactions with journalists.
- Non-print media: radio interviews, television interviews, documentaries.
- Quarterly newsletter: provides updates and progress on the project

- Bi-monthly newsletter for the Northern Cape community: also providing updates and a progress report. In this case in the Afrikaans medium, the majority language in the Northern Cape.
- Public talks to specific stakeholder groups
- An outreach team that visits schools and attends career exhibitions and science festivals.

(source: SKA science communicator A)

5.2.3. Relationships with journalists

When analysing the relationship between the SKA and journalists, a distinction needs to be made between the institutional relationship and the individual relationships that exist between SKA scientists, engineers, and management, and the press. On the one hand, the institutional relationship has been reported as largely positive – and this is not surprising, given that science organisations routinely develop functional working relationships with media organisations (Bucchi, 1998). On the other hand, the individual relationships between scientists and journalists are also generally described as mutually positive – a finding that is more surprising, in light of a literature that suggests that there should be a greater degree of tension between scientists and journalists in general (e.g. Nelkin, 1995), in the African context (e.g. Lugalambi, 2012) in the South African context (e.g. Claassen, 2011a), and in the astronomy sector (e.g. Madsen, 2001). This begs the question – why are the relationships between SKA scientists and the media so positive? Is this because of institutional or organisational factors? Is it because of the peculiar symbolic position that the SKA occupies in the South African public sphere? Or is it because of an alignment of incentives for representing the SKA in the media?

The relationship between the SKA and journalists is described as generally smooth by all the interviewed management within the SKA, in the context of an awareness that the SKA's position in the media is precarious and that this positive relationship need to be maintained (Appendix Q.14.). Internally, engagements with the media are loosely managed. Scientists and engineers are reportedly motivated to engage with the media, and to share their passion for their work on the SKA. However, communications staff occasionally need to act as

intermediaries, for example re-writing their messages in order for them to reach a broader public, and checking to avoid inaccuracies.

Where the contents of messages lie outside of SKA control, for example in the news media, there are occasional inaccuracies, but these are described as minor – for example, providing an incorrect size for the antenna dishes. The SKA communications staff do not ultimately have control over news articles, as journalists are not required to submit these for vetting or accuracy checks. However, much of the factual detail about science and engineering activities required by journalists is provided on the SKA website. Also, as awareness about the SKA has grown over time, the number of inaccuracies has declined. Where inaccuracies do take place, they are largely committed by journalists who have not conducted sufficient research. This is often in response to a spike in media attention and newsworthiness – for example the site allocation decision – where journalists without a background in science journalism are required to quickly cover the SKA, without an awareness of the scale and complexity of the project (Appendix Q.15.). Where such accuracy problems are substantial, the SKA issues statements pointing out where inaccuracies have occurred (Appendix Q.17.). Overall, therefore, SKA management identified two main types of engagements with journalists – firstly, with professional and dedicated science journalists, and secondly with short-deadline non-science journalists responding to a spike in interest (Appendix Q.16.).

According to SKA management, the relationship with journalists could be improved if journalists were more pro-active about looking into the details of the project - finding out who within the SKA is doing the exciting science and approaching these people. It would also be beneficial if more journalists could gain a basic understanding of the science of the SKA. As reported by SKA manager C: ‘you know, if they’re going to interview somebody about cosmology research, then understand the basics of cosmology’ (Appendix Q.18.). Another reported challenge is the communication capabilities of scientists, who don’t always have an aptitude for framing their research in language accessible to the public.

Overall, the generally positive relationship between SKA scientists and journalists can be attributed to the strategic cultivation of long-term trust-based relationships with science journalists, supported by the SKA’s science communication function, by senior management, and by scientists and engineers. Another factor, revealed more clearly by the analysis of media outputs than by key informant interviews, is the ‘good news’ nature of the SKA as a

story and as a symbol, which aligns the incentives of journalists and SKA scientists in terms of how the SKA is framed and represented in the media. This factor is examined in more detail in chapters seven and eight, which undertake content analyses of the news media and the online social media.

5.2.4. Relationships with public sector actors

Given the high level of public funding of the SKA (National Treasury, 2013), and its organisational reporting structure, which entails operational management by the NRF and strategic guidance by the DST, a close relationship between the SKA and these public sector actors, in terms of science communication, could be expected, and is made clear in the evidence. As a business unit of the NRF, and therefore formally part of a government agency, the SKA in South Africa needs to consider the effects that its communication will have on the NRF, DST, and public sector actors more broadly. The communication goals of the SKA and its government sponsors are largely aligned, as they all wish to grow public support and stakeholder support for the project.

There is, however, no direct intervention of government actors in the SKA's internal communications process – the mode of engagement is one of cooperation rather than of oversight or control. The DST communications team does occasionally assist the SKA communications team, particularly with matters relating to state protocol (Appendix Q.19.). Within the DST, the primary contact point is the Chief of Communications and his team of approximately twenty people. Their main points of involvement are with major events or milestones, at which point they draw on their communications apparatus to send additional messages through DST networks and channels. However the relationship with the DST communications function is not formalised – it is an informal working relationship based on mutual goals. The SKA does not require formal approval or gatekeeping functions from the DST.

5.3. Science communication within universities

The SKA is inextricably linked with universities. Many of the SKA's scientists and engineers are also based at universities, or maintain close ties with universities. There is therefore considerable institutional overlap between the SKA and the higher education system. In the

context of the public sphere, universities aim to position their role in the SKA in order to bolster public and stakeholder support, with the aims of increased funding, improved research reputation, and attracting top academics and students. Universities thus share the SKA's goal of sending out positive messages about the SKA – again highlighting a high degree of incentive alignment among key actors in the public sphere.

Internal communications processes at each university affect message construction and the manner in which messages reach the public. Informal and tacit processes by which academics, often acting individually, interact with journalists, also play an important role. Since each university has distinct processes in each case, the analysis first examines, then compares and contrasts, four of the main partner universities of the SKA: the University of Cape Town (UCT), the University of Stellenbosch (US), the University of the Western Cape (UWC), and the University of Kwa-Zulu Natal (UKZN). This sample includes the main partner university for astronomy, the main partner university for engineering, a significant partner university in cosmology situated outside the Western Cape base of the SKA, and a previously disadvantaged university that has experienced rapid growth in astronomy research and teaching.

5.3.1. Internal science communication processes

The key informant at the University of Stellenbosch reported frequent interaction with the media in relation to the SKA. This included engagement with newspapers, engineering magazines, the university media office, and the SKA media office. Reportedly, scientists receive numerous requests from the University of Stellenbosch Media Office, which is located in the Communications and Liaison department (<http://admin.sun.ac.za/communication/>). These requests are usually for technical information about the university's involvement in the SKA, for example the activities of students, the nature of research projects, and how the site is developing. This information, channelled through the media office, makes its way into the campus news and the alumni magazine as well as the mass media.

The media office approaches scientists – generally scientists do not initiate contact. However, this may vary between faculties. For example, the Engineering faculty has its own media office, which reportedly is highly active in communicating on the SKA. One of the SKA

research chairs is based in the Engineering faculty, and he reportedly actively engages with this faculty-level office. Communication is in the first instance project-based, and escalates through a hierarchy of internal news structures, with multiple points of gatekeeping, before possibly entering the mass media. Where the projects of university staff are seen as having ‘a lot of layman appeal’, they are written about in the faculty newsletter. From that point, the most newsworthy (from the point of view of the university communication office) are taken further by the university communication office. A similar process applies to all Master’s theses and PhD dissertations, each of which generates a short write-up in the science faculty newsletter.

The key informant at UCT reported that staff in the astronomy department actively make contact with the university’s communication office (officially the ‘Communication and Marketing Department’, <https://www.uct.ac.za/services/communication/>) when they feel that they have a newsworthy message to disseminate. The informant also described a process of more direct communication with external actors, primarily the SKA itself. He has been actively involved in drafting new releases in collaboration with the SKA science communicator, as part of a general practice of scientists writing SKA news releases in collaboration with the SKA’s science communicators and with the DST’s communicators. This collaboration is necessitated in part by the high visibility of such news releases – which can reach a global audience. Other forms of outgoing communication include engaging with journalists and writing for the popular scientific press, for example *Quest* magazine or the *South African Journal of Science*, which disseminates results to a broader science audience (Appendix Q.20.). Another possible channel is through the science faculty’s communication and marketing committee (http://www.science.uct.ac.za/usr/science/about/ScienceFaculty_Committees.pdf), which maintains contact with scientists to establish whether they have any newsworthy activities to report. In the case of the SKA they have a focus on new observations (from the KAT-7) and new related publications. The goal of the committee is to showcase the efforts and investment by the university in the SKA and astronomy. This illustrates that, in the context of the public sphere, faculties and departments within universities have their own agendas in terms of framing their role in the SKA (Appendix Q.21.).

The process at the University of the Western Cape is similar, also based on a communications structure within the university, in this case the Media Relations Office

<http://www.uwc.ac.za/uwconline/Media/Pages/communication-journalists-.aspx>), which coordinates and disseminates news releases. Since UWC plays a less prominent role in the SKA in comparison to Stellenbosch or UCT, its media activity has been less substantial. However, there has been some activity, notably in relation to a SKA SARCHi chair based at UWC, at the time of research headed by Prof Roy Maartens. The key informant expressed some frustration with the university's engagement with newspapers in general, reporting that, on the one hand, newspapers respond slowly to stories emanating from the university, and on the other hand that scientists do not always supply journalists with the correct information.

At the University of Kwa-Zulu Natal there is a more complex and hierarchical communications structure. The central communications function is vested in Media Relations Unit, which is part of the Corporate Relations function (<http://corporaterelations.ukzn.ac.za/MediaRelations.aspx>). However, key informants described the functioning of the internal communications office as being slow in its reaction towards academics (Appendix Q.22.).

Unlike other universities, UKZN employs a communication officer dedicated to astronomy. This officer is based in the Astrophysics and Cosmology Research Unit. Her objective is primarily to showcase the successes of the ACRU, for example if a well known international speaker is giving a public talk at the Unit, or if staff have received awards. Another motive is to disseminate information about available scholarships and bursaries. This is another example of how internal components within universities can to some extent set their own terms of engagement with the media to achieve their distinct objectives for positioning within the public sphere. The functions of this communications officer include engaging with schools, managing an outreach website (<http://www.acru.ukzn.ac.za/~outreach/>) and interfacing with other levels of the communication function within the university. Interactions with journalists are mediated by the communication officer. She retains a database of media contacts, and when there is a message that the Unit wishes to disseminate, the officer can either send this up the hierarchy to the central communications office, or contact journalists directly. Thus, the dedicated communications officer has developed professional relationships with journalists, while for the scientists this is not the case.

The university also has system of meso-level communication officers, who operate at the college level. This function acts as a mediator between the colleges and the central

communications office. The overall communication structure is thus hierarchical and messages pass through several gates before reaching the public (Appendix Q.23.). However, scientists retain agency over the communication process – they are free to communicate to journalists independently or through the internal communication structures

5.3.1. Relationships with journalists

The relationship between university-based scientists and engineers is institutionally and practically distinct from that between SKA-based scientists and engineers, although where scientists are located in both institutions they need to answer to both mandates. On the whole, the SKA places greater controls and gatekeeping functions on the interactions with journalists, while university-based academics interviewed for this study have considerable freedom to engage with the media on their own terms. In line with Peters (2005), the scientists that were interviewed were motivated to engage with the media in order to ‘teach’ the public about their work, to build a society that enjoy science, and the benefit from the instrumental value of publicity.

The key informant at the University of Stellenbosch reported frequent engagement with journalists. The relationship was described as generally positive, and reporting generally accurate, although one instance of misrepresentation was described involving a journalism student at the university (Appendix Q.24.). The informant also reported frequent interaction with the SKA science communicator (Appendix Q.25.). Some possible improvements in science journalism were however suggested – that more dedicated and highly trained science correspondents in more newspapers would improve the communication of the SKA and keep the public better informed (Appendix Q.26.). The key informant at UCT reported that the accuracy of journalists reporting on the SKA has generally been good. In some instances the short deadlines faced by journalists, and passed on to scientists, make it impossible to react in time, in which case their request is passed on to another scientist (Appendix Q.27.). He also reported that there is room for improvement in the way scientists communicate – that press releases should be written in a manner that is not excessively complicated and that makes it possible for the audience to understand the language and the importance of the research. This observation is in line with Bucchi (1998) and Nelkin (1995), who identify the communication skills of scientists as one of the impediments to science communication (Appendix Q.28.). A key informant at UWC reported only minor engagements with journalists. Generally, at

UWC, engagements with journalists are usually initiated by scientists. However, the informant reported that he did not have a strong personal relationship with any journalists, and this acted as a constraint on communication (Appendix Q.29.). Key informants at the University of KwaZulu-Natal reported frequent, and generally positive, interactions with journalists, mediated by the hierarchical structure of the university's communication function (Appendix Q.30.). The engagement with journalists is also iterative, in that a press release issued by the Astrophysics and Cosmology Research Unit might catch the attention of a journalist, who will then approach scientists in the unit for more detailed information (Appendix Q.31.). Finally, key informants reported a spike in media attention at the time of the site allocation announcement. This increase in media attention is clearly described in the media content analyses in Chapter 7 and Chapter 8.

5.4. Science communication within the public sector

5.4.1. The Department of Science and Technology

Communications within DST, as in the SKA, is a function of top management. The Minister of Science and Technology is the main spokesperson for the department. He or she may delegate to the Deputy Minister or the Director-General, and in turn the Director-General may delegate to the Head of Communications. The Head of Communications manages and co-ordinates four directorates, each of which plays a part in conducting science communication for the SKA (as well as other entities, projects and activities of the DST, for example the NRF, CSIR, or HSRC). These are Media Liaison, Communication and Marketing, Editing, and Speechwriting. Of these, Media Liaison is the most active in science communication for the SKA. Media Liaison responds to media enquiries about the SKA if they require a government response, particularly where enquiries are related to public funding or political support. Other enquiries, particularly those related to operational matters, are re-directed to the SKA's offices. This forms part of a broader cooperation with the SKA communications unit and the international SKA organisation, particularly the SKA Communications and Public Outreach Programme.

There is thus close co-operation among public sector actors in terms of communication, with the DST, NRF, and SKA working together to direct media enquiries to the correct source, share information, and co-construct messages. DST described Southern Science, acting for

the SKA, as a ‘pillar of support’ (government management interview B), including acting as a source for written and visual materials. The three parties conduct monthly meetings which focus on operational matters, including communications. Another communication forum is one internal to the DST, the Science Communicator’s Forum. All the agencies that report to the DST, including the NRF, science councils, etc., participate in this forum, which serves to disseminate information both among these actors and externally, to other government departments and the public.

Journalists, both local and international, reportedly often request information from the DST. These requests are usually related to 1) infrastructure, for example requesting updates on recent developments, 2) the financing of the project, for example how the project is being financed and whether treasury is making adequate provisions for it, and 3) questions related to the SKA’s Human Capital Development Programme. DST described their relationship with journalists as generally ‘excellent’. They reportedly engage with journalists on an ongoing basis, and have cultivated relationships with science journalists, including most of the sample of journalists for this study, as well as science journalists operating in the media of radio and television.

There are four main channels of media outputs from the DST with regards to the SKA: 1) media briefings to brief journalists about important developments on the SKA, hosted by the minister, the deputy minister, the DG, and the Head of Communication. 2) The South African National Editors’ Forum (SANEF), from whom the DST garnered support for the SKA – the editors indicated that they would find space in their publications to profile the SKA. 3) News releases, mostly timed to an activity, e.g. a news briefing, launch, etc. 4) Twitter feed is sent out by the communication and marketing directorate.

5.4.2. The National Research Foundation

The National Research Foundation is a key actor in the communication of the SKA. Within the NRF there is a corporate communications function, which is reportedly very active in communicating about the NRF. The key informant reported that he has frequent interaction with journalists, singling out the *Mail & Guardian* in this regard. Outgoing messages usually address operational matters of the SKA. The guidelines for communicating, including communicating about the SKA, are that the communication must serve a public interest.

However, in this context, there is also a division between confidential and public matters. Many of the activities and discussions within the NRF, including those related to the SKA, are sensitive and not intended for public disclosure. There is thus a gatekeeping function that aims to prevent confidential information from reaching the public. In the case of astronomy, the Deputy CEO: Astronomy has the authority to communicate about astronomy in particular (Appendix Q.32.). More generally, senior managers (Executive Directors and higher) at the NRF act as communication gatekeepers. Events also play a role. For example, the NRF participates in ‘astronomy town meetings’, which are forums for interaction and for communication (Q.33.).

5.5. Conflict and controversy in science communication

Previous studies have suggested that astronomy is not usually portrayed as controversial in the media (Madsen, 2001). In the case of the SKA, the scientific aspects of the project have remained largely free of controversy. However, the broader context of the project has provided some issues of controversy, most significantly that over the site allocation process. Content analysis has shown that this has formed the most common dominant frame of media outputs during the study period. Other controversies, such as the issues of fracking and the development context of the project, are far less prominent. The key informant interviews aimed to establish the role of science communicators in constructing messages about these controversies, as well as their views of the resulting representations in the media.

5.5.1. Site allocation

5.5.1.1. Voices from the SKA and scientists

The site allocation marks a watershed not only in the operational life of the SKA, but in its science communication. Country teams developed and implemented substantially different communication strategies during the periods before and after the site allocation, necessitated by the changing strategic environment and shifting imperatives in the public sphere. The competitiveness that acted as a communications driver before the site allocation, with the aim of bolstering public support for the South African bid, had to be replaced by a unified message, in which the discourse of competitiveness was replaced by a discourse of co-

operation, with the aim of building continued support for the project in both the South African public sphere and in the global public sphere (Appendix Q.34.).

Key informant interviews sought to establish the views of SKA staff regarding the strategic moves that lay behind the site allocation decision. All interviews made it clear that the outcome was a result of a balance of forces, in which, broadly speaking scientific and technical parameters favoured South Africa, and certain socio-economic factors favoured Australia, but in which financial considerations were also a significant factor. Ultimately, it seems that the need to include the sunk investments of both the Australian and South African partner countries contributed to the split site allocation of infrastructure, leading to pressure from both governments to finalise the decision and to include these investments:

- ‘The importance of using the exiting planned infrastructure was a very strong criteria because it was a lot of money already invested’ (management interview: SKA international);
- ‘Both governments had spent a lot of money on their precursors already. So I think the organization had no choice but to split the site’ (SKA manager B).
- ‘Everybody has recognised that South Africa does have the preferred site, but however, you know, we want to take advantage of investments from both sites, so that’s why the inclusion of Australia’ (SKA manager C).
- ‘Mostly though it was just money. If Australia or South Africa had pulled out the project would have fallen apart’ (university scientist and SKA manager B).
- ‘If they withdrew their expertise and their money it would put the whole project at risk’ (SKA science communicator A)

The manner in which this was framed in institutionally sanctioned messages was by using the term ‘maximum use of investments’: ‘The way it was worded was to make maximum use of investments made by both counties which implies that if one of those countries pulls out you lose that investment’ (university scientist and SKA manager B).

The site allocation announcement presented challenges for the South African SKA science communicators. The combination of high stakes, high levels of uncertainty, and an unprecedented spike in media interest, created a high level of pressure. This pressure contributed to reactive tactics that sought to contain any undesirable messages and control

communications mechanisms in order to send messages into the public sphere that were aligned with the interests and requirements of the key actors in the public sphere and the main stakeholders of the SKA (Appendix Q.35.). These challenges were to some extent strategically managed. For example, communication strategies were in place for the three main scenarios in terms of site allocation – Australian, South African, and split site. According to SKA managers, both the Australian and South African strategies were tactical responses to their respective situations, and South Africa would have followed a similar strategy to Australia if the site allocation committee had found the latter to be the preferred site. Moreover, the site allocation, *per se*, remains incomplete, as the specific parameters for the infrastructure to be hosted at each site have not been fully negotiated (Appendix Q.36.).

Competition between Australia and South Africa was, according to SKA science communicators, one of the drivers of the media interest in the site bid, drawing parallels to sporting events, being framed by several key informants (and also by media messages – see chapters seven and eight) as the ‘world cup of science’. This could be interpreted as being beneficial for the SKA’s position in the public sphere, as it attracted media attention and public interest towards the project, and framed the South African bid as the victorious underdog – a framing closely tied to the imperative to counter the Afro-pessimism emerging from the Australian discourse (Appendix Q.37).

Key informants from universities provided a lower level of information about the site allocation decision – indicating that this was largely an issue addressed by the SKA itself and by government actors. However, the competition was, again, framed using sporting metaphors (Appendix Q.38.). Messages that emerged from the Australian media were conditioned by the Australian public sphere, including the motives of politicians, and manifestations of a national sense that Australia was the natural choice for the project (Appendix Q.39.). South African science communicators needed to strategically react to discourses in the Australian media that were antagonistic and Afro-pessimistic, claiming that an African country was inherently incapable of hosting advanced science such as the SKA. The South African responses to these discourses had to be restricted by strategic considerations with regards to the position of the SKA in the South African and global public spheres, leading to a focus on facts, rather than an engagement in any potentially divisive or inflammatory rhetoric (Appendix Q.40.). Nonetheless, the South African SKA communicators faced an imperative to counter Afro-pessimism. This has required restraint, in

the form of focussing on facts and achievements, and at the same time has called upon the communication skills of leadership within the South African SKA and the South African government to garner support for the SKA within the international organisation (Appendix Q.41.).

5.5.1.2. Voices from the public sector

Science communicators within public sector actors have faced unique challenges with respect to positioning the SKA in the public sphere, being answerable to their political constituencies, constrained by public oversight and processes, and facing pressure to achieve the political aims of their stakeholders within higher levels of government.

One of the strategic decisions to be made by public sector actors was how to respond to negative messages emerging from the Australian media and from Australian political actors, for example claims by the Australian science Minister that Kim Carr that ‘There are better ways to sustain development, if that's what your primary purpose is’ (<http://www.smh.com.au/technology/sci-tech/australian-bid-falters-for-25b-telescope-20120309-1upsp.html>), implying that the decision was influenced by aid objectives rather than scientific objectives. In response to such claims, South African government actors were directed by the Minister of Science and Technology to, like the SKA organisation, refrain from releasing potentially divisive or antagonistic messages into the public sphere, and to focus on factual and scientific issues. This helped to cultivate an internal discourse of South Africa taking the ‘moral high ground’ in response to Australian Afro-pessimism and attempts to derail the discourse from the scientific towards the socio-political (Appendix Q.42.). In this process, it is evident that Minister Naledi Pandor took a strong leadership role, acting as a communications gatekeeper for the public sector, and steering the discourse. In the stark example below, she modified the discourse while under pressure to respond to the site allocation announcement, setting the tone for the public sector’s voice in the public sphere:

I wrote the press release for the minister, her people rewrote it in a much more antagonistic way and that was the press release that went to the press. On the drive to the function the Minister realised this was a mess and then she and I rewrote the speech just before she gave it and the first question from the audience was ‘that was

not the speech we were given'. So it goes to show what happens when you have too many people involved in the link.

(SKA manager D)

This quote also illustrates the inter-connections between the science communication efforts of the SKA, public sector actors, and university-based scientists. SKA manager D holds a parallel post at a major partner university, and his science communication efforts have thus spanned these three main actors. This underlines the manner in which gatekeeping functions and close institutional linkages have created alignment and co-operation at the senior management level across actors in the public sphere – and thus possibly acted to increase coherence and positive tone in the resultant messages.

5.5.2.3. Leak by the *Sydney Morning Herald*

On the 10th of March 2012 the Sydney Morning Herald released an article leaking the findings of a confidential SKA report from the site allocation committee recommending South Africa as the preferred site (<http://www.smh.com.au/technology/sci-tech/australian-bid-falters-for-25b-telescope-20120309-1upsp.html>). This generated a significant level of media coverage (see chapters seven and eight), and escalated the controversy surrounding the site allocation. Key informant interviews included attempts to understand the dynamics behind this process. One senior informant, a manager near the apex of the SKA organisation (remaining anonymous for confidentiality reasons), claimed that the purpose of the leak was to soften the Australian public into accepting the inevitable outcome of a split site decision – a decision taken on the basis of previous discourse in the Australian media that the result would favour Australia.

It was leaked, it was a controlled leak just to put pressure on the Australians, in a way to make them realise that they had lost. But the compromise situation was a preordained, I would have told you five years ago that that is the way it was going to go, I have been pushing for it for five years.

(senior SKA manager)

This claim may be substantiated by other comments by key informants, reflecting on Australian media coverage in the run-up to the site allocation announcement, which framed

the outcome as being favourable to Australia. Even after the announcement, which indicated that approximately 70% of the infrastructure would be hosted in South Africa, the Australian press in some instances reported that the announcement was a ‘victory’ for Australia (Appendix Q.43.). However, other SKA staff were unaware of the source of the leak. An alternative explanation is that the purpose of the leak, from an Australian point of view, was to shift the discourse from the scientific arena (where South Africa had the advantage) to the socio-political arena (where, according to the report, Australia had the advantage). Whatever the case, the overall effect was commonly seen as one of increased pressure on the SKA to finalise the site allocation decision, which had been delayed several times (Appendix Q.44.).

5.5.2. Fracking

The possibility of shale gas fracking in the areas surrounding the SKA infrastructure site poses a material threat to the project, and this has to some degree been reflected in media. However, this controversy has received far lower levels of coverage than the issues surrounding the site allocation, suggesting a lower level of news value (see chapters seven and eight). Key informants were asked to provide their views about the question of shale gas fracking, and to comment on how this was represented in the media, with specific attention to how this impacted on science communication.

Most of the key informants from within the SKA organisation were not concerned about the risks posed by fracking, as they felt that the legislation protecting the SKA would be sufficient to prevent any negative effects. SKA staff also highlighted that fracking was still in the early exploratory stages, and that the evidence for its benefits and risks was not yet fully developed. As is the case for other issues, the SKA’s media strategy has been to focus on the facts. However, perceptions within the organisation are not uniform – internal discourse includes perceptions that fracking would have positive outcomes for South Africa, as well as discourse that it would have negative outcomes and would threaten the SKA project. There is also a view that the issue of possible negative effects on the SKA has been co-opted by anti-fracking activists to add further support for their cause in the public sphere (Appendix Q.45.).

Fracking, as a project in the energy sector, is also situated in the public sphere, and has its associated discourses and actors that contest this controversial technology. One respondent felt that fracking, and extractive industries more broadly, pose a threat to the SKA in both

South Africa and Australia, and saw the extent of this threat as being a function of powerful actors who are served by the commercial gains to be made (Appendix Q.46.).

5.5.3. Development context

As highlighted by Madsen (2001), astronomy is a relatively uncontroversial branch of science. In terms of the problematisation of ‘science in Africa’, there is not any evidence of the use of the SKA for purposes of domination or exploitation, as for example identified by Adas (1989) and Diamond (1997), or acting in support of externally imposed or inappropriate development. Indeed, the evidence provided by media content analysis suggests only a very limited degree of contestation related to the development context of the project. Rather, the SKA is framed in a manner consistent with the public understanding of science and science communication literatures (e.g., Bauer, Allum and Miller, 2007), where it is portrayed as an essentially positive movement and an indicator of ‘progress’. At the same time, local voices are largely marginalised, with little representation in the media and little effect on the framing of public discourse.

Key informant interviews revealed a complex set of views and strategies in relation to the SKA’s development context, and how this is represented in the media. Questions related to the development context were reportedly often posed to SKA science communicators, primarily related to justifying the expenditure made by the government and explicating the benefits that SKA would have for society. Respondents felt that these questions required careful answers, as the issues were complex, and also important in terms of building support for the SKA in the public sphere (Appendix Q.47.).

One of the main messages that are constructed by the SKA is related to the mandate of the organisation in relation to development objectives. The primary message is that the SKA is a science project, and that development objectives are spin-offs from this, rather than being core to the organisation’s mandate. The SKA thus cannot be seen primarily as an employment creation vehicle or an economic growth vehicle, even though these will be consequences of the project. The development context is also a critical issue for the communication strategies of public sector actors. Government agencies face the challenge of high expectations, and need to create message to tempter these and align them with the SKA’s mandate (Appendix Q.48.). Several of the key informants highlighted that, although

the SKA is commonly framed as a ‘big budget’ project, its budget is in fact small in comparison to other areas of public expenditure, and that the SKA should not be compared to big-budget development projects in the public sector (Appendix Q.49.).

To gain support in the public sphere, the SKA needs to send out clear messages about the benefits of the project. This is framed in terms of skills and innovation, rather than in terms of employment and growth, although these are implicitly linked. Benefits to local communities are also part of the message, but these are seen as secondary both in terms of the SKA’s function and its mandate. This message requires careful communication and involvement of the leadership of the SKA as well as from government partners and communications structures (Appendix Q.50.).

One aspect of the project’s development context that is emphasized is the effect of ‘inspiring’ people, particularly youth, to take an interest in and participate in science. This framing of the project has been enshrined in policy, going back to the White Paper on Science and Technology (Department of Arts, Culture, Science and Technology, 1996), which set the foundation for the DST’s 10 Year Innovation Plan (Department of Science and Technology, 2007), which underpins the department’s strategic outlook, and which provides for substantial support for astronomy as a national focus area (Appendix Q.51). SKA science communicators indicated a clear awareness of how the SKA was being positioned in the public sphere in terms of its development context, including the identification of actors, interests, discourses, and audiences (Appendix Q.52.).

An aspect of the SKA’s development context that has received relatively little coverage in the media is the impact on the local area surrounding the site. One of the challenges in this regard has been to engage with local farmers, who have been affected by the requirements to reduce radio and other telecommunications interference in the surrounding area, and have as such had their phone and data connections reduced in scope or cut off. The SKA organisation has had to manage negative perceptions from this group as an issue in the public sphere (Appendix Q.53.).

Another local public is the populations of nearby towns. Here, one of the main means of engaging in the public sphere has been through community outreach, rather than media channels. This has involved direct participation from senior management in engaging with

communities to manage expectations and to establish productive relationships. Even within this group, there is competition and rivalry between nearby towns – Carnarvon has been the focal point of SKA interventions and engagement in the public sphere, and there is evidence that other towns, which are only slightly further from the infrastructure site, feel sidelined (Appendix Q.54.).

5.6. Discussion: the role of science communication in the social construction of the SKA in the public sphere

As noted by Gottschalk (2005:1), astronomy in South Africa has a politico-symbolic value in the public sphere, and this has led to a high level of political support, manifested in funding and policy support for astronomy and the SKA. This politico-symbolic value is leveraged in the public sphere by science communicators from the main actors, including the SKA itself, universities, and government agencies (Appendix Q.55.). One key feature of the positioning of the SKA in the public sphere is the alignment of interests of the various South African actors, primarily the SKA, government, and higher education actors, all of whom seek to position the SKA as a ‘good news story’ and a symbol of (South) African science and technology achievement. This has led to strategic and operational co-operation in their communication efforts and the production of clear and non-contradictory messages (Appendix Q.56.). In the context of this overall positioning of the SKA in the public sphere, the analysis of the science communication of the SKA returns to the key dimensions highlighted in Table 11.

5.6.1. Objectives

The communication strategies of the main actors are largely aligned, centred around the objective of bolstering support for the SKA, and each actor’s role in the SKA, within the public sphere, including among specific stakeholders and within the public imagination more broadly. This alignment provides some explanation for the high level of co-operation, and low level of conflict, that characterises the network of actors. The SKA international has the most detailed and formal communication strategy, while at the SKA in South Africa the strategy is largely tacit and applied. Universities and government actors have no codified strategy for communicating about the SKA – rather, this falls under the broader rubric of institutional communication strategies.

It's communication strategy at the international level explicitly positions the SKA within the public sphere, stating as its main and overarching objective the growth of financial, political and public support, both amongst its stakeholders and in the general public. The communication structures and processes of the SKA, both internationally and in South Africa, have been established to achieve this objective.

The communication function of the South African project office of the SKA is thus also primarily oriented towards improving its position in the public sphere, in this case with a focus on the South African public sphere. This requires a delicate balancing act of adhering to the multiple mandates of local and international stakeholders, while at the same time seeking improved public support. The South African project office has a distinct communications strategy, structure, and process. The strategy is however not formalised, and was not made available for research purposes. Rather, it is codified in internally distributed documents that act as a practical guide for communication. The main features of the strategy are the focus on milestones as opportunities for media engagement, and the positioning of senior management as gatekeepers, particularly with regards to sensitive issues of funding and politics. Scientists and engineers are encouraged to engage with the media, but only in their area of expertise.

SKA-affiliated scientists and engineers based at universities conduct science communication largely subject to the constraints imposed on those working within the SKA, although as academics they have greater freedom to engage with the media autonomously. The protocols and gatekeeping functions are therefore not binding on academics – they form a tacit agreement about communication rather than a codified or formalised agreement. Moreover, academics benefit from additional opportunities for communication that arise from their position in the higher education system. All the universities in the sample hosted an internal communications function that provided additional resources for communication activities. The nature of these functions, however, varied substantially between universities in terms of structure, resources, capabilities, and mandate. The main motivation for university-based academics and communicators is also to better position their institutions in the public sphere. Where university-based scientists and engineers are also working on the SKA, their communication aims to support both their university and the SKA in the public sphere, thus aligning the strategies of these institutions.

Public sector actors also aim to positively position the SKA, and their role in the SKA, in the public sphere. In the case of government, a common theme is the justification of public expenditure to stakeholders and constituencies. This again aligns their communication objectives with the other actors – government aims to represent the SKA as a worthwhile investment of public funds, focussing on achievements and milestones, and also positioning the SKA as a symbol of African scientific and technological achievement.

5.6.2. Structure and process

Formal communication structures exist in all the main actors, and these are largely responsible for managing the release of institutionally approved messages, such as news releases. These formal structures also act as gates, in some cases at multiple levels within a hierarchy of communication functions. At the global level, the SKA has a clearly defined science communication structure and process. Within the SKA in South Africa, the science communication consultancy, Southern Science, has played a central role in the implementation of science communication, and senior management play a gatekeeping role over all formal communications. Informal processes are also central to the communication system. The pool of scientists, journalists, government actors, and SKA management is small, and most of these individuals have an awareness of who the key individuals within the other actors are. Personal relationships underpin interactions with journalists, and are used as a selection mechanism to improve the quality and accuracy of reporting.

Within universities, scientists and engineers must adhere to institutional communications structures and processes. These differ across institutions, and are in some case codified and well-developed, and in others informal and minimal in scope. All the universities in the sample have some form of communications office, which acts as the official conduit for media enquiries and news releases. In some cases, such as UCT, this office plays a secondary role to direct contact between scientists and journalists. In others, such as Stellenbosch, the media office acts as the primary connection between scientists and journalists. Within each university there are also differing degrees of hierarchy. At Stellenbosch and UKZN, messages typically ascend through a hierarchy of internal structures before reaching the journalists or the public, while at UCT scientists more often engage directly.

Faculty and departmental structures are also important. The science faculty at UCT and the engineering faculty at Stellenbosch both host communications offices, and both have issued press releases about SKA-related research at the university. The astronomy department at UCT works with the university's communication office to issue press releases. The most well-developed communication structure relevant to the SKA is at UKZN, where the Astrophysics and Cosmology Research Unit has a dedicated media liaison officer. This additional resource has greatly enhanced the unit's science communication outputs and capabilities. The gatekeepers acting within these Higher Education communication structures have less influence than those within the SKA. University-based scientists, in line with the principle of academic freedom of expression, have more scope to take the initiative and to engage directly with journalists and the public without oversight.

Government communication structures are highly formalised, although not directly in relation to the SKA. The DST has a fairly large communications team that expends considerable resources on the science communication of the SKA. The highest gatekeeper and spokesperson is the Minister of Science and Technology, although this function is usually delegated to top-ranking civil servants. The NRF is also active in science communication related to the SKA through its 'corporate communications' function, with the Deputy CEO: Astronomy acting as primary gatekeeper.

5.6.3. Audiences

The range of audiences that are targeted is very large, ranging from the general public at the international level to small niche audiences within the academic, technical, and political arenas. The SKA international takes primary responsibility for international audiences, while the South African project office takes primary responsibility for national audiences. Taking into account this very large and complex scope, the SKA's communication strategy identifies a set of communication roles, responsibilities, channels and messages in order to frame and manage its communication activities. Universities and government actors target their messages at the South African public, as well as their own constituencies, for example academic specialists and policy makers.

5.6.4. Channels

In keeping with the large and diverse set of audiences, communication takes place through a multitude of channels. The SKA, both in South Africa and internationally, makes use of most of the main channels available for science communication, extending far beyond that of engagement with the mass media. These channels, which structure the arrangement of the communication and outreach function, include branding, online media, outreach, networking, materials and publications, events and conferences, and public and local affairs. In South Africa, the primary channels are the social media, print media, broadcast and other non-print media, newsletters, and events.

Universities and government actors are more selective, focussing on news releases, events, and interaction with journalists. The channels used by university-based communicators are the news media (engagement with journalists), social media, and scientific publications. The main channels for communication from the DST are news releases, events, media briefings, direct engagement with journalists, and social media. The main channel for communication by the NRF is the issuing of news releases, but the NRF also engages extensively with journalists, and stages events such as ‘astronomy town meetings’.

5.6.5. Messages

In terms of the messages sent out by the SKA, both internationally and in South Africa, the notion of milestones is a central organising concept, creating a focus on facts, achievements, and news value. At universities the messages are more focussed on the release of new research outputs and technical achievements. Government actors seek to highlight the success and progress of the SKA, positioning it as a worthwhile investment of public funds, and as a symbol of South African scientific and technological progress and achievement. Outgoing NRF messages are largely related to operational matters, and need to serve a ‘public interest’.

5.6.6. Relationships

All main actors participate in a network of communication that forms a framework for information flows and the construction of messages. This network consists of both formal and informal relationships between actors, which facilitate co-ordination and the flow of information. The relationships among actors in the network thus underpin the overall functioning of science communication. The general alignment of strategic objectives among

actors appears to lead to operational alignment, with a high level of co-operation reported among all the main actors.

The SKA organisation's communication function manages a complex set of relationships with multiple actors in order to co-ordinate communication activity and to answer to the multiple mandates, stakeholders, and publics to which the SKA is accountable. Relationships with journalists are reportedly positive, with the SKA organisation working closely with a smaller network of trusted journalists, as well as an extended international mailing list of peripheral journalists. Responsibility for maintaining relationships with government actors is largely devolved to the country level. Firms participating in the SKA, particularly in terms of research and development, co-operate with the central communications function in order to align their messages with the SKA's, which effectively acts as a loose gatekeeper in this regard.

Amongst the SKA, DST, and NRF, a loose and informal division of communication functions directs queries related to public policy and funding towards the DST, about public oversight of operations to the NRF, and about standard operational questions and science and technology questions to the SKA. The relationship between the DST communications team and the SKA communications team, particularly the outgoing science communication consultant, was described as central to their communication of the SKA.

Universities are also important communications partners, but through a different mode. There are no formally established communications agreements between the SKA and universities, although informal networks and relationships play a co-ordinating and mediating role. At universities, relationships with journalists vary more between individual scientists than between institutions, and are largely the prerogative of individual academics. Generally positive relationships were only occasionally faced with accuracy issues.

Amongst all the actors, relationships with journalists are generally described as positive, and are based on trust and personal relationships. Moreover, because the pool of science journalists in South Africa is small, the main journalists are all well known to the main science communication actors, fostering a close-knit interaction between science communicators and science journalists. It thus seems that, contrary to the concerns of the British Royal Society (1985), and Claassen (2011a), and Clayton and Joubert (2012), there is

a generally positive and productive relationship between scientists working on the SKA and journalists reporting on the SKA.

In terms of the relationships that each of the actors has with journalists, the critical role of trust emerged as a common theme. Each of the actors indicated that they have two types of relationships with journalists. Firstly, they have close relationships, built up over time and through personal contact, with a small circle of journalists who they trust to accurately and fairly represent the SKA. These journalists are usually the first to receive information, in many cases before the corresponding news release is issued to other journalists or the public. Secondly, there is a larger 'mailing list' of journalists with whom actors do not have such long term and trusting relationships. These journalists usually receive information through bulk channels such as news release mailing lists or Twitter feed, and are in some cases seen by actors as possible sources of inaccuracy in their reporting.

5.7. The role of science communication in the social construction of the SKA in the public sphere

Table 14 provides an abstracted overview of the main characteristics of science communication across the main actors and analytical dimensions relevant to the SKA. This illustrates the high level of alignment across actors in the public sphere, and their mutually interlocking communications structures and strategies, which have together created a generally positive and coherent set of messages about the SKA. The four main sets of actors outside the media (the SKA international, SKA South Africa, universities, and government agencies) all aim to grow support in the public sphere for the SKA project, with each actor targeting somewhat different publics, stakeholders, and constituencies. Each actor operates a structured communication process, with gatekeeping functions at the apex of the organisation, with the exception of university-based scientists, who retain a high level of agency in terms of engaging with the media. Together, the science communication effort operates through all the main media channels, including the news media, social media, news releases, outreach programmes, public events, the scientific press, newsletters, etc. The outputs focus on positive messages about achievements in terms of milestones, facts, and scientific or technical progress. Each of the actors manages a complex set of relationships with other actors, including journalists, and there is a high level of codified and tacit co-operation at the mid and senior levels of each organisation. Together, this interlocking system

of science communication frames the SKA as a symbol of science and technology achievement. Controversies in the media have been strategically addressed by this science communication system, with tactically co-ordinated, integrated, and coherent responses from the main actors, particularly with regards to the issue of the site allocation.

Figure 7 provides a high-level illustration of this analysis, indicating the main social actors, the science communication structures and functions within each actor, and generalised illustrations of their relationships in terms of science communication.

Figure 7: A model of science communication for the SKA

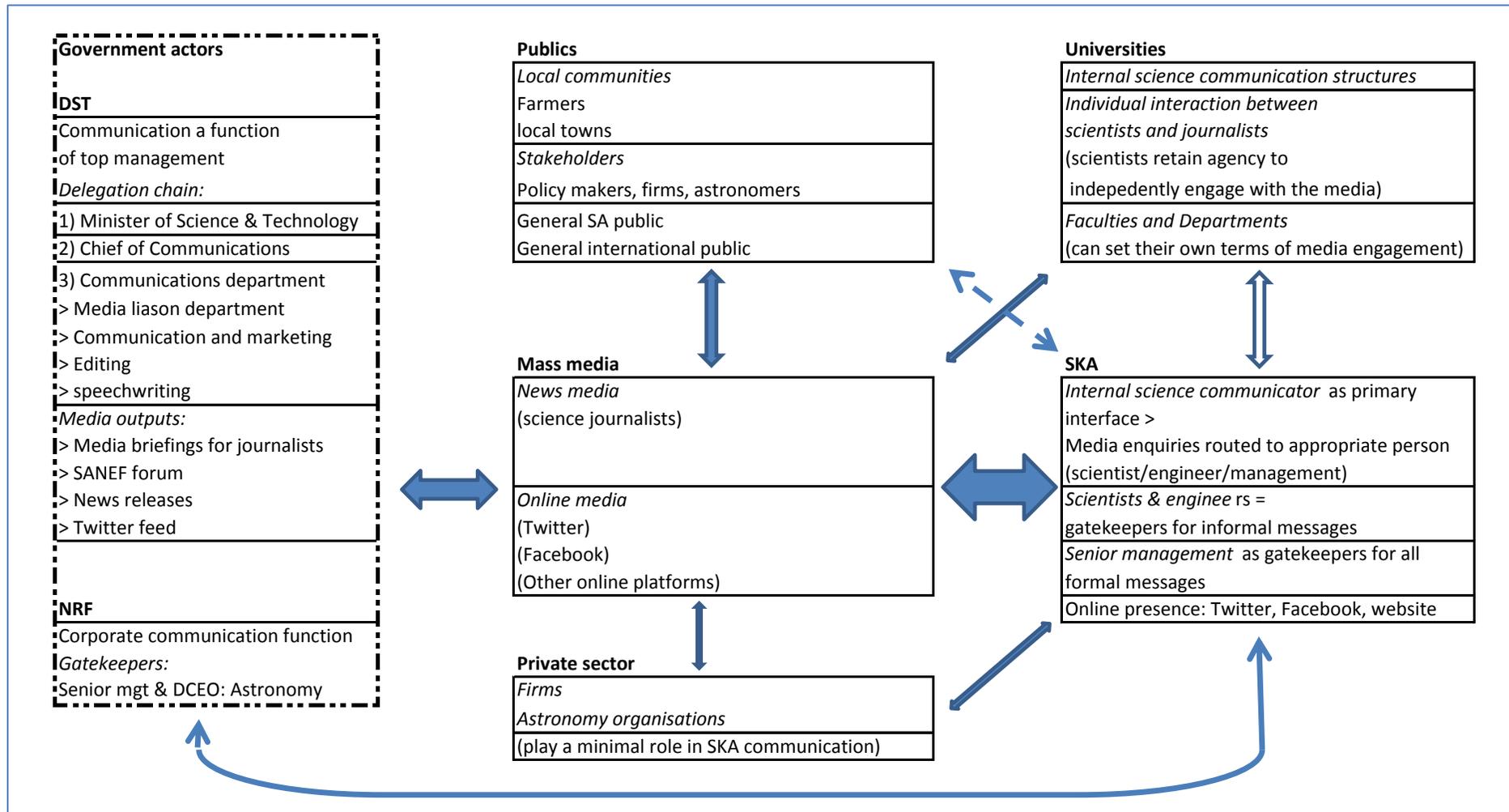


Table 14: Overview of science communication for the SKA

	SKA international	SKA South Africa	Universities	Government agencies
Objectives	<p>Grow financial, political and public support for the international SKA project by communicating its value to stakeholders and the general public.</p> <p>Articulated in a formal strategy</p>	<p>Answer to multiple mandates and grow support for the SKA amongst stakeholders and the South African public.</p> <p>Articulated in an informal strategy, set of practices, and tacit agreements.</p>	<p>Position their role in the SKA in order to bolster public and stakeholder support, with the aims of increased funding, improved research reputation, and attracting top academics students.</p> <p>Specific faculties, departments, and research units aim to position themselves within the public sphere in terms of their own role in the SKA.</p>	<p>Garner public support for government involvement in the SKA, particular for the high level of funding that has been provided.</p> <p>No clearly articulated strategy – the objectives are a function of government’s strategic imperative to mobilise public support for its actions.</p>
Structure & Process	<p>Communications and Outreach</p>	<p>Communications manager</p>	<p>Internal communications offices. In some</p>	<p>The official spokesperson for the DST is</p>

	<p>Manager Communications and Outreach Working Group Communications and Outreach Network</p>	<p>Science communication consultant Internal gatekeeping process at the apex of the organisation</p>	<p>cases hierarchical with multiple gatekeepers, in other cases with a flat structure. Faculties, departments, and research units in some cases have their own internal communications structures and capabilities. Academics have more freedom than SKA scientists to engage with the media without oversight or gatekeeping.</p>	<p>the Minister of Science and Technology, a role often delegated to top civil servants. The DST has a 20 member communications team divided into 4 directorates. The NRF has a corporate communication function which acts as a channel for messages. The Deputy CEO: Astronomy and top management act as gatekeepers.</p>
Audiences	<p>Differentiated strategies for local, national, and international audiences</p>	<p>Institutional stakeholders Narrow audiences – e.g.</p>	<p>Engagement with journalists Academic astronomy and</p>	<p>Media actors, primarily journalists. South African</p>

		<p>astronomy community</p> <p>The local (i.e. infrastructure site) community</p> <p>Broader South African public</p>	<p>engineering communities</p>	<p>public as citizens</p> <p>Policy makers</p>
Channels	<p>Most major communication channels.</p> <p>Online and social media to play an increasing role.</p>	<p>Social media</p> <p>News media</p> <p>Non-print media</p> <p>Newsletters</p> <p>Events</p> <p>Outreach activities</p>	<p>Engagement with journalists</p> <p>The popular scientific press</p> <p>The specialised scientific press</p> <p>Newsletters</p>	<p>Press releases</p> <p>Events</p>
Messages	<p>Broad range of messages types, tailored to meet the strategic objective in communicating with each distinct audience.</p> <p>Focus of mass communication messages is on milestones.</p>	<p>Focus on milestones to maintain accuracy and positive messages about achievement.</p>	<p>New research outputs</p> <p>Milestones and achievements</p>	<p>Positive messages about the SKA's achievement</p> <p>Positioning the SKA as a symbol of African scientific and technological advancement</p>

<p>Relationships</p>	<p>Manages a complex set of relationships with multiple actors.</p> <p>Generally positive relationships with journalists – a trusted core set of journalists and a larger set that receive press releases.</p>	<p>Manages a complex set of relationships with multiple actors.</p> <p>Senior management play a key role.</p> <p>Scientists and engineers encouraged to engage with the media</p> <p>Control over news content achieved by preferentially cultivating relationships with dedicated science journalists</p>	<p>University based scientists and engineers have more freedom to engage with journalists on their own terms and with minimal control and gatekeeping</p>	<p>Close working relationship between the DST, NRF, and SKA co-ordinates communication efforts by directing enquiries to the correct destination.</p> <p>Co-operation also extends to co-authoring of press releases and co-operation in the staging of media events.</p>
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Chapter 6: Science journalism

6.1. Introduction

In the conceptual framework of this study (see Figure 3), science journalism plays a key role, acting as a main source of messages that emanate from the news media. For analytical purposes, science journalism has been examined separately from other aspects of science communication, which form the focus of chapter 5. These findings are brought together in a broader synthesis in the concluding chapter.

Science journalists act as a bridge between institutional science communicators and the news media. Within the public sphere, science journalists play a systemically central role, receiving inputs from actors in the public sector, private sector, higher education, and science sector, and using these to inform messages that enter the news media as opinion-leading or popular messages. Moreover, in the public sphere, science journalists operate in a broader social context that conditions the internal and external processes that characterise science journalism and impact on the nature of the resultant messages.

This conceptualisation points towards three main areas of investigation. Firstly, the context of science journalism in South Africa requires investigation, as this sets the scene in which science journalists must operate. Secondly, an examination of the *external* processes of science journalism is required – the relationships that science journalists have with other actors, and how other actors are positioned to provide relevant information and messages. Thirdly, the focus narrows to look at the *internal* processes of science journalism, which looks within media actors to examine the impact of news value, the strategies of individual journalists, the effects of newsroom processes, and the multiple levels of gatekeeping, all of which influence how science messages, and messages about the SKA, are constructed.

Returning to the overarching conceptual framework, this chapter has clear links with the preceding and subsequent chapters. Science communicators outside the media (examined in chapter 5) are reportedly the main sources of information for science journalists. This establishes a close systemic connection between science communication and science journalism, which is further explored in the concluding chapter of this study. Secondly, this chapter sets the scene for the subsequent chapters on representations of science in the media.

This makes it possible to establish how the structures and mechanisms of science communication and science journalism have produced particular patterns and characteristics in the messages they produce about the SKA.

6.2. The context: science journalism in South Africa

The context of science journalism in South Africa was explored in key informant interviews. On the whole, interview respondents described a science journalism landscape that is in line with the findings of Van Rooyen (2004) and Claassen (2011a, 2011b), but provided additional details of how this landscape is perceived from the point of view of journalists covering the SKA. Science journalism in South Africa is seen by these journalists as a small niche that is encroached upon by other areas of reporting that have greater news value to the South African public. Most news publications do not have a dedicated science section or dedicated science journalists. Where there are science journalists, they usually occupy a niche on the boundary of science journalism, overlapping with health, environment, or education (for example journalists D and E). Only a handful of journalists in South Africa are dedicated to science coverage without such a niche orientation. This small set of journalists – dedicated science journalists – constitutes the majority of the sample of journalists for this study. Dedicated science journalists have had a greater propensity to cover the SKA, as it does not fall easily within one of these boundary areas (Appendix Q.57.). Moreover, the sample includes approximately half of the total population of relevant journalists. SKA science communicator A reported that she has interacted with only twelve or thirteen South African journalists in terms of communicating about the SKA. This sample includes seven journalists, six of which have played leading roles in covering the SKA – highlighting the high level of representativity and validity of the key informant interview sample.

‘Space’ for science journalism is hard won, sometimes after protracted negotiations with editors and management. The main point of debate is reportedly the news value of science – editors argue that the South African public are less interested in science than in the traditional areas of politics, sports, economy, and entertainment (Appendix Q.58.).

Low levels of science knowledge and awareness in South Africa present a constraint for science journalism. This limits the public understanding of science and public interest in science (see Reddy *et al.*, 2013), and also limits the ability of newspapers to understand and

therefore publish science stories. There is a contrast between South African newspapers and international opinion-leading newspapers in this regard. In one example, of the discovery of the Higgs Boson in 2012, the *New York Times* and the *Washington Post* placed the story on the front page, while leading South African newspapers didn't – partially because they didn't understand the science involved, or because of a lack of structural support for science stories

This limitation has also applied to the communication of the SKA. The capacity of editors and journalists to engage with science content is reportedly constrained, and editors reportedly show little sign of truly understanding the content of science stories – or they are too apathetic to engage with the stories. Either way this places limitations on the role that science can play in the newsroom and on the page (Appendix Q.59.). Journalists who do not have a background or training in science journalism are often called upon to cover science stories ad hoc. This reportedly lowers the quality of science reporting (Appendix Q.60.).

As highlighted in Chapter 5, from the point of view of the SKA, senior management take a generally positive view of science journalism in South Africa, although the SKA's science communicators are more guarded, citing several systemic problems within South African science journalism, including a shortage of editorial space, non-science journalists covering science topics, and a lack of critical thinking. However, in this context, the SKA has an advantage in terms of communication because of its general appeal and newsworthiness, and because of the strong public support that the government has provided (Appendix Q.61.).

Overall, it seems that, as pointed out by Claassen (2011a) and Van Rooyen (2004), science journalism operates on the margins of the South African mass media, fighting for editorial space, poorly understood by editors, and usually without a dedicated section or editor within the newspaper. Science journalism is challenged by perceptions of low news value, and faces a public with low levels of knowledge of or interest in science. Representations of the SKA in the media occur despite these challenges, indicating that the news value of the SKA in particular has been sufficient to overcome these structural challenges, motivating science journalists to lobby for coverage, inspiring sufficient interest and perceived news value among editorial staff to provide the required space, and ultimately responding to the unusual scenario of a relatively high level of public interest in a science story. The analysis of representations of the SKA in the mass media (chapter 7) illuminates this process, showing how this unusual story has been constructed by journalists – thus providing both a diagnostic

tool for understanding the mass communication process and for understanding what aspects of the SKA were seen to have news value in the public sphere.

6.2.1. The South African Science Journalists' Association

In South Africa, the only organisation representing science journalists is the South African Science Journalists' Association (SASJA), which is an associate member of the African Federation of Science Journalists, and a member of the World Federation of Science Journalists. The activities of the association include networking and training in the area of science journalism (<http://sasja.org/>). Networking functions include meetings, a Facebook page, and a Google Group mailing list for science news updates and information sharing. The mandate of the SASJA is to demystify science journalism and to advocate for high levels of science reporting in the South African media. Due to the limited number of science journalists in South Africa, membership of SASJA is largely composed of science communicators who operate outside of the news media, including science communicators for universities and other large institutions. This composition has led to some criticism. One journalist reported that the organisation does not clearly distinguish between the roles of science journalists and science communicators (Appendix Q.62.). However, others were less critical, seeing it as a reflection of the science communication landscape in South Africa, where science communication offers more professional opportunities than science journalism (Appendix Q.63.).

The SASJA has played a relatively minor role in the communication of the SKA. The SKA's science communicators have engaged with the SASJA to organise meetings both in Cape Town and in Gauteng, to allow journalists to interact with SKA scientists and management. There is no specific campaign related to the SKA, but the SASJA has posted information about the SKA on its social network pages. This information has been supplied by the SKA's science communicators, in both formal and informal capacities. This has served as a catalyst for journalists covering the SKA (Appendix Q.64.).

6.2.2. The role of the Afrikaans media

The Afrikaans language media play a distinct and important role in the communication of the SKA, particularly in the communities around the SKA site, for example the towns of

Carnarvon, Loxton, and Williston. The dominant language in and around the SKA site is Afrikaans, and it is therefore the language of this immediate constituency. Afrikaans-language media are thus particularly important in positioning the SKA within the part of the public sphere. The newspapers that are read in the local community are primarily from the Afrikaans press. The SKA's local community monthly newsletter is in Afrikaans. Since it is sent with municipal accounts to private homes, it reaches the majority of local households in formal dwellings. Moreover, all the community engagement activities in the area are conducted in Afrikaans, for example site visits and forums for community meetings. Thus, in terms of reaching the local public, the Afrikaans medium is key (Appendix Q.65.) and therefore forms part of the media content analysis.

6.3. External processes: relationships and sources of information

Croteau and Hoynes (2003:22) specify three types of social relations that are important to the goals of mass communication studies, namely internal relationships within the media, the media's relationships with external social structures in society, and the media's relationships with audiences. This chapter is focussed on the first two relationships, while the analysis of media representations of the SKA (chapter seven and chapter eight) focuses on the third. In the public sphere, relationships create channels for information transfer between journalists and other actors. In an actor-network conceptualisation of media process, understanding these relationships and information flows is critical to gaining an understanding of the overall shape, scope, and functioning of this system. As such, this section focuses on the relationships between journalists and other actors in the public sphere, and examines the nature of information flows that are exchanged between these actors.

Journalists use a variety of tactics to undertake surveillance and to source information. They draw extensively on personal relationships and networks, which in part evolve over time (for example, relationships originating at universities) and which in part are purposively maintained and extended (for example, active relationship-building with South African and international scientists). Journalists also have a variety of preferences for the use of online information sources, with each journalist in the sample reporting a unique pattern of online data use. These tactics are informed by their journalistic approach or strategy, depending on whether they are aiming primarily for 'proactive' reporting on new information that is not yet

available in the public domain, or whether they are undertaking routine ‘reactive’ reporting, with is more focussed on gathering publically available information to inform a story.

Table 15 illustrates the sources of information used by six of the science journalists in the sample, including information from the SKA, universities, public sector actors, and private sector actors. The seventh science journalist in the sample has provided information mainly with respect to her senior position at the SASJA and the positioning of the SKA in the public sphere, but has not undertaken extensive science journalism with regards to the SKA. These six journalists however represent a critical mass of science journalists in South Africa, and together have been responsible for a significant proportion of coverage of the SKA.

Of the six journalists in this sample, three conducted interviews in person, while the other three responded in writing to both the general questionnaire (Appendix A) and the dedicated questionnaire about sources of information (Appendix C). Due to the practicalities of fieldwork, the data available from interviews is generally of a higher resolution and in a different format than that available from written responses. In order to simplify this complex data set into a visual format that allows for easier comparison of these two types of responses, an indication of the ranking of these sources of information is graphically included, separating sources that were not significant, sources that were occasional, and sources that were important, either because they were used frequently or because they provided critical information. This established an abstracted view of sources of information, which are discussed in more detail below.

Table 15: Sources of information for science journalists reporting on the SKA

Legend:

	Not a significant source of information
	An occasional source of information
	A major source of information

Actors / Journalist	A	B	C	D	E	F
The SKA						
SKA scientists &						

management						
SKA website						
SKA Twitter feed						
SKA news releases						
SKA international office						
SKA science communicator (Southern Science)						
SKA events						
SKA African partner countries						
Universities						
University communications						
University-based scientists						
SARCHi chairs						
Scientific journals						
Public sector						
DST						
CSIR						
Other government actors						
NRF						
Private sector actors						
Firms						
Media sources						
Twitter						
Google alert						
Science alerts						
Syndicated news feeds						
Other journalists						

According to Boffin (2009) and Madsen (2001), institutional news releases are a main source of information for science journalists. This is also true of the journalists reporting on the SKA, who draw on institutional news releases from the SKA itself, as well as universities and government agencies (see Table 15). At the highest aggregate level, it is clear that the SKA

organisation itself is by far the most important source of information for journalists. Other sources of information (universities, the public sector, firms, media sources) are used occasionally, but are in no case described as a major source of information. One exception is the use of science journals, which one journalist reported as a major source. Thus, outside the SKA, other actors are at best peripheral sources of information, again underscoring the importance of the SKA's science communication function.

This finding is central to understanding of how messages about the SKA are constructed, highlighting the close link between science communication (explored in Chapter 5) and science journalism. The manner in which information is collated and released by the SKA has a major impact on the information available to journalists, and therefore one can postulate that it also has an impact on how journalists represent the SKA in the mass media. In particular, during in-depth interviews, exploratory questioning made it clear that SKA senior management, scientists, and science communicators were a critical resource, based on personal relationships that had evolved over time. This again underscores the significance of personal relationships and networks in the communication of the SKA.

6.3.1. The SKA as a source of information

The SKA science communicators were a significant sources of information for all the journalists in the sample, and described as a major source of information by four of the six journalists. This is closely followed by relationships with senior management and scientists. SKA's senior management is almost exclusively comprised of scientists, and many scientists are in management positions or have management functions. This group is also a major source of information for half the sample, with only journalist F reporting that he did not draw on such relationships. This particular journalist is based in Durban, which might have explanatory value in terms of access to SKA management. Other important sources of information are SKA news releases and SKA events, used by four and five of the journalists respectively. Outside South Africa, the international headquarters are an occasional source of information for most of the sample, while in contrast none reported receiving information from any of the African partner countries. The SKA's website and Twitter feed were occasionally used by most of the sample, with only one journalist describing the website as a major source of information.

Personal relationships play a central role in mediating between journalists and the SKA, including senior management, scientists, and science communicators. Firstly, through ongoing engagement, the complexities and news value of the SKA are better understood by journalists. Secondly, the insider information that is (strategically) provided by senior management can be used to inform a story that provides something new to the reader, something that is not yet in the public domain – thus driving ‘active’ reporting. These relationships are cultivated over a long period of time (Appendix Q.66.).

The science communicators for the SKA, Southern Science, were described as an important source but, in contrast, primarily for ‘reactive’ reporting – reporting on information that is already in the public domain. This was reportedly used by journalists that are less competitive and are less focussed on breaking news and providing something unique to their readers. Where journalists sought ‘active’ reporting, the news feed from the SKA’s science communicators was at best a source of background information. However, strategies differ among the interviewed journalists – three of whom indicated that the SKA’s science communicators were a major source of information (Appendix Q.67.).

The events that have been staged by the SKA have also played a catalytic role, placing journalists in touch with key informants and also providing them with a tacit feel for the scale and scope of the project – and hence its possibility of capturing the public imagination. One catalytic event was a site visit for journalists hosted by the SKA in 2005. Here four journalists visited the site (three of whom are included in the key informant interview sample), along with the Premier of the Northern Cape province and the Minister of Science and Technology. Senior management of the SKA engaged directly with journalists, which provided them with a basic understanding of the SKA that made it possible to take up further engagement. The three interviewed journalists that participated in this event each described it as the beginning of a long-term undertaking to report on the SKA, and in all cases this continued up until the time of research (Appendix Q.68.). As eloquently stated by one journalist:

We flew to Carnarvon and it was a wonderful flight over the Cederberg and Tankwa Karoo. My strongest impression is probably of the wide open space and the dusty Karoo vegetation and the complete lack of any permanent infrastructure. If memory serves there was just a mobile office and a single common-or-garden little

telecommunications receiving dish, but I can't recall why it was there - possibly as a prop, or perhaps to send back data from a team who were on-site conducting baseline studies of radiation? I just remember that it wasn't a terribly impressive scene on a physical level. But I must have been impressed by the speakers - Bernie, Justin and I remember Rob Adams being there - and I think that hearing about the project for the first time really excited me, even though I knew nothing about radio astronomy, because I wrote a reasonably comprehensive piece, and I do also recall researching a bit of background material for that. And I recall especially driving back to the airport - runway, actually, it's not an airport at all - sitting in the passenger seat and being totally amazed by Adrian Tiplady, who was driving and who spoke about the project non-stop all the way back. That information to me was mind-blowing, and especially from someone who at that stage had probably only recently graduated.

(science journalist D: written response 9 April 2014)

Moreover, events provide a rich source of information that can lead to in-depth and multiple articles (Appendix Q.69.).

The international headquarters of the SKA were not described as a major source of information, although four journalists reported using this as an occasional source. Personal relationships with senior management at the international headquarters are more difficult for South African journalists to cultivate, and as such only routine information is usually made available. One journalist reported that the SKA international office was too slow to respond to requests, and that personal networks were on the whole not sufficiently developed to provide the kind of high-level and up-to-date access to information that would lead to a story. However, one journalist indicated that press releases from the SKA international office did occasionally inform his stories, and another indicated that a personal relationship with a senior manager makes it possible to occasionally source information (Appendix Q.70.).

On the other hand, none of the journalists reported receiving any significant information flows from any of the African partner countries, highlighting how poorly developed the communication functions in these countries have been (Appendix Q.71.).

6.3.2. Universities as sources of information

The most commonly used source of information at universities is the university's own communications function, which four journalists describe as an occasional source. One journalist reported university news releases as a source of information about the SKA, primarily from UCT and Rhodes. Only two journalists reported that they engage with university-based scientists directly. However, the exception is university-based scientists that also have an institutional base within the SKA. Many of the scientists, as well as some engineers, that are involved in the SKA, both directly and indirectly, have their institutional home at a university. One example is Prof. Justin Jonas, who is based both at Rhodes University and at the SKA organisation, and who all interviewed journalists described as a source of information to some extent.

6.3.3. Relationships with scientists

The relationship between SKA scientists and science journalists is explored from the point of view of scientists in Chapter 5, and is explored from the point of view of journalists in this chapter. This also provides an empirical basis for describing this critical link in the overall network of actors that positions the SKA in the public sphere, and thus contributes significantly to the overall modelling of this system. Contrary to the general trends established in the literature, however, the evidence suggests that, with regards to the SKA, the relationships between scientists and journalists have been largely positive. Again, this establishes the case of the SKA as something of an outlier in terms of the communication of science. However, there were some concerns identified in the relationship, and these are highlighted in the analysis below.

The range of SKA-related scientists (including those based at the SKA and at universities) that journalists have access to is largely a function of their personal networks. This includes networks that have been retained from university education, as well as networks that are cultivated in South Africa and internationally. Science journalists who also have a background in science, particularly at the tertiary level, have an advantage in terms of establishing relationships with scientists and in terms of making sense of the information gained during these interactions. Journalists aim to establish a trusting and positive working relationship with scientists, as this is in their own interests. One journalist has purposively extended her network of scientists to include international scientists, as they provided a different view and emphasis on the SKA project (Appendix Q.72.). Other journalists

indicated that there was a low level of capacity to engage with journalists among junior scientists. For example, where junior scientists have divulged sensitive information, and therefore placed the journalist and themselves in a compromising position (Appendix Q.73.).

In line with the findings of chapter 5, which delineated the science communication policies and practices of the SKA, journalists found that scientists are willing to provide information about science aspects of the SKA, but not about strategic, political, or contentious aspects (Appendix Q.74.).

Thus, in contrast to much of the literature on the relationship between journalists and scientists (e.g. Royal Society, 1989; Nelkin, 1995; Claassen, 2011), in the case of the SKA there is generally a positive working relationship between journalists and scientists. However, some of the challenges that are identified in the literature were mentioned, including scientists' fears that journalists will misrepresent scientific information, and scientists being seen as 'unapproachable' :

I have great admiration for them, but I find they are often afraid I will distort their science in my reports through a lack of knowledge. Often however, they are grateful that I was able to relatably and understandably report on their findings to the general public....I have a solid basic understanding of astronomy, which helps a lot. SKA reporters should possess some background knowledge on astronomy, in order for scientists to take them seriously. Scientists can focus on being more approachable.
(science journalist E: written response 15 April 2014)

I have a good relationship with scientists in general (in particular also with science communicators). It is a formal relationship and normally revolves around their work in a specific field. I would not say I am on first-name terms with many scientists... Scientists force journalists to think harder and longer than they would with a different story. They also inspire me to question their research and the way things are in the world. If the scientist is excited and passionate, it tends to reflect in the article. I think a lot of the time journalists are not aware of developments regarding the SKA and they normally do not have the time to go looking for information. If scientists are more forthcoming with information, there might be more stories in the media about

their work. Journalists are often pressed for time and good press releases with pictures and contact details go a long way in getting the story out there.

(science journalist F: written response 24 April 2014)

6.3.4. Public sector sources of information

Public sector actors have played a small but systemically important role as sources of information about the SKA. In the public sector, the DST is the most common source of information, reportedly used by five of the six journalists, and a major source of information for one journalist. This is followed by the CSIR, which is used by half the journalists. Taxonomically, the CSIR is a research institute, and in this sense has more in common with universities, but is included among public sector actors as it is publically funded and reports to the Department of Science and Technology on a public mandate. The NRF was only reported by one journalist as a source of information (through press releases), despite evidence that the NRF undertakes substantial science communication activity (see Chapter 5).

However, the main public actor in terms of communication is the DST. Five journalists specified DST news releases as part of their surveillance of SKA information. For two of these journalists, the DST is a significant source of information gained through personal contacts based on relationships maintained with officials within the department and even with politicians. For others they are seen as generally competent champions of the SKA in the media: ‘They are keen to push SKA coverage... I think it's actually doing quite well, DST does a good job of keeping the media informed and of hyping the project’ (science journalist E: written response, 15 April 2014).

One journalist described her relationships with DST senior officials, including their communication department, as ‘good professional relationships’ which often resulted in information being obtained. However, another journalist described this relationship as ‘difficult’, particularly those with the communication department (Appendix Q.75.). As with the SKA, personal relationships are key to accessing information from government actors. One journalist described how her variety of such relationships creates multiple opportunities to access information, allowing her to escalate her requests if they are unsuccessful, to the point of directly contacting the Minister (Appendix Q.76.). However, this positive relationship does not remove the possibility of future conflict. Journalists are monitoring the

government and are willing to report on any problems that might arise – as this would have news value and would be in line with their vocational purpose as journalists: ‘I’m still willing to nail them to the mast and Tommy Makhode knows this, that I’m waiting and I really do actively look for wrongdoing to show that’ (science journalist C: interviewed 27 November 2013).

One journalist detailed the frustrating and unproductive nature of her interaction with the DST. Her dissatisfaction included the sending of information that was out of date, as well as a lack of consideration for journalists when managing events related to the SKA. For example, during a public event at the SKA, journalists were hosted far from the site, at a location with no internet or phone access, and the transportation to the site failed to arrive. It was thus impossible to file their articles from the location and their reporting was therefore out of date by the time they returned from the site visit. The relationships with individual officials are not good – instead, one individual was referred to as ‘nasty’ (Appendix Q.77.). Another journalist framed with problem more diplomatically: ‘I would like more information on a more regular basis from DST and I would like the department to be more even-handed in the way they facilitate journalists’ attendance at SKA events’ (science journalist D: written response 9 April 2014). Science journalist F reported that the DST could improve its engagement with journalists in several respects:

Government should be more forthcoming with press releases and information regarding the progress of the SKA project. They should organise media trips to view the progress on site. They should respond to queries in time for us to reach our deadlines.

(science journalist F: written response, 24 April 2014)

6.3.5. Private sector sources of information

Relationships with private sector actors seem to play a minor role in the communication of the SKA. Firstly, of all the private sector actors, only firms in the SKA value chain were identified as sources of information. Other private actors, such as the International Astronomy Union (IAU) and the Office of Astronomy for Development (OAD), were not highlighted as sources of information by any journalists. Three of the six journalists use firms as sources of information, but those that did indicated that they were at best a minor source.

Considering the central role played by engineering firms in the design and construction of the SKA, it is not surprising that at least some journalists have had contact with firms in the process of reporting on the SKA. One journalist reported interaction with South African firms (including EMSS) as well as multinationals (such as IBM and Astron). These interactions are more tenuous than interactions with scientists, as journalists generally do not have pre-existing relationships with firms. Thus, these interactions have required initiative from journalists to be established. However, once established, these interactions are generally smooth and firms are generally willing to engage with journalists. The main point of communication with firms is senior management – specifically managing directors - rather than firm-based communications officers. The engagement with large multinationals is somewhat more challenging, as there is a larger bureaucracy to be navigated, and contact must usually first be made with a communications officer. However, informal relationships also play a role. One journalist reported that she networks with senior management of multinational firms at astronomy events abroad, which gains her access to such individuals.

6.3.6. Online sources of information

Online sources of information include Facebook, Twitter, Google alerts, news alerts sent by the major science academies and associations, and mailing lists for the SKA South Africa and SKA international. Journalists reported a variety of strategies and preferences for using online sources of information, with five of the six journalists using at least one online source of information, and equal proportions (2/6) reporting occasional use of Twitter, Google alerts, science alerts, and syndicated news feeds respectively. However, none of these were reported as major sources of information. The main online sources of information from the SKA facing the general public, namely the website and Twitter feed, were occasionally used by most of the sample, but only one journalist described the website as a major source of information.

This overall pattern is in line with journalists' strategies, which aim to source information that is new to the public. These sources of information were described as being used for background or routine information, not for the critical news content that would initiate or frame a news story. This is more commonly provided by personal contacts. Journalists reported that if a major story has appeared on a social network such as Twitter, it is already

too late to be considered ‘news’: ‘I follow all of them on Twitter, but chances are very high that I know about what’s going on before the newsletter goes out because I will have someone there who will tell me’ (science journalist C: interviewed 27 November 2013).

The SKA website was mentioned by most journalists as an occasional source of information. However, as expressed by journalist A: ‘If she [Marina] put something out on twitter she would have already mailed me about it. It wouldn’t differ.’ Journalist C put it more starkly: ‘If I find or see SKA news on Twitter then I’m really not doing my job.’ While Twitter is reportedly useful for monitoring international news, when it comes to monitoring local news, personal connections provide more up to date, new, and more detailed information.

Google alerts run active search functions, trawling the internet for news items that include specified key words – one journalist had it set to ‘science’ and ‘South Africa’. This was described as highly effective – if even a minor publication in another country runs an article mentioning those search terms, it is picked up by the Google Alert function. The press alerts sent out by science organisations have the advantage of being slightly ahead of the mainstream online media – these alerts usually provide notice of upcoming publications a few days before they are published, allowing journalists time to prepare for the release of the publication. However, syndicated news feeds seem to play only a minor role in the surveillance function of journalists: ‘I watch the wires generally in my work and so I may occasionally pick up something about the SKA, but I don’t use syndicated news-feeds specifically for the SKA’ (science journalist D).

Journalists take pro-active steps to establish surveillance mechanisms to monitor the SKA in the online media. Sometimes a particular lead will prompt a journalist to run a specialised search in order to locate detailed and contextual information (Appendix Q.78.).

6.3.7. Personal contacts and networks

Informal personal relationships and networks play a key role in circulating information about the SKA. All the journalists reported that these are critical, particularly in relation to accessing valuable new information that seeds the possibility of a novel and newsworthy story for publication. Personal relationships with senior management and scientists were

reportedly the most important, but relationships are also cultivated with university scientists, as well as individuals within public and private actors.

For example, one journalist studied astronomy at Rhodes University before entering a career in journalism. She also studied radio astronomy and undertook work experience at HartRAO. Some of the academics that tutored this journalist were later employed as top ranking SKA scientists and managers. This allows her a ‘back door’ into the SKA. Her personal connections within the organisation trust her enough to bypass formal procedures. This has allowed her to occasionally get a ‘scoop’ before other journalists can access this information through regular channels. However, this was not her only source of information gained from personal relationships. Others included relationships with DST staff and university-based academics that had built up over time. She has also established relationships with other senior staff at the SKA in South Africa and at the international headquarters in the UK.

Building personal relationships with key informants is thus one of the main information gathering strategies of South Africa’s top science journalists – those that aim for a ‘scoop’ rather than reporting existing news emanating from line feeds or the social media. Journalists aim to build trust by establishing long-term relationships that can provide evidence of reliability and professionalism. As expressed by another journalist:

I have been a science journalist now for many years and you have to build individual contacts. The communication with the SKA has been very good. I like the people and I like Marina. Marina is worth her weight in gold and I hope they keep her on forever. It was also getting to know the people and going the extra mile, going on the trips, sitting having a beer with them. It was getting to know Bernie and it wasn’t easy and I had to prove myself to Bernie I think. Well not prove myself but it took three to four years for him to see that I am not writing shit and factually correct, so it has been a road.

(science journalist A: interviewed 27 January 2014)

6.4. Internal processes: journalists’ strategies, news value, and gatekeeping

In an actor-network conceptualisation of media processes, each actor enters into relationships with other actors, but is also subject to internal processes that influence the manner in which

the actor engages externally and processes information internally. This section focuses on these internal processes with the news media, seeking to establish an empirical basis for understanding how aspects internal to the news media play a role in shaping representations of the SKA. The main driver of internal processes is news value, which is explored first. The main structures and mechanisms which react to this driver are those of gatekeeping and other newsroom functions, including the strategies and actions of journalists, news editors, and senior or executive editors.

6.4.1. News value

In line with previous research into science journalism in South Africa (Claassen, 2011a, 2011b), journalists reported that science, in general, has a low level of news value in South Africa. This is, to some extent, a reflection of a generally low level of public interest in science (Reddy *et al.*, 2013) and of a cultural context that does not generate a high level of interest in science. In a highly politicised society, such as South Africa, political news generally has higher news value than science news. Pop culture also tends to trump science in terms of news value.

There are several other challenges with regards to representing the SKA in a manner that can be considered to have news value. Many aspects of the SKA that are of critical importance to the project itself have little news value in the public imagination, for example infrastructure development or negotiations about hosting and partnerships agreements. Journalists have to look elsewhere for their stories. One particular challenge in terms of news value is that ‘big announcements’ have higher news value than incremental steps. However, science in general, and the SKA in particular, operates for the most part incrementally (Appendix Q.79.).

The news value of science also depends on the readership of the publication. Publications with a more popular or working class audience (for example *The Sun*) have a lower news value for science. However, publications aimed at the middle class (e.g. *Business Day* or the *Mail & Guardian*) have a slightly greater news value attached to science. Then, among these publications, science journalists need to employ differing approaches to story construction. For example, the *Mail & Guardian* has a focus on narrative stories about social impact, while *Business Day* has a focus on financial and economic aspects. In either case, journalists can employ ‘stealth’ tactics to bring science news into the publication – usually not in a front

page or leading position, but nonetheless gaining some coverage (Appendix Q.80.). However, the SKA, in comparison to other science topics, has a relatively high news value, making it something of an outlier in terms of science communication. Science communicators for the SKA reported that the interest shown by journalists far exceeded that shown in other areas of science (Appendix Q.81.).

However, journalists made it clear that the SKA must compete for editorial space according to the same news value criteria that are generally applied across all topics. They include proximity, human interest, the ‘hard news/curiosity’ factor, and the ‘so what?’ question - whether, in the journalists estimation, readers will be interested in the story. The literature suggests that news value is also determined by attributes such as include a large scale of events, closeness to home, clarity of meaning, a short time scale, relevance, personification, negativity, significance, and drama and action (McQuail, 2005: 310). The SKA certainly has some of these attributes (large scale of events, significance, possibly ‘closeness to home’), but lacks others, such as short time scale, negativity, drama and action (Appendix Q.82.).

However, journalists also reported that some aspects of the SKA have particularly high news value, setting it apart from other science projects and science topics in South Africa. A composite list of the aspects of the SKA that are considered by journalists to have news value (drawing on the full sample of journalists), includes:

- human development;
- the African VLBI network;
- the international aspect of the SKA, particularly in relation to Australia;
- funding;
- infrastructure;
- the science and the results of science activity, both in astronomy-related fields and in other related fields such as supercomputers and big data;
- the monetary value of the project;
- socio-economic spin-offs for South Africa and Africa;
- the promotion of science education generally in South Africa and Africa;
- employment opportunities;
- the promotion of the knowledge economy in South Africa and Africa and connecting these to the global context;

- graduate and post-graduate bursary schemes;
- the impact on the local area, e.g. Carnarvon, and
- Social and economic benefits to South Africa.

These aspects inform the analysis of representations of the SKA in the news media in Chapter 7.

Although there are news values for the SKA that have remained consistent over its history, there are some aspects that are clearly periodised around the watershed moment of the announcement of the site allocation of the project. Prior to the site allocation announcement, competition with Australia generated a high level of news value, drawing on an underlying public competitiveness with Australia that has a long history in South Africa. One journalist described this as one of the South African public's 'schizophrenic' attitudes – a propensity to complain about the country yet draw passionate support for South Africa in the context of international rivalries – particularly those based on sport.

However, after the site allocation announcement, the underlying news value of the SKA shifted. With the international rivalry falling away, the focus has been on the science and engineering aspects. At the same time, the focus of messages emanating from the SKA organisation itself has shifted to a tone of collaboration rather than competition. One challenge that has arisen is that of making this new focus – on science and engineering – more accessible to the general public. Journalists and science communicators described this focus as more suitable to the specialist science media, rather than the mass media, and that effort is needed to make these aspects of the SKA accessible to the general public (Appendix Q.83.).

For example, the SKA science communicator issued a news release about the first science paper that was published about the KAT-7. This was included in the major astronomy publications and in the news releases of institutions such as the American Astronomical Society, but received less coverage in the mass media. The SKA science communicator A reflected that 'Mass media interest will be much more about will we find aliens and those quirky kinds of angles', as the limits of the public's general understanding of science provides a limitation to what will have news value in that sphere.

6.4.1.1. Science and news value: the case of SETI

The content analysis of news media and social media reveals that the Search for Extra-Terrestrial Intelligence (SETI) science research question of the SKA received significantly more coverage than other science research question (see chapters 7 and 8). Key informants were asked why they thought this science aspect of the SKA had been treated differently, providing insights into the news value of SETI, and into the manner in which this has been treated by science communicators and journalists. Science communicators and journalists highlighted a relatively high perceived news value attached to the notion of SETI, and reflected that this led to relatively higher levels of coverage in the media in comparison to other science research questions, despite the fact that SETI is only a long term peripheral goal of the SKA project (Appendix Q.84.). A SKA science communicator reported that the news value of the SETI research question was disproportionately represented in the news media as an ‘angle’ that would attract a greater audience, despite the fact that this research question was of a lower scientific priority, particularly for the MeerKAT component of the SKA, which will be the main operational component until the latter stages of the project (Appendix Q.85.).

Key informants were asked whether they were aware of any institutional protocols for managing media engagement in the event of success in the SETI programme. Most respondents were unaware of any protocols, with the exception of one senior SKA manager, who indicated that verification from multiple international sources would be required before such information could be released to the media. Respondents within public sector actors were not aware of any government protocols for such an eventuality. Respondents did however comment, in various ways, on the enormous impact such a discovery would have for science and for humanity more broadly (Appendix Q.86.).

6.4.2. Newsroom processes and gatekeeping

The concept of gatekeeping provides a powerful explanatory framework for understanding the processes within the media that lead to media outputs that enter the public sphere, as outlined by Shoemaker (1991), Shoemaker and Vos (2009), and Barzilai-Nahon (2008), including related notions of selection criteria (DeFleur and Dennis, 2002), selective framing and news value (Gans, 1979; McQuail, 2005; Chong and Druckman, 2007), and systemic

bias (e.g. Shoemaker *et al.*, 2001). These concepts, as outlined in the literature review and conceptual framework, are applied to the SKA case study to more clearly delineate its main features.

News value plays a key determining role in shaping messages about the SKA, and this is intrinsically tied to gatekeeping and other newsroom processes. Newsroom processes are, in a sense, Darwinian, in that stories compete for editorial space, and those with the greatest survival characteristics make it to press in the context of the overall competition. Within the set of stories that make it to press, there is an additional stratum of competition to gain more prominent positions in the opening pages and to secure space for longer articles rather than briefs. Thus, while the news value of each piece is important, newsroom processes also have an influence over whether a particular story will make it into the public sphere.

According to key informants (Appendix Q.92.), there are three primary levels of gatekeeping inside the media for news stories about the SKA:

1. Individual journalists control which stories they choose to write and how these messages are constructed;
2. News editors cull from the available set of stories based on their mandated priorities, such as considering news value and appealing to readers, and
3. Senior or Executive editors act as final gatekeepers, and can act as mediators where there is disagreement between journalists and news editors.

Individual journalists exercise considerable agency in their gatekeeping function, which includes aspects of framing and selection. Journalists C and D highlighted that they do not write commissioned articles, but search for and write up their own stories. Since newspapers don't have dedicated science supplements or sections, science journalists need to attempt to 'sell' their stories *ad hoc* to the most appropriate part of the newspaper – the news desk, the business desk, etc. Moreover, journalists were quite adamant that their reporting was free of external influences – that this was part of their vocational responsibility (Appendix Q.87.). Each journalist used his or her own sense of news value and story interest to select particular aspects from the spectrum of possible stories to construct about the SKA. In line with the science communication practices of the SKA, several journalists focussed their reporting on milestones. Journalists also decide on the initial tone of their message. All the journalists reported that the tone of their coverage was generally positive (Appendix Q.88.). However,

two journalists reported that part of their task was to monitor for corruption or any other problems and report on them. All journalists aim to provide informative coverage – with a focus on making the immensely complex project accessible to their publics (Appendix Q.89.).

Journalists reported a balance between reactive and proactive strategies for reporting – both for themselves and reportedly for coverage of the SKA in general (Appendix Q.90.). For journalists seeking to write stories that are unique and present new information – and therefore gain a competitive edge of other science journalists, one tactic is to ‘throw it forward’ – rather than focussing on a current story or achievement, the focus is shifted forwards in time towards the next expected milestone. This is particularly relevant if the initial source of the story is from a source that is already publically available, such as a line feed or Twitter (Appendix Q.91.).

Once messages have passed through the initial gate of the journalist, the engagement between science journalists (generally advocating for increased space for science coverage) and editors/gatekeepers (generally concerned about news value and therefore restricting science coverage) presents an ongoing contestation with a variety of tactics employed – and represents an instance of structure and agency operating in tension with regards to reporting on the SKA. If a news editor blocks the publication of a science story, a science journalist can ‘go over his head’ to approach the executive editor. However this strategy has long-term pitfalls as it may have a negative impact on the journalist’s relationship with the news editor (Appendix Q.92.).

Journalists that aim to bring their stories into the public sphere thus need to clear several gatekeeping processes. Journalist D identified four or five points where each story requires the approval of an editor or an editorial team:

All my pieces are subject to the normal “gate-keeping” processes i.e. I inform the news editor that I will be submitting a piece on X or Y, and he/she will put this on the news diary for discussion at the general news conference that is normally led by the editor, ahead of publication. I then submit the completed piece to the news editor, who will read it and, if satisfied, put it through for processing on a page. It will then be read by a sub-editor, edited to fit the allocated space and have a headline and sub-

heads added, before being sent to a revise sub-editor for final checking. The completed page will normally also be proofread before publication.

(science journalist D: written response 9 April 2014)

There are several factors which influence the outcome of gatekeeping processes, including the seniority and reputation of the journalists, their efficacy at persuading news editors to consider their stories, the preferences of editors, and the capacity of editors to engage meaningfully with science content. Overall, editorial support for science content varies substantially between publications – a handful of South African publications produce the large majority of science reporting (Appendix Q.93.).

In addition to these gatekeeping functions, there are a variety of newsroom processes which influence the construction of messages about the SKA (Appendix Q.94.). Elements to consider, based on interviews with science journalists are:

- The stage in the news cycle (include the time of day, the day of the week, and the time of the month);
- Availability of editorial space, which in turn is influenced by the status of other stories (or the shortage thereof);
- The availability of resources for reporting – which influences the capacity of journalists to gather information and put together high-value stories (for example, science journalist E reported that his newspaper did not usually provide funds to travel to events at the SKA site), and
- Other commitments that journalists might have.

In conclusion, there is a systemic link between gatekeeping functions and the news value of science, in this case the news value of the SKA. In general, gatekeepers (mostly news editors) restrict coverage of science and the SKA on the basis that it does not have sufficient news value – that the public are less interested in these topics than in others. News value is thus the main driver of newsroom processes, particularly those of story selection, gatekeeping, and the framing of stories. However, journalists are also active agents in the process, acting to lobby for increased editorial space for science, and implementing a variety of tactics to achieve this. This engagement represents an instance of structure (of media organisations) and agency (of journalists) operating in tension. In addition to these gatekeeping functions, several other

newsroom processes have an impact on shaping messages, including the news cycle, editorial space, and resource allocations.

There is also an element of ‘systemic bias’, as outlined in Soroka (2012) and Shoemaker *et al.* (2001). The organisational culture within South African news media organisations does not highly value science stories, and organisational structures are not commonly established to produce such stories. These organisational issues are institutionally embedded, and are contextualized by broader institutions outside of the media, for example limited public understanding of science and limited public interest in science. This is in alignment with the findings of Claassen (2011a), who also reported that limited structural support and limited capabilities amongst journalists and editors to engage with science content resulted in a systemic bias against science reporting. However, in terms of news value, the SKA is clearly an outlier in terms of the communication of science, as it appears to have greater news value than most science topics. One of the key drivers of this news value is reporting on the controversies, conflicts, and competitiveness associated with the site allocation. This controversial aspect of the SKA project, and the manner in which journalists have reported on it, are examined in the next section.

6.5. Conflict, controversy, and science journalism

Some clear areas of controversy related to the SKA have emerged from both key informant interviews and the analysis of media content. Interviews with science journalists sought to identify their views on these controversies, and the manner in which they have reported on them, taking into account issues such as news value, gatekeeping, and the positioning of the SKA in the public sphere. The sections below highlight the main findings from these interviews in relation to the primary controversy related to the site allocation of the project, as well as the less prominent controversies related to shale gas fracking and the project’s development context.

6.5.1. Site allocation

As was the case with science communicators, science journalists saw the underlying reason for the split site allocation of SKA infrastructure to be financial – that the possibility of South Africa or Australia withdrawing from the project could undermine the project as a whole:

‘There’s too much money involved for it not to split. Too much money, too politicised (science journalist C: interviewed 27 November 2013).

Science journalists reported that the competition with Australia has had inherent news value, as it was an instance of a long standing relation of competitiveness and occasional antagonism between the two countries – in other words, that the SKA fits into an existing narrative of South African – Australian competition. It also appears to have formed a proxy discourse for a broader set of issues, including those related to South African–Australian emigration, Afro-pessimism, tension between developed and developing countries, and associated notions of national and cultural identity. As is evident from the media content analyses, this framing of the project has been popular in both the news media and the social media, highlighting the power of this discourse in terms of news value and influence in the public sphere (Appendix Q.95.).

Due to the politicised nature of this competition, the announcement of the final outcome was interpreted as a political compromise in which Australia, as a developed country competitor and all its other associations, unfairly or inappropriately influenced the SKA’s internal systems to capture part of the infrastructure, despite the outcome of the site allocation committee, which found in favour of South Africa.

The *Sydney Morning Herald* leak of the site allocation report favouring South Africa to host the SKA infrastructure was a topic of interest to science journalists covering the SKA. The consensus was that the leak was attributed to the Australian SKA partners as a move to better position the bid in the Australian public sphere by catalysing public opposition to the finding and increasing public pressure to host the infrastructure in Australia: ‘The leak must have been from Australia’s side to the Australian media to highlight our weak points’ (science journalist A: interviewed 27 January 2014).

Science journalists are sensitive to pressures in the public sphere, for example from government actors to frame the project in a positive light – as a science and technology achievement for South Africa, and for which the government can claim some responsibility (Appendix Q.96.).

Framing by public sector actors has also occurred in a negative sense – for example by aiming to restrict reporting on the SKA which does not conform to this overarching message. The Department of Science and Technology is seen as strongly framing the SKA in the public sphere according to its own interests, as a South African project with a high level of South African agency. In this regard, the Department is seen to be ‘guilty of putting out information devoid of any international context’. One journalist received negative feedback from government actors to a story which profiled the Australian contribution to the SKA, framing the project as a global enterprise in which the Australian partners played a key role (Appendix Q.97.).

6.5.2. Development context

The development context of the SKA has emerged as a salient issue in the key informant interviews and the media content analysis, although this area has received far less attention than the question of site allocation. Aspects of the SKA’s development context include the justification of expenditure on basic science in the developing country context, the impact on local farmers and communities, and the role of the SKA as a partner in local development initiatives. In key informant interviews, journalists were asked to describe the manner in which they have reported on these issues, and how they see them as being positioned in the public sphere.

One of the key issues identified by science journalists was the task of delineating the social responsibilities of the SKA as a science project. Here the challenge was to establish, in the public sphere, that the SKA did not have as a primary mandate the social or economic development of local communities – that this was not included in its budget or its objectives. Such development has and will occur, but as a secondary objective or ‘spin-off’ from its primary activities. This tension runs through much of the discourse related to the SKA’s role in the development context (Appendix Q.98.).

Journalists indicated an awareness of the local development issues, such as the complaints by local farmers about telecommunications restrictions, and how different social actors utilise the SKA to further their own interests, including the representation of these interests in the public sphere (Appendix Q.99.).

Journalists also reported an awareness of the manner in which the development context of the project was positioned in the public sphere by public sector actors, including the rhetoric used in science and technology policy and legislation. One science journalist referred to the 1996 White Paper on Science and Technology, which was also quoted by key informants based within government agencies. This White Paper framed science as being developmental in its objectives, but also aspirational, with the goal of moving beyond traditional ‘development’ and joining the global scientific and technological community. This indicates an awareness of the public sphere imperatives identified by Gottschalk (2005), which suggests that the ANC government has supported science, and astronomy, on the basis of its development prospects, but also on the basis of its associated international prestige and potential as a symbol to counter negative stereotypes of Africa. Another journalist also highlighted the imperative, for government actors and the necessity, from their strategic position, to strongly support the SKA in the public sphere (Appendix Q.100.).

6.5.3. Fracking

Key informants viewed the topic of fracking as being polarised in the media and in public opinion, and as a consequence not sufficiently related to facts or scientific research as a basis of argument or opinion. The contestation in the public sphere between corporate interests orchestrating pro-fracking ‘campaigns’, and non-profit organisations aiming to prevent fracking on environmental or social bases, have reportedly polarised the public debate. The SKA enters this larger debate as a potential tool for those opposed to fracking (Appendix Q.101.).

6.6. Discussion: the role of science journalism in the social construction of the SKA in the public sphere

The application of this study’s conceptual framework to the key informant interviews makes it possible to draw some conclusions regarding the three main areas of analysis relevant to science journalism, namely the context of science journalism in South Africa, external relationships between journalists and other social actors, and internal processes within the news media. Together, these analyses provide an indication of how social actors construct representations of the SKA in the public sphere through the news media.

Key informant interviews show that science journalists reporting on the SKA are keenly aware of the strategic outlooks of the various social actors with an interest in framing the SKA in the public sphere, particularly the interests of public sector actors. This is related to an awareness of the SKA's politico-symbolic value as a symbol of 'globalised science in an African context', and resultant claims on this value by various actors.

The SKA is an amazing project and I think that it's an important way of recasting our identity as a nation that can do science and that is good at science, so a large part of that is trying to reframe our conversations. It's not this is the first time in its history that South Africa has ever done Science. South Africa is incredibly good at a large number of fields of science, from paleo-science, nuclear science, satellites, I mean we have historical skills, but people don't know about it, so the SKA is a way to tack on that idea that we are capable of doing good science and that's part of our national identity.

(science journalist C: interviewed 27 November 2013)

As is the case with science communicators, the site allocation announcement marked a watershed in communication about the SKA, and journalists needed to change their strategies at the time to respond to a shift in the news value of the project. The theme of international rivalry, which in the run-up to the site bid provided a high level of news value, fell away, and the focus shifted onto a more diverse set of issue, of which the science and engineering were the most prominent. This has led to the challenge of making these aspects of the project more accessible to the public, and advocating for space for such stories in the news media.

The context of science journalism in South Africa, as reported by science journalists is broadly in line with that described by Claassen (2011a), and Van Rooyen (2004). Science journalism is seen be operating on the margins of the news media, having to constantly advocate for editorial space, and overcome obstacles such as a lack of institutional structures for science journalism, limited capacities of editors and journalists to engage with science, and a perceived low level of news value for science stories. However, it is also clear that the SKA is something of an outlier in this context, as it enjoys comparatively high levels of news value, and has received strong support from the public sector. Thus, the stories related to the

SKA have been comparatively easier to steer through the gatekeeping process and into the public sphere.

Journalists reported varying strategies in their surveillance and information-sourcing methods, with some focussing on competitive ‘proactive’ reporting, with the aim of bringing new information into the public sphere, while others favoured ‘reactive’ reporting, which focuses on collating information already in the public sphere to inform a story. These stances impact on the information-gathering routines, with ‘proactive’ reporters making a greater effort to cultivate relationships with scientists and institutions, and ‘reactive’ reporters relying more in online sources of information.

Of all the public sphere actors, the SKA itself is by far the most significant source of information for science journalists, primarily through the channels of the SKA’s science communicators and through personal relationships with scientists and senior management. Universities were usually a source of information through formal institutional communication channels.

The relationships between science journalists and other actors create channels for information transfer, and depend heavily on personal relationships. Relationships between journalists and scientists are reportedly largely positive, based on mutual trust, long term strategically cultivated personal relationships, and effective co-operation. Some limitations were noted, for example a limited capacity by junior scientists to engage with the media, and limited capacity for journalists not specialising in science journalism to engage with scientists. These findings suggest that in the case of the SKA, the nature of relationships between journalists and scientists varies somewhat from the extensive literature addressing this relationship, for example Nelkin (1995) and the Royal Society (1989). Whereas this literature highlights several sources of miscommunication, conflicting roles, and strained relationships, in the case of the SKA the relationships were largely positive and productive, premised on strong personal connections within a small science community. Although there were some reported instances of strain in this relationship, these were the exception rather than the rule.

Actors in the public sector have played a systemically important role in the social construction of the SKA as a symbol. The DST has been the primary source of information from the public sector, and has explicitly framed the SKA as a national science and

technology achievement that places South Africa on the global scientific stage. As with the other actors, personal relationships between journalists and individuals in the public sector are important mechanisms for facilitating information flows. The private sector, on the other hand, plays a minimal role in communicating the SKA, with press releases from firms in the SKA value chain being the primary source of information from this sector.

The notion of gatekeeping provides a useful analytical framework for understanding the internal processes within the mass media that condition the manner in which science journalists produce messages about the SKA. Clear gatekeeping mechanisms are identified, in line with the attendant literature, for example Shoemaker (1991), Shoemaker and Vos (2009), Barzilai-Nahon (2008), and DeFleur and Dennis (2002). Firstly, news value is the primary driver of gatekeeping processes, as it forms the main criterion by which news editors assign editorial space to stories about the SKA. Compared to other science topics, the SKA reportedly has a relatively high news value, although this depends on the audience of the publication. The three main internal gates for stories are 1) the selection choices of individual journalists, 2) the culling choices of news editors, and 3) the final approval of senior or executive editors. Overall, however, journalists exercise a high level of autonomy in terms of framing the SKA. Factors that influence the outcomes of gatekeeping processes including the seniority and reputation of the journalists, their ability to advocate for editorial space, the preferences of editors, and the capacity of editors to engage with science content.

This highly integrated system of internal and external relationships forms a mediating channel between science communicators, based in the SKA and other actors, and public that receives messages through the news media. The analysis makes it clear that science communicators within the SKA have an important role to play, as the most significant source of information for journalists. Journalists and editors also play critical roles as they debate the news value of the project and made editorial decisions accordingly. This leads the analysis towards the next chapter, which shifts the focus onto understanding the composition of the messages that are ultimately produced by this system, by presenting a media content analysis of news media outputs about the SKA.

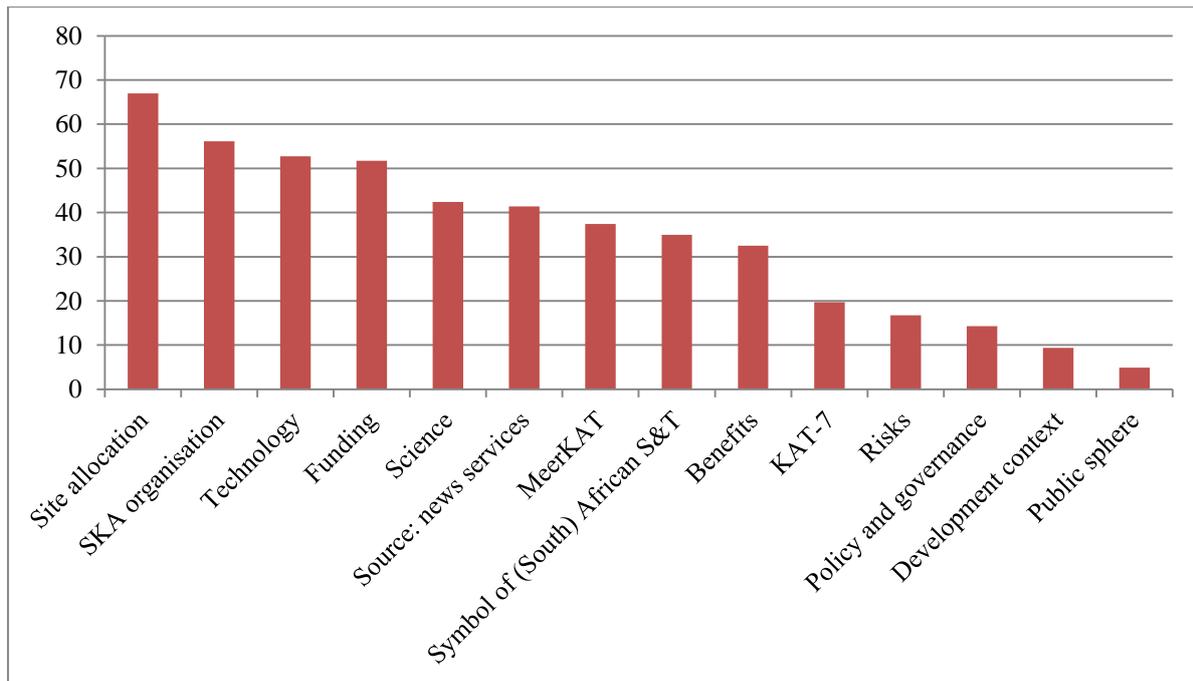
Chapter 7: Representations of the SKA in the news media

7.1. Introduction

The manner in which the SKA is represented in the news media, and through this positioned in the public sphere, is a function of science communication processes (examined in chapter 5) and processes within the media (examined in chapter 6). Representations of the SKA are analysed here as outputs of these processes.

As indicated in the methodology (chapter 3), the final sample for news media coverage of the SKA consists of 203 articles drawn from 15 publications, including both online news publications and print news publications. Media content analysis established a coding system of 18 functional code families and 295 individual codes applied to this data set (see Appendix D). The main code families include tone (benefits and risks), references to science and technology aspects of the SKA, sources of information (news services, quoted actors), SKA precursor instruments (KAT-7 and MeerKAT), organisational aspects of the SKA, funding issues, policy and governance issues, references to public opinion and the public sphere, and issues of controversy, including the site allocation process, the possibility of shale gas fracking, and the development context of the project. In addition, each article was coded with a publication, a date, and a dominant frame, and all instances where actors were quoted in the text were recorded. The most commonly occurring code family (other than the three codes that applied to all articles, and codes for quotations) was that related to the SKA's site infrastructure bidding process and the subsequent discourse about the location of the infrastructure site, again re-iterating this as the dominant theme associated with the SKA in the public sphere.

Table 16: Overview of main code families (percentage of sample that includes each code family)



Drawing on these main families of codes, this chapter presents a detailed analysis of representations of the SKA in the news media. This includes analyses of:

- A profile of the publications in the sample, including the type of publication and its ownership;
- Dominant frames, how these have changed over time, and how they are differentiated among publications;
- Periodisation and changes in coverage over time, including the establishment of correlations between key events in the periodisation and changes in coverage;
- Tone, including an examination of representations of benefits and risks, and the balance between the two;
- Sources of information, including the use of news agencies and the use of quotes from key actors;
- Science and technology, including reporting on science research questions and technological aspects of the SKA;
- Precursor instruments, specifically the KAT-7 and the MeerKAT;
- The SKA as an organisation, focussing on representations of partner countries and the framing of the SKA as an organisation;
- Funding issues, including both funding by partner countries and funding streams accessed by firms competing in the SKA's supply chain;

- Policy and governance, including both codified (legislated) and tacit political support;
- The SKA as a symbol of globalised science in an African context, and
- Issues of conflict and controversy, including the site allocation process, the question of fracking, and the project's development context.

7.2. Publications

The sample represents a wide range of online news publications and online versions of print news publications. These are summarised in Table 17Figure 8. This illustrates several characteristics of the sample. Firstly, the effect of the concentration of the media sector in South Africa is marked. More than half of the sample is concentrated in just four publications, which are owned by three firms, namely Naspers, Avusa, and M&G Media. From another point of view, the publications owned by the four largest South African publishers (Naspers, Avusa, Sekunjalo Independent Media, and M&G Media), together with Creamer Media, the national leader in specialist engineering news, together account for 72% of the sample. The independently-owned publications are all online news sites that have produced fewer articles that refer to the SKA – these account for approximately 17% of the sample. The remaining articles are from news services (6%) and a public news agency (5%). This ownership profile is in line with the concerns of McQuail and Siune (1998) and van Cuilenberg and McQuail (2003), which note a global decline in public ownership of the media and increased ownership concentration as a result of mergers and acquisitions – thus giving a small number of actors disproportionate power.

The composition of the sample is balanced between online versions of print publications and dedicated online news publications. Just over half of the sample (54%) is sourced from online versions of national print publications, including one daily newspaper, three weekly newspapers, and one weekly magazine. Just under half of the sample (47%) is sourced from online news sources, including large publishers (News24, iol.com), independently-owned publications (moneyweb.co.za, bizcommunity.com, mybroadband.co.za, sagoodnews.co.za), a publically-owned news service (Media Club South Africa), and online news services (allafrica.com; Reuters Africa). However, the distinction between print and online sources is increasingly blurred - for example, the iol.co.za online news publication includes articles

from a variety of newspapers, as well as some content produced specifically for the website. Overall, this points towards increasing integration between print and online platforms.

This spread of publications is useful for analysis, as it provides a broad overview of the South African news media within a relatively small sample that has been coded to a high degree of resolution. This is a key benefit of using the dataset provided by the SAASTA.

Table 17: Coverage of the SKA by publication

Publication	Articles	Publication type	Ownership	Ownership type	Description
News24.com	29	Online news publication	Naspers	Corporate	South Africa's largest online news publication
Business Day	26	National daily newspaper	Avusa	Corporate	Focuses on the South African economy and business sector
Mail & Guardian	25	National weekly newspaper	M&G Media	Corporate	South African opinion leader. Focuses on political analysis, investigative reporting, arts and popular culture
Sunday Times	22	National weekly newspaper	Avusa	Corporate	Most popular weekly newspaper in South Africa
Moneyweb.co.za	18	Online news publication	Independent	Independent	Moneyweb Holdings is an integrated media company focusing on investment information
City Press	13	National weekly newspaper	Naspers	Corporate	South Africa's third-biggest selling newspaper.
Allafrica.com	11	Online news publication	AllAfrica Global Media	News service	News aggregator with a focus on Africa
Iol.co.za	12	Newspapers and online portal	Sekunjalo Investment	Corporate	Serves the online versions of The Star, Pretoria News, The Daily Voice, Cape

					Times, Cape Argus, Weekend Argus, The Mercury, Post, Isolezwe, Daily Tribune, Sunday Tribune, The Independent on Saturday and the Sunday Independent.
Media Club South Africa	11	Online news publication	Brand South Africa	Public	Operated by Brand South Africa, the official marketing agency of South Africa, a schedule 3A public entity, registered as a Trust. Its executive authority is the Minister of Communications. The focus is on disseminating positive messages about South Africa.
Engineering News	10	National weekly magazine	Creamer Media	Corporate	Part of the Creamer Media Group, which focuses on various economic sectors. Engineering News is South Africa's most popular publication focussing on the engineering sector.
Bizcommunity.com	7	Online news publication	Independent	Independent	Serves professionals in the advertising, marketing, media, retail sectors
Fin24.com	5	Online news publication	Naspers	Corporate	Created by a merger of the news

					website <i>Finance 24</i> and the online version of the weekly magazine <i>FinWeek</i> . It is South Africa's most popular finance portal. Content focuses on business and investment issues, and the primary audience is business executives and investors.
Mybroadband.co.za	5	Online news publication	Independent	Independent	Focus on ICT related news
SAGoodnews.co.za	5	Online news publication	Independent	Independent	Focus on 'good news stories' about SA
Reuters Africa	4	News agency	Thomson Reuters Corporation	News service	International news service – this division focuses on Africa

Sources: media content analysis, websites of all publications

7.3. Dominant frames

A ‘dominant frame’ refers to latent content that provides a discursive framework or set of assumptions that frame the discourse. As with comparable studies (Durant, Bauer and Gaskell, 1998; Gamson and Modigliani, 1989; Nisbet and Lewenstein, 2002; and Bauer, 2005), key framing discourses were identified in an inductive manner. Since each article can frame the SKA in multiple ways, in each case a decision was taken to identify the ‘dominant’ or overarching frame, and one dominant frame was coded per article. This grounded coding process identified nine overarching dominant frames:

Site allocation: the bidding process to host the infrastructure site, discourse about the site location.

Science, technology & engineering: science aspects (research questions, new knowledge), technology and engineering aspects.

Skills development: education, skills, bursaries, and skills development.

Development context: local economic development, local social development, the role of astronomy in development.

Public policy: codified public policy (Astronomy Geographic Advantage Act, VAT relief), tacit public policy (political support).

Funding and investment: funding of the SKA by partner countries, funding flows through the supply chain.

SA S&T achievement: the SKA as a symbol of South African achievement in science and technology.

African S&T achievement: the SKA as a symbol of African achievement in science and technology.

Fracking controversy: the controversy related to proposed shale gas fracking near the SKA core site.

Just under half of the sample has as a dominant frame the site allocation process, which includes the site bidding process and subsequent discourse about the site location decision. The second most common dominant frame is that of science, technology, and engineering aspects of the SKA. Less common dominant frames represent minor or auxiliary discourses. The use of dominant frames did not vary substantially across publications, largely due to the overall focus on the site allocation (see Table 18). Only three independent online news publications (bizcommunity.com, sagoodnews.com, and mybroadband.co.za) had a greater focus on other dominant frames, in this case on (South African achievement in) science, technology and engineering. When one adjusts for this finding by focussing on the second most common dominant frame, the focus again shifts onto science, technology, and engineering aspects, which is the second most common dominant frame for eight of the twelve publications that focussed primarily on the site allocation.

Overall, this paints a picture of a primary focus on the site allocation, a secondary focus on the science and technology, and a much less common and incidental focus on other aspects of the SKA. This can be interpreted in light of the literature related to news value (e.g. McQuail, 2005:310), gatekeeping (e.g. Shoemaker, 1991), and framing (e.g. McQuail, 2005:379) – suggesting that journalists have selected and framed messages about the SKA that are related to the site allocation and the science and technology aspects of the project, and that these have passed through gatekeeping structures on the basis of having sufficient perceived news value.

Table 18: Dominant frames by publication (percentage of each publication's sample)

	Site allocation	Sci tech & eng	Skills development	Development context	Public policy	SA S&T achievement	Funding and investment	African S&T achievement	Fracking
Allafrica.com	36	27	0	18	9	0	0	0	9
Bizcommunity.com	0	29	14	14	0	29	0	14	0
Business Day	62	12	4	8	8	0	4	4	0
City Press	46	8	8	8	15	0	0	8	8
Engineering News	70	30	0	0	0	0	0	0	0
Fin24.com (division of News24)	40	20	0	20	0	0	0	0	20
Iol.co.za	58	8	8	8	17	0	0	0	0
Mail & Guardian	56	20	4	0	4	4	4	8	0
Media Club South Africa	73	27	0	0	0	0	0	0	0
Moneyweb.co.za	39	11	17	0	11	6	11	0	6
Mybroadband.co.za	40	60	0	0	0	0	0	0	0
News24.com	48	17	10	0	3	7	7	3	3
Reuters Africa	75	25	0	0	0	0	0	0	0
SAGoodnews.co.za	20	40	0	0	20	20	0	0	0

Timeslive.co.za	36	14	14	18	0	5	9	5	0
As % of total sample:	49	19	7	6	6	4	4	3	2

7.4. Periodisation and changes in coverage over time

The intensity of coverage of the SKA is correlated with key events in the periodisation of the project (see Figure 8). Moreover, the profile of the coverage, for example as indicated by dominant frames that have characterised the sample, has changed over the course of the study's window period, influenced by key events (see Table 19). The site location announcement in May 2012 marks a clear division in the dominant frames of reporting. For example, skills development was not utilised as a dominant frame for a single article prior to the site location announcement, but thereafter made up a substantial proportion of the sample (in June, July and August this made up the most common or joint most common dominant frame) – suggesting that this became a concern once it was realised that South Africa would indeed be hosting the majority of the SKA. Another marked change subsequent to the site location announcement was an increase in the use of African and South African science and technology achievement as a dominant frame.

Figure 8: Coverage of the SKA September 2011-August 2012 (number of articles per month)

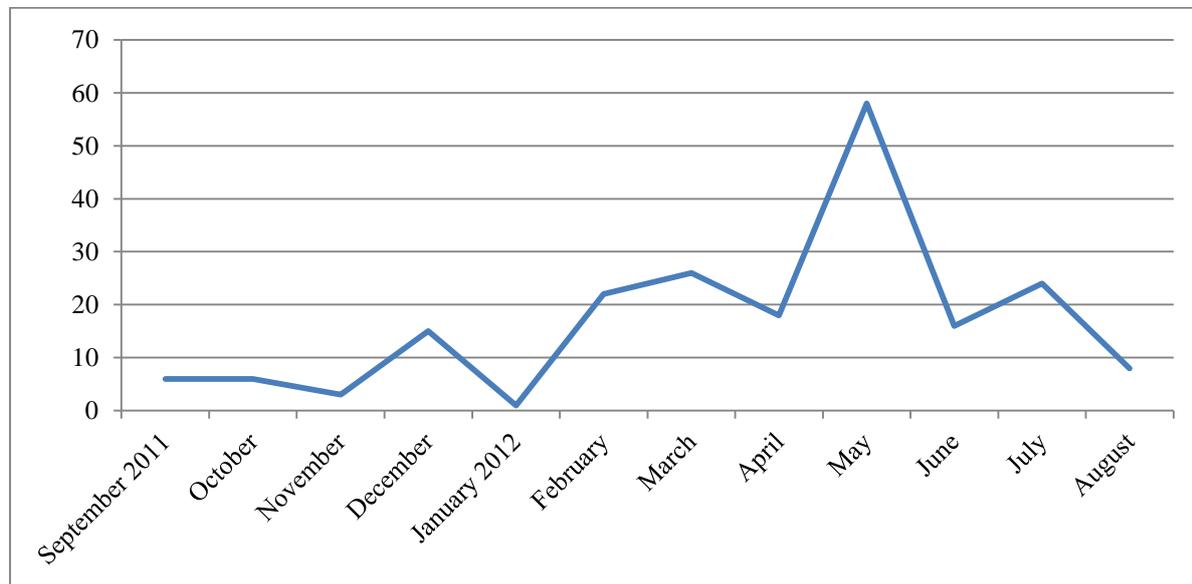


Table 19: Dominant frames: composition over time (number of articles)

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Site allocation	3	2	1	7	1	10	22	13	34	4	2	1	100
Science, tech & eng	2	3	2	3		3	3	3	11	4	3		37
Skills development										3	9	2	14
Development context	1						1	1	2	3	3	1	12
Public policy		1	0	5		4			1			1	12
Funding and investment						2			3		3		8
SA S&T achievement						1		1	1	2	2	1	8
African S&T achievement						1			2	1	1	2	7
Fracking						1			3		1		5
TOTAL:	6	6	3	15	1	22	26	18	57	17	24	8	203

The key changes over time, and postulated causes for these changes, are presented for each month below:

September 2011 - January 2011: Coverage in late 2011 was low, with only six articles in September and October, and three in November. At this stage the site allocation may have been too distant to have substantial news value. In December 2011 there were 15 articles, which suggests an increase in reporting; however, six of these mentioned the SKA only in passing, as they were all different manifestations of the DA's annual 'report card' for the cabinet, in which the Minister of Science and Technology, Naledi Pandor, was briefly praised for her role in supporting the SKA. This is reflected by an increase in 'public policy' as a dominant frame during this month (see Table 19). Thus, in-depth coverage did not materially increase between November and December 2011. Coverage dropped to its lowest level in January 2012 (only one article). Overall this indicates that the SKA during this period did not have as high a level of news value as it would have later in the research time period.

February 2012: Coverage increased in February 2012 (from one article in January to 22 in February) in anticipation of the expected site allocation announcement that was to take place on the 4th of April. Another driver was the 2012 State of the Nation speech and the 2012 Budget speech, which both briefly mentioned the SKA - and as a result the Fuseware search algorithm drew several articles referencing these speeches into the sample. However, in effect these were not focussed on the SKA, and represent only a minor reference to the project. Four of the 22 articles reported on these speeches. As in December, this is reflected by an increase in 'public policy' as a dominant frame during this month.

March 2012: March 2012 saw the second-highest level of coverage of the SKA out of all the months in the research period. This had two main drivers. Firstly, the anticipation of the site allocation announcement in early April generated increased interest. Secondly, on the ninth of March the *Sydney Morning Herald* and *Canberra Times* leaked an internal report from the organisations scientific committee favouring the South African site. This provoked responses from South African actors. This controversial move was mentioned in 21 of the 26 articles included in the March sample – one can thus infer that this had significant news value and served to increase coverage during that month.

April 2012: Coverage declined slightly in April (18 articles compared to 26 in March), but remained higher than in 2011. The main driver of news value during this period was the anticipated announcement on the 4th of April, followed by the news that the announcement would be delayed. Seven of the 18 articles highlighted the delay in the site allocation announcement and the anticipated impact this would have on the process. During this time the possibility of a split site location become more commonly mentioned, being highlighted in five of the 18 articles.

May 2012: The main spike in coverage, coinciding with the site location announcement, was in May. This is in line with the most common dominant frame - that of the site bid and the site allocation of the SKA infrastructure. Fifty-eight articles, or 29% of the sample, are concentrated in this month. This forms the core of the sample both quantitatively and qualitatively, as the key event during the period of study takes place in this month. The site allocation dominates the discourse both before and after May 2012, and also has the highest levels of controversy and news value.

June 2012: In June coverage declined again, although it remained higher than before the site allocation – reflecting ongoing interest in the project. Coverage in June shifted from a focus on the site bidding process to include a more diverse set of dominant frames. This set of articles thus illustrates an engagement with a broader set of issues in the aftermath of the site allocation announcement, with journalists increasingly engaging with issues of science, technology, skills, development, and (South) African science and technology achievement.

July 2012: In July there was a minor increase in coverage as various institutions engaged with the repercussions of the site allocation. This saw a further shift in dominant frame away from the site allocation, towards a focus on skills development. However, this shift was in part driven by institutional processes – the NRF engaged with the media on the topic of skills development for the SKA, and this was reported on by eight of the 24 articles that are included in the sample for July. Nonetheless, the trend of increased diversification of coverage of the SKA continued from June.

August 2012: In August coverage declined, possibly indicating that the SKA as an item of news value had passed its peak and was set for a period of reduced coverage – although this

remained higher than in 2011. Continuing the trend of coverage after May 2012, there was a wider variety of dominant frames in August.

Overall, thus, an analysis of the periodization of the sample reveals the influence of key events in shaping news value and coverage, the role of institutional responses in shaping the locus of dominant frames, and the overall shift to a broader range of dominant frames after the site allocation announcement in May 2012.

7.5. Actors

Any actors that were referred to in the text were coded and were allocated an ‘actor type’ in line with the conceptual framework, which identifies the SKA, public sector actors, universities, research institutes, and private sector actors (firms and industry bodies), as well as the media, as the main sets of actors that influence representations of the SKA. The main actors that were referred to in the sample (all those represented in more than 5% of the sample) are indicated in Table 21. The most commonly mentioned individuals are the heads of the central organisations: Naledi Pandor, then the Minister of Science and Technology, and Bernie Fanaroff, the Project Director for the South African SKA.

Articles referred most commonly to actors within the South African government, followed by the SKA, and to a lesser extent universities and firms. Other types of actors, including international governments, research institutes, and local stakeholders, were referred to much less frequently. This tells us that the story of the SKA, as represented in the South African media, is a story in which the South African government and the SKA organisation are the main characters, universities and firms are supporting actors, and the remainder can be seen as extras. This is in line with the overall framing of the project as South African and African achievement, and in line with the major role played by the South African government and the SKA as sources of information (as explored in chapter 5 and chapter 6, and illustrated in Table 25 and Table 26). It also again highlights the manner in which local voices have been marginalised, as local stakeholders were only referred to in 6% of the sample.

Table 20: Actors referred to in the sample by actor type (cumulative %)

Actor type	Total
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SA Gov	211
SKA	121
University	53
Firm	51
Aus Gov	19
EU Gov	18
US Gov	16
Science facility	14
Research institute	11
Local stakeholders	6
SA political party (DA)	4

Note: the cumulative percentage total for each actor type is the sum of the percentage totals for all the individual actors in each category

Table 21: Actors referred to in the sample (as a % of the sample)

Actor	Actor type	Total
Naledi Pandor	SA Gov	78
Bernie Fanaroff	SKA	41
Justin Jonas	SKA	32
DST	SA Gov	27
John Womersley	SKA	26
Chris Evans	Aus Gov	19
Jacob Zuma	SA Gov	19
Phil Mjwara	SA Gov	19
NRF	SA Gov	17
NASA	US Gov	16
AU	African Gov	15
Derek Hanekom	SA Gov	14
IBM	Firm	9
Wits	University	9
Large Hadron Collider	Science facility	7
Miller Matola	SA Gov	7

Adrian Tiplady	SKA	6
African VLBI network	SKA	6
Brand South Africa	SA Gov	6
Cisco	Firm	6
Nithaya Chetty	SA Gov	6
SANSA	SA Gov	6
Val Munsami	SA Gov	6

7.6. Tone

The measurement of tone in the context of analysis of science in the media has focussed on the identification of benefits, risks, and controversies (Nisbet and Lewenstein, 2002; Durant, Bauer, and Gaskell, 1998; Weingart, Engels, and Pansegrau, 2000; Gastrow, 2010). This has made it possible to establish whether articles that report on a particular controversy provide balanced coverage (both risks and benefits, or neither) or take a partisan stance by reporting on only the risks or only the benefits.

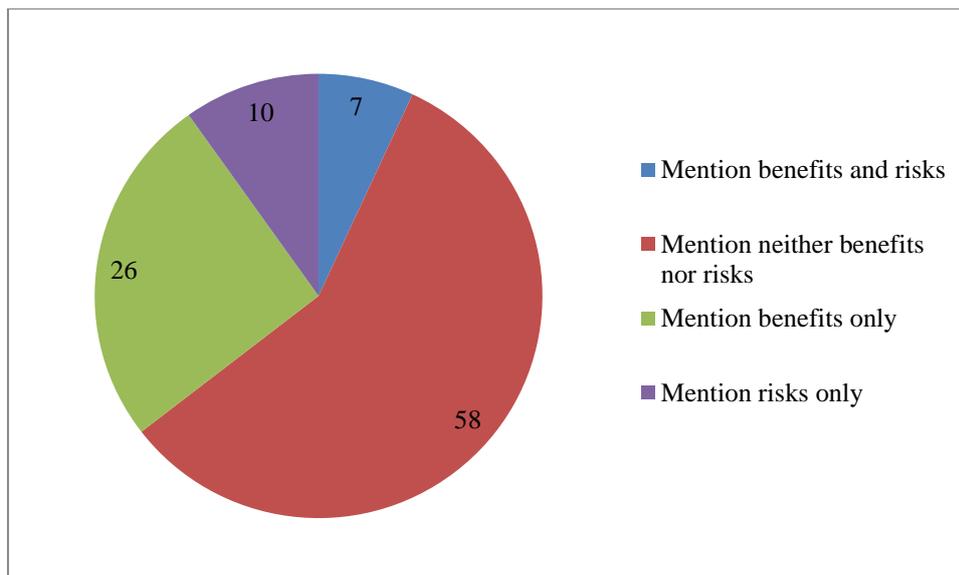
However, this methodology has largely been applied to areas of controversial science topics, such as biotechnology and climate change. Thus, while helpful in establishing and measuring tone, the methodology requires adjustment for the astronomy sector, which is ‘a non-contentious fundamental science with well recognised and respected, peaceful aim’ (Madsen, 2001:5). The SKA, as a whole, is not controversial in the same way that climate change or genetic modification are controversial – it is not subject to widespread contestation in the public sphere. However, there are aspects of the SKA that have experienced some controversy. By far the most significant of these is the site bidding and site allocation process, followed by much lower levels of coverage of the SKA’s development context and the question of shale gas fracking.

Thus, instead of focussing on issues of controversy, the coding system for measuring tone has taken a narrower focus on the explicitly stated material benefits and risks that are associated with the SKA as a whole. The findings of this analysis should thus be interpreted in this light. Notably, several variables that could be interpreted as indicators of ‘tone’ have been excluded here as a result of this focus. For example, a framing of the SKA as a symbol of science and

technology achievement could be interpreted as indications of a ‘positive’ tone, but this is not an explicit indication of a material benefit or a risk. Overall, indeed, the SKA is pervasively represented in a positive light, as a project that is desirable for South Africa (almost unanimously presented as such in the discourse on the site allocation process) and desirable from a scientific point of view.

The codes for this analysis, like the other codes, emerged from both deductive and inductive processes drawing on all data sources. Fifty-eight percent of the sample mentioned neither benefits nor risks – focussing instead on other issues. Of the remaining articles, the majority were positive in tone, with 26% of the sample reporting on benefits but not on risks. A smaller proportion (10%) reported only on risks. Only 7% of the sample reported on both benefits and risks (see Figure 9).

Figure 9: Reporting on benefits and/or risks (percentage of sample)



The benefits associated with the SKA were largely related to the development of South African science, technology, and engineering skills and capabilities, and to socio-economic development more generally. Direct references to the public sphere, such as showcasing South African science and technology capabilities, increasing public awareness of science, and building an ‘inclusive information society’ were less commonly cited (see Table 22).

Table 22: Reporting on benefits

	% of sample
Strengthen SA S&T capabilities	13
Attract people to S&T careers	10
Socio-economic development (general)	10
Skills development (bursary schemes)	9
Attract international skills	8
Skills development	8
Technological spin-offs	6
Foreign direct investment	5
Job creation	4
Showcase SA S&T capabilities	3
Increase public awareness of science	1
Inclusive information society	1
TOTAL articles mentioning benefits	33

The risks associated with the SKA include both potential negative consequences of the project and potential risks that may undermine the project itself – thus presenting a risk *to* the SKA as well as a risk *by* the SKA - factors which present a risk to the SKA project are inherently risks that may lead to broader negative consequences. The most commonly cited risk was skills development - that South Africa faced a significant challenge in terms of achieving the level of skills that would be required to a) win the bid (prior to May 2012) or b) to successfully implement and benefit from the project. Funding was reported as another challenge for the SKA. The global financial crisis had, during the time period of the study, continued to constrain science and astronomy budgets globally, and this was seen as a factor that could undermine the progress of the SKA. An external threat to the SKA was identified as the effort by oil companies, spearheaded by Shell, to initiate shale gas fracking in the region surrounding the SKA core site. Finally, five articles mentioned negative impacts on local communities, primarily related to the need to constrain telecommunications in order to achieve RFI mitigation in the area.

Table 23: Reporting on risks

	% of sample
Skills development	7

Funding	5
Fracking	3
Telecommunications in the local area	1
Negative impact on local communities	1
TOTALS:	17

7.7. Sources of information

Understanding the manner in which representations of the SKA in the media draw on various sources of information is critical to understanding the overall functioning of the communication processes that render these representations. Two main proxies for sources of information have been used. Firstly, there is a proxy for drawing on syndicated news feeds – all references to such feeds, through news agencies, have been coded. A second proxy is that of direct quotation used in an article. Of course, such proxies are not a highly accurate measure – they do not indicate *how much* these sources of information are drawn upon in each article (to code this would be beyond the feasibility constraints of this study), but they do provide a high-level indication of which sources are used in each article, and these data can be interpreted in the context of other data points to gain a deeper understanding of how different sources of information are drawn upon in representations of the SKA in the media.

Syndicated news feeds were used by 41% of the sample, with the most commonly used source being the South African Press Association (SAPA), followed by the French news agency Agence France Presse (AFP) and Reuters. One could speculate that the chief science communicator for the SKA at the international level originates from France, which may have fostered closer links with the French news agency. This finding suggests a relatively high degree of homogeneity, with a large proportion of articles drawing on a small number of sources. This also suggests that these sources are highly influential in framing the discourse. For example, a similar proportion of articles drew on news agencies and quoted major actors such as the South African government and the SKA itself.

Table 24: News services

\	% of sample
SAPA	26

AFP	11
Reuters	10
More than one news service	9
At least one news service	41

The coding process offers a high-resolution picture of who is quoted (see Table 26). The most commonly quoted individuals are Naledi Pandor (the Minister of Science and Technology), Bernie Fanaroff (Director of the SKA South Africa Project Office), Justin Jonas (Associate Director of Science and Engineering at the SKA South Africa), and John Womersley (Chairman of the SKA Board), who together make up a substantial proportion of the quotes made in the total sample. From an actor point of view, the South African government and the SKA are clearly dominant sources. Sixty-four percent of the sample quoted one or both of these actors. Firms and university scientists were referenced less often. Local stakeholders, Australian actors, and research institute scientists are largely marginalised and were only quoted in a handful of articles (see Figure 10).

South African public sector actors are the most commonly quoted group, quoted in 43% of the sample. This is largely made up by quotes from the South African Department of Science and Technology (DST), which was quoted in 40% of the sample. Other public sector actors include political parties (the ANC and the DA), spokespersons from the national and provincial governments, the president, government agencies such as Brand South Africa, and the NRF.

The SKA organisation, globally, is marginally the second most common source of quotes, being quoted in 42% of the sample. Both South African and international sources of quotes are prominent – 36% of the articles included quotes from the South Africa SKA and 23% from the SKA international organisation. This indicates that, as a source of information, there is a preference for the South African component of SKA organisation.

The third most commonly quoted sets of actors were university scientists and firms, each of which was quoted by 8% of the sample. The sample also strongly illustrates, by omission, which actors have been marginalised as sources of information. Scientists from research institutes were not commonly quoted – perhaps a reflection of the university base of many of

the SKA's partner scientists. Only five articles (2%) quoted a local stakeholder, suggesting a marginalisation of the voices of the local community. Only one article quoted the SKA's Australian office, revealing an unsurprising bias in favour of the South African voice from the SKA. Finally, only 5% of the sample quoted a university science communicator. University science communicators thus appear to play a 'behind the scenes' role in connecting scientists and the media, rather than engaging with the media directly.

One can gain a composite picture of how institutions are quoted by establishing patterns within the dataset. Focussing on the main sets of quoted actors (SA government, SKA SA, SKA international, firm, university scientist) an analysis of co-occurrence illustrates how articles in the sample have selectively quoted from these actors (see Table 25). Firstly, this analysis clearly illustrates the dominance of government actors and the SKA organisation in the discourse. Of the 139 articles that include quotations from this set of actors, only ten exclude the South African government and the SKA organisation (i.e. include only university scientists and firms). In 42 of the articles, only South African government actors are quoted, suggesting a degree of bias. Twenty-one articles quote only SKA actors.

Overall, it is apparent that the South African government and the SKA itself are the core actors in terms of quotes, and the other actors are included in coverage of the SKA as supplementary sources of information. One can infer that journalists are engaged primarily with the SKA and government actors as sources of information, and that they supplement this with information gained from other actors. This highlights the relationships between journalists and the SKA and between journalists and government actors as key channels in the overall science communication process.

Figure 10: Quoted actors (as a percentage of the sample)

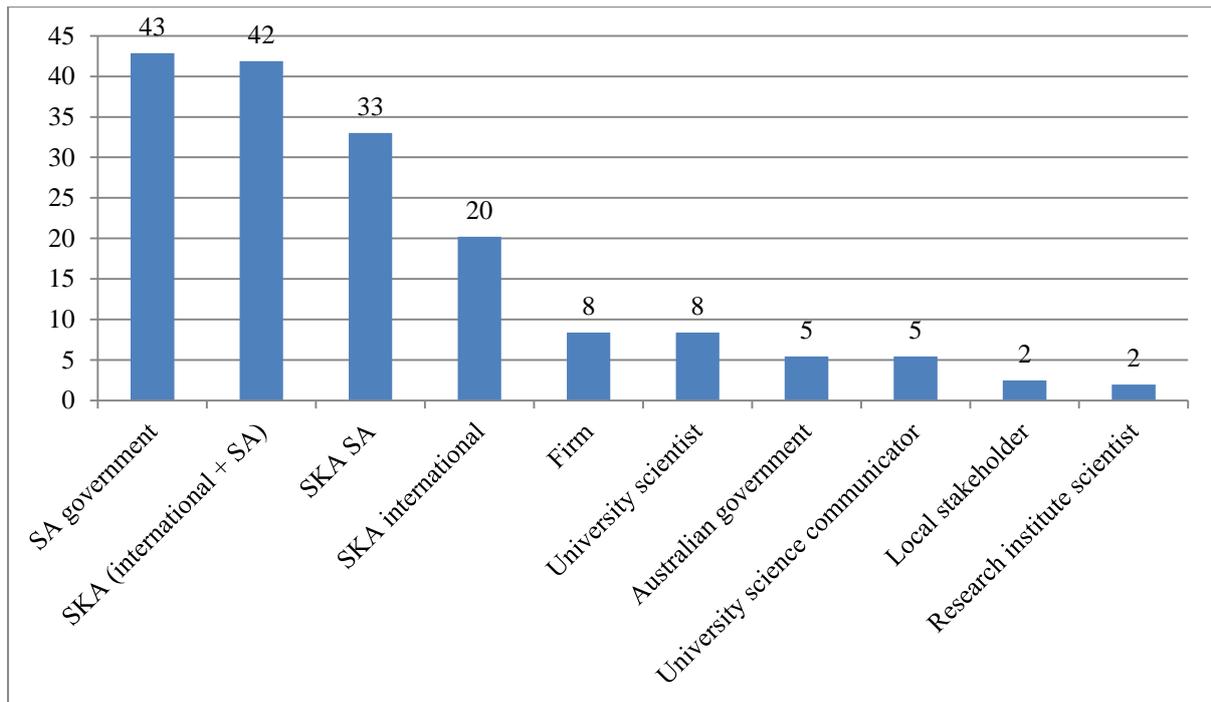


Table 25: Quotations by actors and sets of actors

Quoted actors	% of articles
South African government only	21
South African government + SKA SA	10
SKA SA only	6
SKA international only	4
South African government + SKA SA + SKA international	4
SKA SA + University scientist	4
South African government + SKA international	3
SKA SA + SKA international	3
Firm only	3
SKA SA + SKA international + University scientist	2
South African government + SKA SA + University scientist	1
University scientist only	1
South African government + SKA SA + SKA international + University scientist	1
South African government + SKA SA + SKA international + firm	1

South African government + firm	1
SKA international + firm	1
TOTAL articles with quotes	68

Table 26: Individuals and organisations quoted in the sample

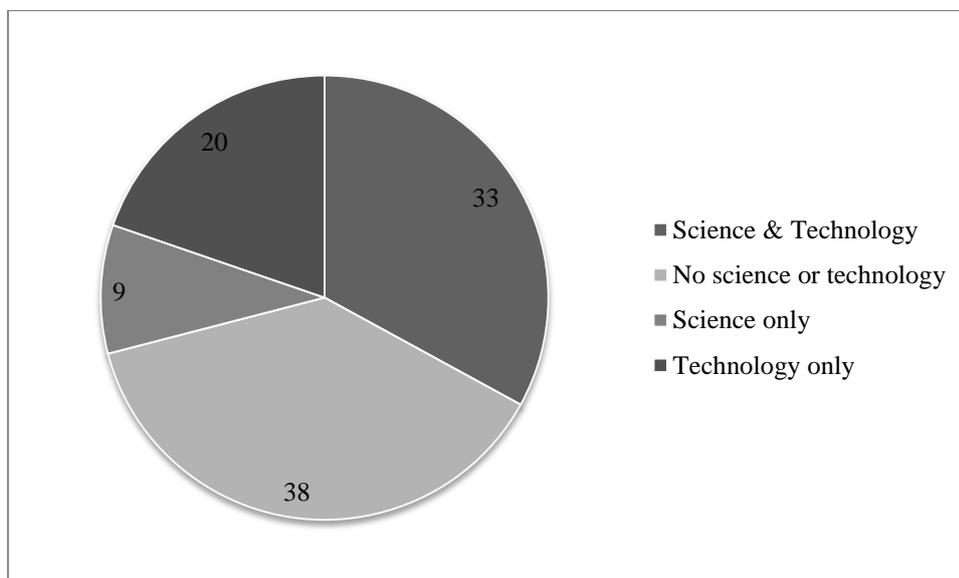
Actor	Organisation	Number of articles
Naledi Pandor	DST	46
Bernie Fanaroff	SKA (South Africa)	34
Justin Jonas	SKA (South Africa)	28
John Womersley	SKA (international)	25
Firm actor	Firm	16
Phil Mjwara	DST	15
University scientist	University scientist	11
Derek Hanekom	DST	10
Juanita Kloppers-Lourens	DA	10
Chris Evans	Australian gov	9
SKA international statement	SKA (international)	7
Michiel van Haarlem	SKA (international)	6
Richard Schilizzi SKA scientist	SKA (international)	6
Val Munsami	NRF	6
Caroline Zunckel	University scientist	5
Jacob Zuma	South Africa gov	5
Nithaya Chetty	NRF	5
Vishnu Vejjala	University scientist	4
UASA	Trade union	4
Adrian Tiplady	SKA (South Africa)	3
DA	DA	3
Government actor (national government)	South African government	3
Phil Diamond	SKA (international)	3
Research institute scientist	Research institute scientist	3

Willem Esterhuyse	SKA (South Africa)	3
ANC	ANC	2
Australian government actor	Australian government	2
Daphne Lekqwathi	SKA (South Africa)	2
Jasper Horrell	SKA (South Africa)	2
Katherine Blundell (Oxford)	University scientist	2
ANC press release	ANC	1
Bob Carr	Australian government	1
Brian Boyle	SKA (Australia)	1
Carnarvon local stakeholder	Local stakeholder	1
Claude Carignan	University scientist	1
David Block	University scientist	1
DST	DST	1
SA provincial government	South Africa government	1
IBM	Firm	1
Jocelyn Burnell	University scientist	1
LJ Du Toit EMSS	Firm	1
Michael Kramer (Max Planck Institute)	Research institute scientist	1
Miller Matola (Brand South Africa)	South Africa government	1
Nadeem Oozeer SKA scientist	SKA (South Africa)	1
NRF spokesperson	NRF	1
Rob Adam	DST	1
Sarah Blythe	University scientist	1
Sergio Colofrancesco	University scientist	1
SKA SA	SKA (South Africa)	1
Thomas Auf Der Heyde DST	DST	1
Tshepo Seekoe	DST	1
University science communicator	University science communicator	1

7.8. Science and technology

Approximately two-thirds of the sample (63%) reported on science and technology aspects of the SKA. Thirty-nine percent mentioned science aspects. The latter were divided into science research questions (33%) and other science elements (18%). Fifty-three percent mentioned technological aspects of the project. One third (33%) mentioned both science and technology aspects (see Figure 11). All this suggests that technology has slightly higher news value than science, but they are most commonly both addressed in the same article. It also confirms an expectation that representations of the SKA, as a major science and technology project, would mostly include references to science and technology.

Figure 11: Reference to science and technology aspects of the SKA (as % of the sample)



7.8.1. Science

Science aspects of the SKA, like other aspects, were coded through a grounded methodology in combination with a top-down approach. The top-down approach initially coded for the five main science research questions of the SKA, as defined by the organisation (<https://www.skatelescope.org/science/>). These five questions are:

1) *Galaxy evolution, cosmology and dark energy*: This research question is focussed on the evolution of galaxies, the expansion of the cosmos, and the nature of ‘dark energy’ that is postulated to drive this expansion.

2) *Strong-field tests of gravity using pulsars and black holes:* This research question aims to test Einstein's theory of gravity and challenge the theory of general relativity.

3) *Investigating the origin and evolution of cosmic magnetism:* This research question aims to understand what generates giant magnetic fields in space

4) *Probing the dark ages - the first black holes and stars:* This research question aims to understand the formation of the first stars and black holes by looking back in time to before the first light in the visible spectrum lit up the universe.

5) *The cradle of life: searching for life and planets:* This research question will aim to detect extraterrestrial signals and search for complex molecules, the building blocks of life, in space.

The SKA also defines as a sixth research question a '*blue sky*' ambition to remain flexible and open to new questions and new approaches:

“Flexible design to enable exploration of the unknown: While this is truly exciting and transformational science, history has shown that many of the greatest discoveries have happened unexpectedly. The unique sensitivity and versatility of the SKA will make it a discovery machine. We should be prepared for the possibilities.”

Source: <https://www.skatelescope.org/science/>

However, the grounded, or bottom-up, coding process rendered a slightly different set of codes, based on the manner in which research questions were represented. Research questions were commonly grouped in a different manner to that laid out by the SKA. For example, the ‘formation of the first stars and galaxies’ was commonly mentioned as a research question, even though in the framework of the SKA’s science questions this refers to two separate research questions, namely the origins of the first galaxies (research question 1: cosmology, galactic evolution, and dark energy) and the origins of the first stars (research question 4: probing the dark ages – the first stars and black holes). The ‘origins of the universe’ was commonly mentioned as a research question, which also refers to both of these research questions. In addition, although the blue-sky research objective of the SKA was not explicitly explored in the sample, there were numerous references to the more abstract objective of addressing ‘fundamental questions in physics and cosmology’, which can be used as a proxy

for blue sky research. As such, the final coding system for science research questions draws on both the stated science objectives of the SKA and the coding structure that emerged from the text, rendering six codes for science research questions and one for blue sky research:

- Cosmic magnetism;
- Dark energy and the expansion of the universe;
- Dark matter;
- Formation of the first stars and galaxies;
- Gravity;
- Origins of the universe;
- Search for extra-terrestrial intelligence (SETI), and
- Fundamental physics and cosmology.

As indicated in Figure 12, there are substantial differences in the coverage received by these research questions. This can be interpreted as indicators of relative news value, as journalists have selected some research questions over others. The search for extra-terrestrial intelligence was the most commonly mentioned – and clearly a favourite in terms of the news value of the project. The ‘origins of the universe’ was also commonly reported, followed by the question of dark energy and the expansion of the cosmos. The least commonly represented questions were those related to gravity, dark matter, and cosmic magnetism – possibly because these questions are more difficult for the lay public, and for journalists formulating and defining their stories, to easily understand and engage with.

There was also a marked pattern in terms of the number of science questions that articles mentioned, characterised by a tendency towards selectivity. Most of the articles that mentioned science research questions mentioned only three or four questions, rather than the whole set. Only a very small proportion mentioned all the research questions. This is further evidence of a selection process by journalists, which focuses on the research questions that have the highest news value.

As expected, the profile for coverage of science research questions is different within the subset of articles with science, technology and engineering as their dominant frame. These articles referenced all the science research questions of the SKA more often – although a smaller proportion made reference to the open ended question of ‘fundamental physics and

cosmology’. Moreover, this sub-set of articles had a different emphasis, in which SETI was not the most commonly mentioned research question. More articles mentioned the research questions of the origins of the universe and the expansion of the universe (dark energy), and a similar proportion mentioned dark matter and SETI respectively. These articles also tended to mention more research questions per article (see Figure 13), indicating that articles within this dominant frame provide greater depth of coverage with respect to the science aspects of the SKA.

Figure 12: Reporting on science research questions

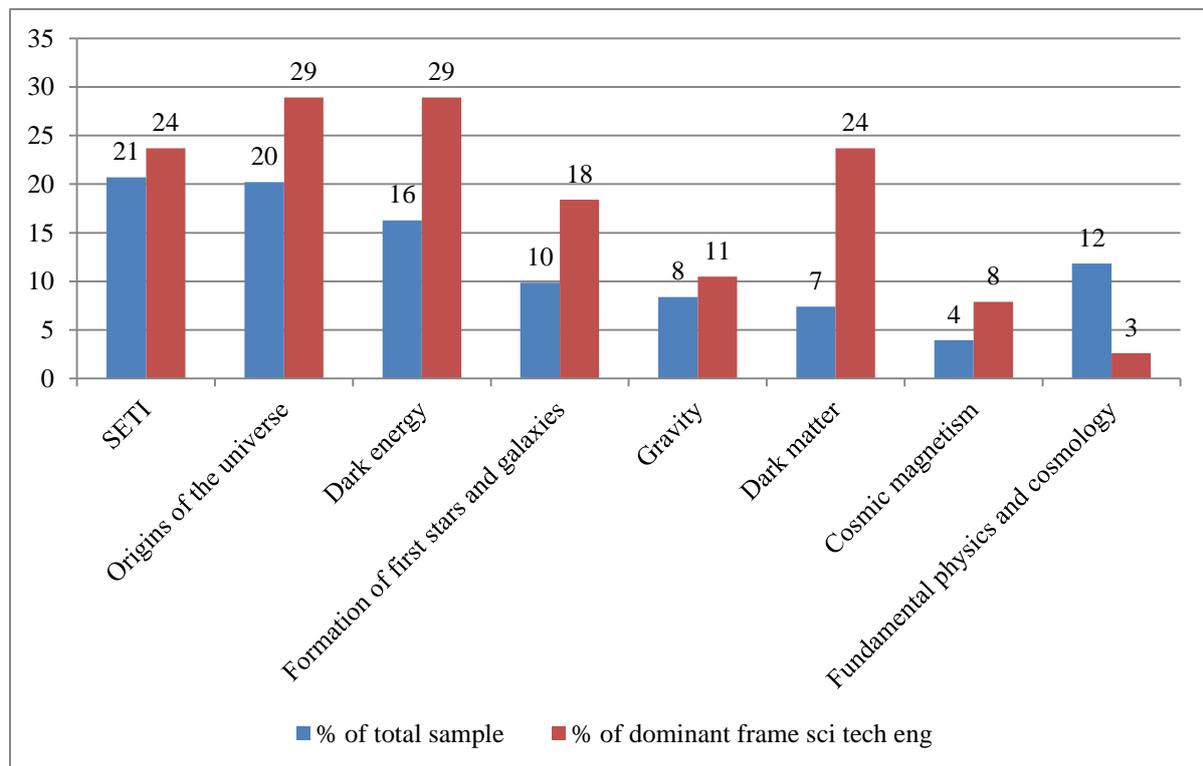
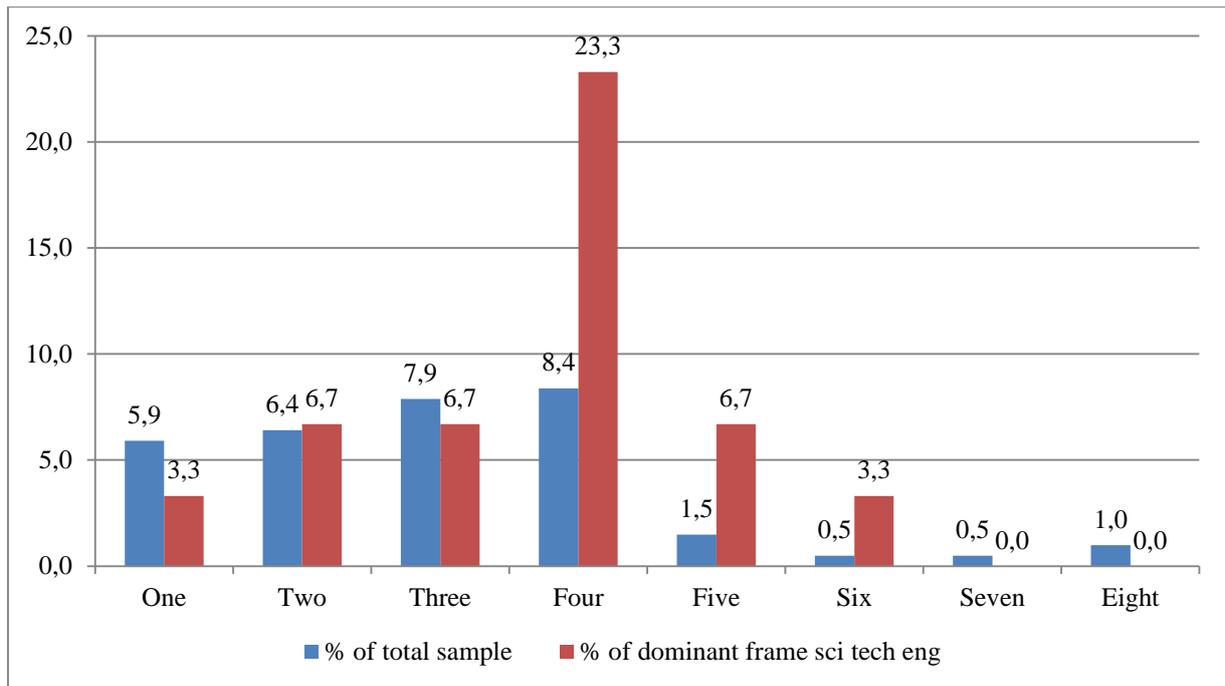


Figure 13: Number of science research questions mentioned per article as a % of the sample



Note: excludes 'zero' responses where no specific research questions were mentioned and coded. Articles with a dominant frame 'science technology and engineering' could have no relevant codes if the article focussed on technology only, or on science in general, rather than specific science research questions.

In addition to the SKA's research questions, several other science elements emerged from the grounded coding process (see Table 27). The broad areas of physics, cosmology, and astrophysics were most commonly referred to, with a far less common reference to astrobiology. In 1.5% of the sample the significance of the SKA was compared to that of the discovery of the Higgs Boson. The PAPER project, another radio-astronomy project taking place at the SKA core site, was mentioned in 2% of the sample.

Table 27: Science elements (other than research questions)

	% of sample
Physics	11,8
Cosmology	7,9
Astrophysics	4,4
PAPER project	2,0
Higgs boson	1,5
Astrobiology	0,5

TOTAL articles with science elements	18,2
--------------------------------------	------

7.8.2. Technology

Since the technological aspects of the SKA are so numerous, the coding process for technology variables was driven by a bottom-up process, grouping together the various technology-related references that occurred in the text. As indicated in Figure 14, the most common reference was to the antennae dishes and receivers (28%) – although this consisted largely of very brief references, for example to the number of dishes or their distance from the core site. There was very little detailed coverage of the dish or receiver technology *per se*. The second most common technology aspect was on the data processing that would be required by the SKA (12%), followed by the challenges of RFI mitigation and data transport. If one groups the various ICT-related technologies together, a total of 15% of the sample reference these codes.

As is the case with coverage of science aspects, coverage of technology aspects is selective, with the majority of articles that mention a technology aspect highlighting only one code (see Figure 15). Only a small proportion of the sample reports on multiple aspects of the SKA's technology. Reporting on technology is thus, in a sense, shallow – an isolated reference to the receiver dishes or the data processing requirements, but little in the way of a broader overview. This suggests that the technological aspects of the SKA are mostly mentioned in passing, rather than as a focus area or a topic for in-depth reporting.

An exception to this, as expected, lies in the articles that have science, technology and engineering as a dominant frame. Within this sub-set of the sample a higher proportion of articles reported on more than one technology aspect (see Figure 14 and Figure 15), and substantially greater attention is given to technology aspects other than the receivers and dishes, particularly in relation to data processing, data transport, RFI mitigation, interferometry, the ROACH board, and South African innovation more broadly. If the ICT-related codes are combined, for this sub-set of articles, ICT becomes the most commonly referred to technological aspect of the SKA, with 32% of the sample reporting on one or more aspects of ICTs. This confirms that, in general, the most prominent technological aspect of the SKA is its dishes and receivers, but where the project is primarily framed as a science and technology undertaking, it is more commonly represented as an ICT project.

Figure 14: Reporting on technology aspects of the SKA

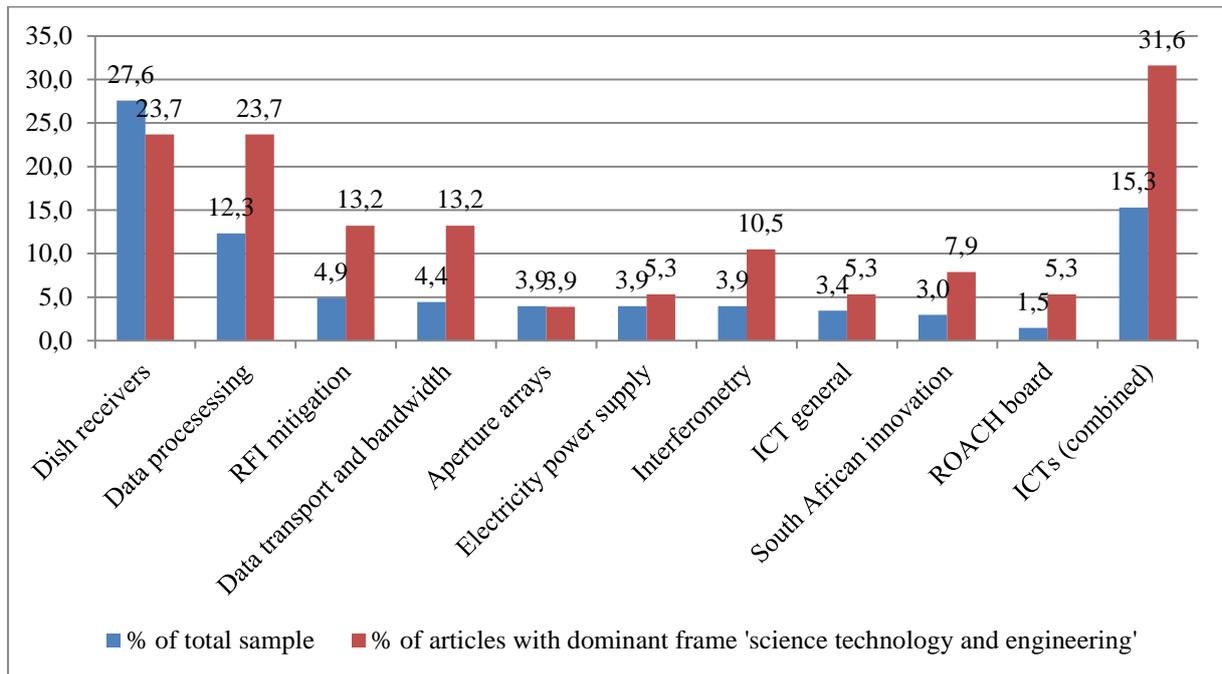
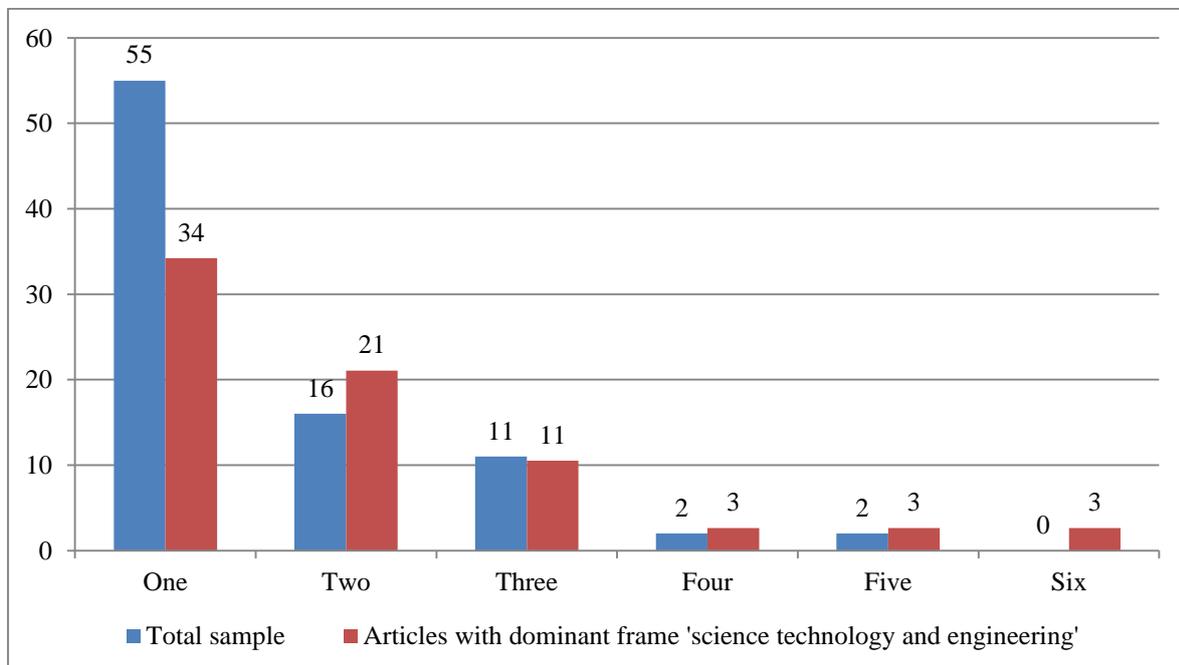


Figure 15: Number of technology aspects mentioned per article as a %

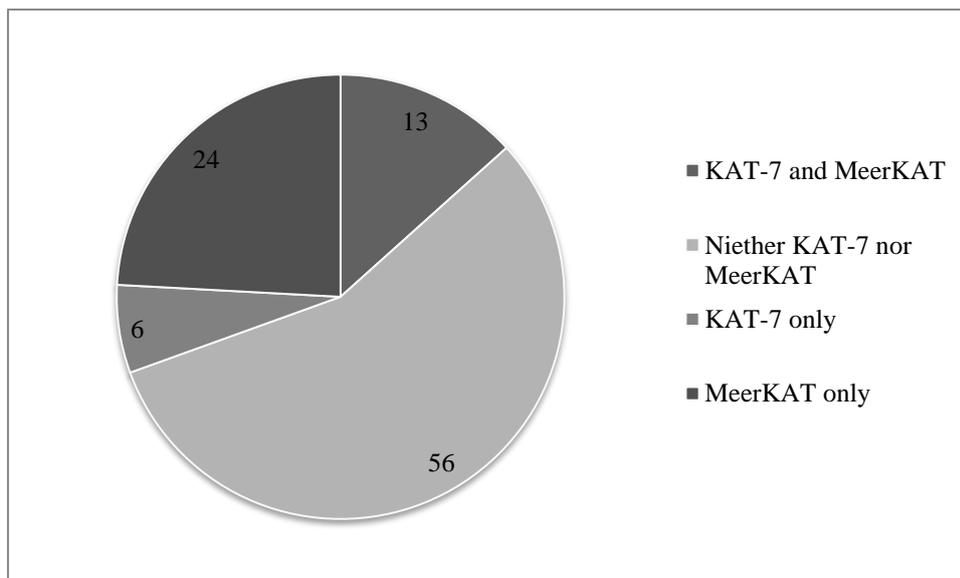


Note: excludes 'zero' responses where no specific technologies were mentioned and coded. Articles with a dominant frame 'science technology and engineering' could have no specific technology codes if the article focussed on science or on technology in general, rather than specific technologies.

7.8.3. The precursors

The precursor instruments, KAT-7 and MeerKAT, received a moderate level of coverage in reporting on the SKA. Nineteen percent of the articles referred to the KAT-7, while 37% referred to the MeerKAT. Interestingly, there was a low level of co-occurrence for these codes – only 13% mentioned both the KAT-7 and the MeerKAT. In terms of discourse, these precursors were often framed as indicators of science and technology capabilities – as evidence that South African capabilities were sufficient to develop and construct working prototypes for the SKA. By contrast, only 6% mentioned the Australian precursor, the ASKAP – again revealing a biased focus on South African achievements.

Figure 16: Reporting on the precursors – KAT-7 and MeerKAT as a % of the sample



The KAT-7 was the only component of the SKA in South Africa to have been used for science purposes by the time of study. This science aspect of the KAT-7 was mentioned in six articles, specifically referring to two main science achievements:

- Images of the Centaurus A galaxy 14-million light years away, as well as its associated black hole, and
- Images of the NGC 3109 galaxy, which is about 4.3 million light years away from Earth, in the constellation Hydra. This included images of radio emissions from the neutral hydrogen gas in the galaxy as well as indications of the direction it is moving.

These science achievements were drawn upon to frame the KAT-7 as a source of significant science outputs for the SKA as well as evidence of South Africa’s capacity to conduct world class astronomical science. Bernie Fanaroff is quoted in one article (P130) underlining these points:

“A large proportion of the science planned for the SKA - and MeerKAT - involves mapping of the universe using neutral hydrogen. Because of the ongoing expansion of the universe, distant galaxies are moving away from us. Measuring the frequency of the spectral line from neutral hydrogen in those galaxies allows us to work out how far away they are. By finding billions of distant galaxies, astronomers will be able to map the structure of the universe and how it has changed over time.”

(Source: Bernie Fanaroff, quoted in P130)

Nine percent of the articles mentioned the MeerKAT’s technical capabilities, and 9% also referred to the funding of the MeerKAT - either its cost or the process behind government funding that has supported it. Three percent mentioned that the MeerKAT’s observation time had been booked up five years in advance even prior to its completion – an indication of the instrument’s technical and scientific value. However, only two articles specifically mentioned the MeerKAT’s research projects.

Table 28: References to the MeerKAT as a % of the sample

	% of sample
MeerKAT	37
MeerKAT capabilities	9
MeerKAT funding	9
MeerKAT observation booked up in advance	3
MeerKAT research projects	1

7.9. The SKA organisation

Several aspects of the SKA, from an organisational point of view, emerged from the grounded coding process. These included references to the SKA’s global partner countries, African partner countries, Australia as a partner country (including the ASKAP, the

Australian precursor instrument), as well as to the UK-based headquarters of the project. References to Australia as a partner country were coded separately from references to Australia as a competitor during the site allocation process.

This provides insight into how the SKA has been framed. The main reference was to the SKA's African partner countries (33%), followed by the global partner countries (22%). A smaller proportion of articles (6%) mentioned that the SKA is headquartered in the UK. There was also proportionately little coverage of Australia's role in the SKA, other than as a competitor in the bidding process. Only 10% of the sample mentioned Australia as a partner country (rather than as a competitor), and only 9% referred to the infrastructure site in Australia. The SKA is not, overall, represented as a Western, Northern, or developed country project with an infrastructure base in Africa, but rather as an African project with a management node in a developed country – and even this aspect is significantly under-represented – and a smaller partner infrastructure site in another developed country. This suggests that, overall, the SKA is framed as an African project in which South Africa has leadership, rather than a global project in which the UK has leadership, again underscoring the social construction of the SKA as a symbol of *African* science and technology.

Table 29: Organisational components of the SKA as a % of the sample

\	% of sample
African partner countries	33
Global partner countries	22
Construction timeline	21
Australia as a partner country	10
Australian site	9
ASKAP	6
UK HQ	6
TOTAL mentioning organisational aspects	56

7.10. Funding, policy and governance

More than half of the sample mentioned funding aspects of the SKA. The large majority of these articles mentioned the cost of the project, or otherwise stated the monetary value of the

project. This could be interpreted as one of the main aspects of news value of the SKA – its size in financial terms, as an indication of scale, achievement, prestige, benefits, and high stakes. In terms of contribution to this cost, only 5% mentioned the contribution of the South African government. Even fewer specifically mentioned financial contributions by partner countries (1%) and only one article specifically mentioned funding by the Australian government.

Another aspect of funding that emerged from the grounded coding process was the competition by firms for space in the SKA's supply chain and innovation network. Eight articles referred to this on an international scale, while 5 mentioned this in the South African context.

Table 30: Funding aspects of the SKA

	% of sample
Monetary value/cost of the project	48
Contribution by the South African government	5
International supply chain competition	4
South African supply chain competition	2
Contributions of partner countries	1
Contribution by Australian government	0
TOTAL articles mentioning funding aspects	52

Policy aspects of the SKA were mentioned by 14% of the sample, primarily in relation to the Astronomy Geographic Advantage Act (9%). Other aspects included references to the strong support that government has provided to the project (in a generalised sense). More isolated references included those to the Strategic Infrastructure Programme (1 article only) and to VAT relief for the SKA project (3 articles). Even articles that had policy and governance as a dominant frame did not in all cases mention any specific policy aspects. This is because several of these articles referred to political statements, such as the State of the National address, where the SKA was mentioned as an achievement, and thus claimed in the public sphere by government actors, but without any detailed discussion of specific policy or governance aspects.

Table 31: Policy aspects

	% of sample
Astronomy Geographic Advantage Act	9
Government support (general)	4
Strategic Infrastructure Programme	0
VAT relief for SKA	1
TOTALS articles mentioning policy aspects	14

7.11. Controversy and contestation

7.11.1. Site allocation

The site allocation of the SKA's infrastructure represents the most common dominant frame, most controversial issue, and most complex set of content analysis codes. Approximately half of the sample had this issue as their dominant frame, and two-thirds mentioned at least one aspect of the issue. This suggests that the site allocation process has had the highest level of news value of all the aspects of the SKA. This is in line with McQuail (2005:310) who identified main generic features of news value to include a large scale of events, closeness to home, clarity of meaning, short time scale, relevance, consonance, personification, negativity, significance, and drama and action. While the more technical and scientific aspects of the SKA might lack drama, action, and negativity, the controversies which accompanied the site allocation process arguably included such aspects. The competition between Australia and South Africa, with high stakes and national prestige on the line, was marked by several arguably negative messages from both sides, and was framed as a dramatic international rivalry in the news media.

There are three main groups of codes associated with the site allocation. The first, and most common, is related to the bidding process, in which South Africa, leading an African team, was competing with Australia, in collaboration with New Zealand. This includes discourse related to the controversial leak by the *Sydney Morning Herald* and *Canberra Times* of the Site Advisory Committee's report favouring the South African site, reported on subsequently by the journal *Nature*. This sub-set of codes occurred in 49% of the sample. A second group of codes are related to the site allocation announcement itself, which received considerable

coverage in its own right. This includes the delays that occurred in the announcement. This sub-set occurred in 35% of the sample. A third, less common set of codes are related to subsequent discourse about the split site location that was announced, including the benefits, risks, and science implications of the split site decision – occurring in 9% of the sample.

Table 32: The SKA infrastructure site allocation as a % of sample

	%
Site bid	49
bid competition with Australia	35
bid leak by Sydney Morning Herald	15
bid internal SKA process	13
bid advisory committee recommendation for South Africa	12
bid leak by Sydney Morning Herald SA response	8
bid political aspects	7
bid rhetoric indicating slit possibility	5
bid good astronomy conditions at SA	5
bid possibility of sharing	4
bid security in SA	4
bid Australian economic/political stability	3
bid leak by Canberra Times	3
bid lower costs in SA	2
bid political insecurity in SA	2
bid competition with Australia sport metaphor	1
bid Nature leak	1
bid reference to sympathy vote	1
bid better infrastructure in SA	1
bid majority of in SA	1
Site location announcement	35
location announcement split	18
location announcement (delay)	13
location announcement (reaction to)	7
location announcement	6
Split site and related issues	9

location split cost implications	7
location split (general)	3
location split benefits	2
location split risks	1
TOTAL:	67

Note: sub-totals do not equal the sum of component code frequencies, as there is overlap of these codes in the data

7.11.2. Fracking

Fracking was represented as a controversial issue in only a very small proportion of the sample, represented in Table 33 in terms of the number of articles, as most codes are too infrequent to use percentages as indicators. Only six articles mentioned fracking, all of which framed the issue as a risk – whether as a potential threat to the SKA, as a question of political opposition between the SKA and oil companies, or in terms of the role of policy (the fracking moratorium, the Astronomy Geographic Advantage Act) in protecting the SKA from the various campaigns of the oil companies. No articles mentioned any benefits of fracking. Despite the low level of coverage, the discourse was hotly contested and the stakes were framed as high.

Table 33: Fracking

	Number of articles
As a potential threat to the SKA	3
Moratorium	3
Opposition between SKA and oil companies	3
Not yet certain whether will pose risks for SKA	2
Risks	1
Role of the Astronomy Geographic Advantage Act	1
Benefits	0
TOTAL number of articles mentioning fracking	6

7.11.3. The development context

The development context of the SKA received a relatively low level of coverage in the news media. In the broadest sense, significant proportions of the sample included text references to the Northern Cape (64) or Carnarvon (45), which are both geographical regions with substantial development needs. However, a much smaller proportion of the sample, only 19 articles, specifically mentioned development aspects of the SKA. Only four articles examined the broader issue of astronomy in developing countries, in which the benefits of astronomy are weighted against other priorities in the development context.

The development role that the SKA has or could play in Carnarvon accounted for most of the reporting on the development context, including aspects related to economic growth, local skills development, and escalating property prices. By contrast, Williston, the second closest town to the SKA site, more distant from the site than Carnarvon by only 20km, was mentioned only three times. This again points towards an issue of local exclusion – where Carnarvon has benefitted substantially from the presence of the SKA, but other nearby towns might not have, despite the small distances separating them.

Some articles mentioned the local development context more generally, referring primarily to the beneficial impact on local economic development (3%), but also to the limits to the project's development impact (3%) and even the negative impact that the project may have on local communities (only 2 articles), particularly in terms of telecommunications.

Table 34: The development context

	% of sample
Local economic development	3
Astronomy in developing countries	2
Carnarvon local skills development	2
Carnarvon property prices	2
Carnarvon economic growth	1
Limitations to development impact	1
Williston	1
Negative impact on local communities	1
TOTAL articles mentioning development context	9

These articles reveal complex discourses that include local hopes and expectations, efforts to manage these on behalf of the SKA, and acknowledgement that the benefits to local communities require a degree of agency on their behalf in order to be materialised, as indicated in the excerpts below.

One in two locals are unemployed, and the SKA team cautions that most of the jobs will be in the construction phase on the site, which will host the lion's share of the SKA alongside Australia. “The people have got high expectations. The expectation is this is going to alleviate the poverty in this region, and you know it's a science project, it's not a job creation project,” said Pieter Snydam, stakeholder relations manager.

Source: Appendix H P108: SKA breathes life into sleepy hollow 2012-07-24

Louw said he set up his brick-making business three months ago and now employs 40 people. “Some of them will tell you that the people of Carnarvon haven't really benefitted from it, but we all benefitted from it. They must just open their eyes,” he said. “There's a lot of people that complain nothing is coming to them. But it's because they want something to happen by itself. There's a lot of opportunities and there's still a lot of opportunities that people haven't thought about. They must just do something themselves.”

Source: Appendix H P108: SKA breathes life into sleepy hollow 2012-07-24

The Northern Cape's telecommunications crisis has been deepened by SA's bid to host the Square Kilometre Array (SKA) radio telescope, which has become a focal point of frustration for local farmers. Cellphones, radios and most telecommunications interfere with radio telescopes and, while the SKA site decision is yet to be finalised, the 64-dish precursor - MeerKAT - is definitely going into operation. It will be the largest radio astronomy telescope in the southern hemisphere until the SKA comes online in 2024. The government passed the Astronomy Geographic Advantage Act of 2007 to preserve the radio quiet in the area. Local farmers have argued this would infringe on their ability to stay connected and develop the area, and would worsen urbanisation and depopulation.

Source: Appendix H P187: Telkom deaf to Northern Cape, say farmers 2012-20-04

7.12. Representations of the SKA in the Afrikaans news media

As highlighted by Roelofse (1996:70), the South African press has historically been divided on the basis of language and race, with the main divisions being the English, Afrikaans, ‘alternative’ and ‘black’ press. However, in the contemporary context, such divisions and classifications are outdated (Switzer and Adhikari, 2000) and require revision in the context of globalisation and the new media. Nonetheless, the distinction between the English and Afrikaans presses remains relevant, as they continue to address different readerships, and thus might represent the SKA in different ways.

Analysis of the science communication process and science journalism process associated with the SKA (Chapters 5 and 6) has highlighted the important role of the Afrikaans medium news publications in representing the SKA in the public sphere. The SKA, in terms of demographics, is embedded in an Afrikaans-speaking part of South Africa. Afrikaans is the most common language in and around the SKA infrastructure site in the Northern Cape – in nearby towns such as Carnarvon, it is the primary language of communication. In the Western Cape, where the South African SKA head offices are based, Afrikaans is also the most commonly spoken language. Afrikaans is spoken by 68% of the population of the Northern Cape, and 55% of the Western Cape (Statistics South Africa, 2012). This has had several impacts on science communication related to the SKA. Communication efforts by the SKA itself that have been directed at local communities in the Northern Cape have primarily been produced in an Afrikaans medium. Also, the embeddedness of the SKA in an Afrikaans-speaking local context means that the readers of local Afrikaans language news publications have a greater stake in, and therefore possibly interest in, the SKA. This may in turn form a basis for a higher news value for the SKA. From this basis, one could hypothesise that the Afrikaans news media would pay more attention to the SKA, resulting in proportionately higher levels of coverage than the English language news media, with a greater focus on the local context, particularly in the Northern Cape and local urban centres.

In order to test these hypotheses, and to further explore the nature of representations of the SKA in the Afrikaans news media, as well as to provide a basis for comparison with the English news media, an Afrikaans language sample has been included in this analysis. The particular publication that was chosen was *Die Burger*. Established in 1915, this is one of the leading Afrikaans language daily news publications, and also the dominant news publication (in any language) in the area of the SKA’s site infrastructure, with a quarterly circulation of

60,354 in the second quarter of 2012 (source: Audit Bureau for Circulation). This makes *Die Burger* an ideal source for media content relevant to representations of the SKA in the Afrikaans media.

As described in Chapter 3, the sample was obtained through a keyword search of *Die Burger*'s online archives. A total of 71 relevant articles were found through this search. The media content analysis of this sample has been made possible by the application of a non-interpretive coding system using automated search terms, combined with a manual verification process, to identify occurrences of specific terms in the text. The coding system for the Afrikaans language sample is substantially less complex than its counterpart, as only a small fraction of the overall coding system was suitable for both the English and the Afrikaans language samples. As a result, the interpretation of the results of this content analysis depends to a greater extent on the use of proxies and indicators, rather than directly applicable data. Another limitation is that this reduced dataset cannot be used at a high level of resolution – although it does form a complete, valid, replicable, and highly reliable source of aggregate data to describe the sample as a whole. Within these constraints, the analysis of the Afrikaans medium sample presented below highlights key findings in terms of overall coverage, periodisation, representations of actors, representations of the precursor instruments, and representations of the local development context. Codes for other aspects of representations of the SKA did not include any non-interpretive codes and could therefore not be included in the analysis.

7.12.1. Periodisation and changes over time

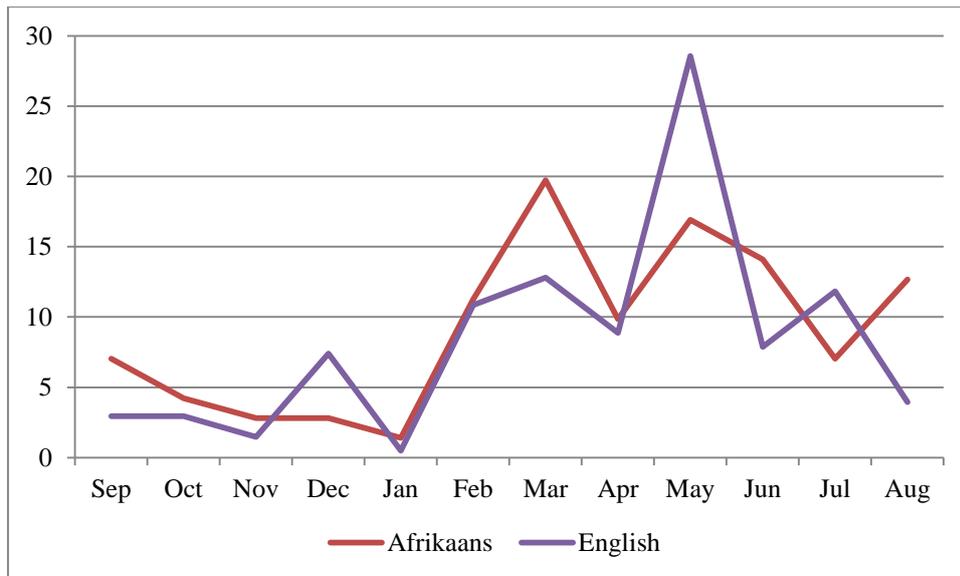
The output of articles referring to the SKA from *Die Burger* is considerably higher than at comparable publications in the English language sample. The total number of SKA-related outputs from the country's opinion-leading newspaper, which also has a science correspondent (the *Mail & Guardian*) was 22 during the study's time-frame. In comparison, *Die Burger* produced 71 articles. This finding is in line with that of Van Rooyen (2004), who found that the Afrikaans press employed relatively more science journalists than the English medium press, and thus has greater capacity to publish science-related messages. This are two other possible causes – firstly, as outlined above, the embeddedness of the SKA in a local Afrikaans readership and public. Secondly, in a sample drawn from a single publication, the efforts of an individual journalist can make a difference. Elsabé Brits, *Die Burger*'s science

correspondent, has evidenced a great interest in the SKA, and has thus published extensively on the topic. Of the 71 articles, 42 (59%) were written by Brits or drew on her previous publications as a source of information – illustrating that an individual journalist may have an impact on the overall profile of media outputs, and that to this extent may exercise significant agency within the overall structure of the media environment.

The changes in output over the course of the study's time-frame, when compared to the English language sample (see Figure 17), has been generally similar, with some notable differences. Both samples produced a low level of coverage in 2011, with spikes in coverage in March 2012 and in May 2012, followed by a decrease until August 2012, which nonetheless remained higher than in 2012. The main difference is that the largest spike in coverage for *Die Burger* was in March 2012, and the second largest was in May 2012, whereas for the English language sample this was reversed. *Die Burger* provided detailed coverage of the main events that took place in March, including the anticipated site allocation announcement, and the controversial leak of the internal SKA report recommending South Africa by the *Sydney Morning Herald*. Another explanatory factor is that as a single publication, the number of articles that could be written about the site allocation announcement was limited, particularly between 25 and 31 May. On the other hand, the spike during this period for the English language sample reflects a sharp response among the English language news media as a whole, within which many publications that usually provided very limited or no coverage of the SKA produced news outputs related to this key event in the project's periodisation.

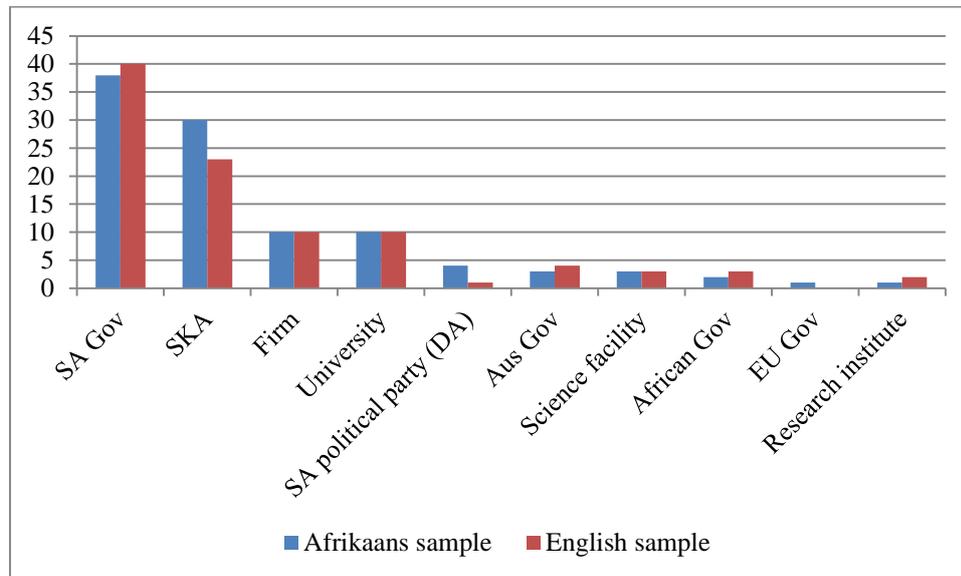
The similarity of the two samples in terms of output over time validates the hypothesis that news media publications, in both English and Afrikaans, have increased or decreased their outputs of representations of the SKA in response to key events in the project's periodisation – itself a response to changing levels of news value and the negotiation of outputs through the respective gatekeeping systems. If this hypothesis were false, and outputs were not closely tied to periodization, then the two samples would be more likely to reveal different patterns of outputs over time.

Figure 17: Output over time for the Afrikaans and English language samples (expressed as a % of the sample)



7.12.2. Actors

References to actors are suitable for non-interpretive coding, as automated coding functions can be applied to specific text strings, including the names of actors or the translated names of actors – this does not require interpretation. The representations of actors in the Afrikaans language sample is analysed here and compared to similar data extracted from the English language sample. This includes an analysis of references to individual actors, expressed as a percentage of the sample that make a reference to each actor (see Table 35). In addition, there is an analysis of aggregated data for different types of actor – each actor was assigned an ‘actor type’ using the same methodology employed for the English language sample, based on the main actor categories defined by the conceptual framework. Thereafter, the percentage totals for each actor were added together to form a cumulative figure for each actor type – the figure therefore does not indicate the proportion of the articles that make reference to that type of actor, but rather frequency with which actors of that type are referred to within the sample. Given the different sizes for the English and Afrikaans samples, these data were then normalised in order to provide a basis for comparison. The normalisation process involved establishing a total from the sum of all the actor types, and using this to normalise the data by expressing the figure for each actor type as a proportion of this total, multiplied by one hundred to provide a normalised figure (but not a percentage figure). Through this process, the data for the English and Afrikaans samples were rendered comparable as indicators of the proportionate density of references to each actor type in the respective samples (see Figure 18).

Figure 18: Actor types referred to in the text by actor type (normalised totals)

References to actors in the Afrikaans sample follow a similar pattern to the English language sample. In both cases, overall, the South African government and the SKA are the most commonly referenced to actors, followed by firms and universities, and with other actors playing minor roles. In both languages, actors from firms and universities were referred to with approximately equal frequency. This suggests that, at an aggregate level, English and Afrikaans news coverage of the SKA refers to a similar profile of actors. This also validates the findings in both cases, indicating that the choice of reference to actors is not arbitrary, but a reflection of an underlying structure, set of choices, or priorities that are common across languages and publications.

There are however some significant variances. The main difference between the two samples, at this level, lies in their differing representations of South African government and SKA actors. The Afrikaans language news media quoted public sector actors relatively less often, and SKA actors relatively more often. *Die Burger* therefore represented the SKA with a greater focus on the organisation itself, and a lesser focus on the government actors that enabled it, in comparison to the English language sample. One other significant difference was a more common reference to the South African official opposition political party (the Democratic Alliance or DA), which played a peripheral role in the English language sample but a somewhat more substantial role in the Afrikaans language sample. This suggests a

slightly different political orientation for *Die Burger* in comparison to the English language media.

Table 35: Actors referenced in the text (as a % of the Afrikaans sample)

Actor	Actor type	TOTALS:
Bernie Fanaroff	SKA	30
Naledi Pandor	SA Gov	30
DST	SA Gov	15
Junita Kloppers-Lourens	SA political party (DA)	7
Justin Jonas	SKA	7
Chris Evans	Aus Gov	4
IBM	Firm	4
Jacob Zuma	SA Gov	4
NRF	SA Gov	4
Oxford	University	4
Phil Mjwara	SA Gov	4
Telkom	Firm	4
Willem Esterhuyse	SKA	4
African Union	African Gov	3
Jasper Horrell	SKA	3
John Womersley	SKA	3
Nokia-Siemens	Firm	3
SALT	Science facility	3
SANSA	SA Gov	3
UCT	University	3
Wits	University	3
Adrian Tiplady	SKA	1
ASTRON	Research institute	1
Berkeley	University	1
Caltech	University	1
CERN	Science facility	1
Derek Hanekom	SA Gov	1

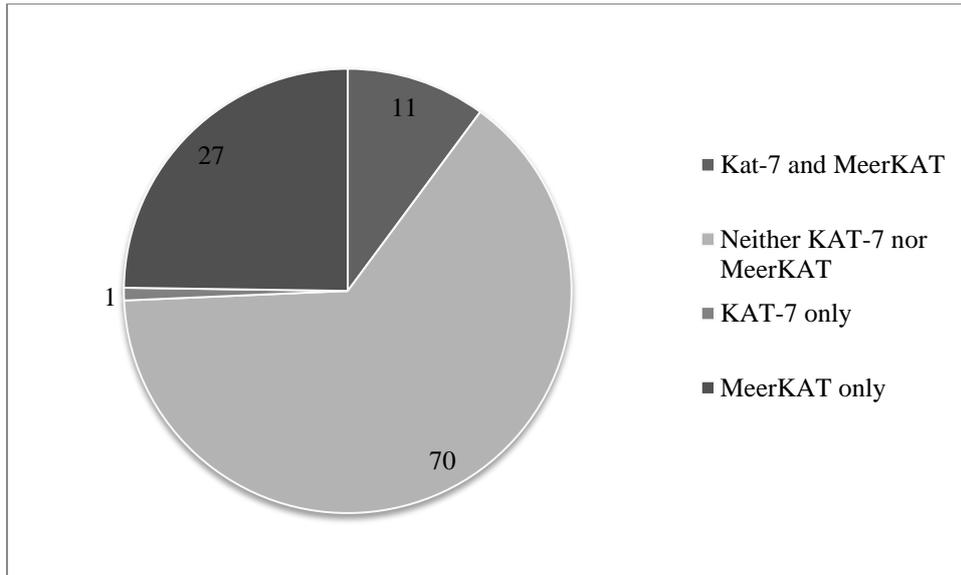
Elon Musk	Firm	1
EU	EU Gov	1
Intel	Firm	1
Marina Joubert	SKA	1
Microsoft	Firm	1
University of Manchester	University	1
University of Pretoria	University	1

Note: Actors from the ruling party (African National Congress) have been categorised in their state capacities, and as such within the SA Government (public sector) category

7.12.3. Precursors

Most of the English language coding variables for science and technology aspects of the SKA are interpretive, requiring some degree of qualitative assessment to identify science research questions or particular technological aspects of the project. However, references to precursor instruments are highly suitable for non-interpretive coding, as the terms KAT-7 and MeerKAT could be identified through automated text string searches. References to the precursor instruments show a similarity to the representations found in the English language sample (see Figure 16). In both cases, most of the sample did not make reference to the precursors (70% of the Afrikaans sample, 56% of the English sample), approximately a quarter made reference to both, followed by a smaller proportion making reference only to the MeerKAT. In both cases only a small fraction made reference only to the KAT-7. From this one could infer that the news value and journalistic utility of the precursors were greater for the English media than for the Afrikaans media. The reasons for this are difficult to deduce from the data, but may include the preferences of individual journalists or a proportionately greater focus on the SKA rather than its precursors.

Figure 19: references to the SKA precursor instruments in the Afrikaans sample (%)



7.12.4. Development context

Most of the coding variables associated with the SKA's development context are interpretive – they rely on a qualitative assessment of the text that associates it with a particular aspect of the project's development context. However, there are some variables that are suitable for non-interpretive coding, namely direct references to the towns closest to the SKA core site, as proxies for references to the project's local context and local impact. The data rendered by these codes again reveals a similar pattern across the two samples, with a slightly higher proportion of articles in the Afrikaans language sample making reference to both Carnarvon and to Williston. This suggests that on the whole the two samples made reference to the SKA's local context to a similar extent, although the Afrikaans sample paid somewhat more attention to this context. This is in line with analysis of the science journalism process, which highlighted that the Afrikaans press have played a more significant role in the local area of the SKA site.

Table 36: References to local towns (%)

	Afrikaans sample	English sample
Carnarvon	27	22
Williston	4	1

7.12.5. Reflections on the analysis of the Afrikaans media database

The Afrikaans language media content analysis provides basic comparative data with which to assess representations of the SKA in the media. The findings from this analysis are in alignment with the analysis of the role of the Afrikaans media in science journalism related to the SKA, but the media content analysis provides some additional contours to this analysis, as well as providing validation for selected findings from the English language analysis. *Die Burger*, as the source for the Afrikaans language content database, has published more extensively on the SKA than its English language counterparts – a finding in line with previous research into science journalism in South Africa (Van Rooyen, 2004). This is also in line with the hypothesis that the Afrikaans news media, operating in the dominant local language around the SKA site, would perceive relatively higher news value for the SKA, and thus produce relatively more related messages.

However, the overall pattern of publication over the course of the study's time-frame is similar to the English language sample. References to actors in the public sphere also show a similar pattern to the English language sample, although the Afrikaans press refer relatively less often to South African government actors, and relatively more often to SKA actors, indicating a different emphasis in representations of the project. In terms of science and technology, the only variables that were suitable for non-interpretive analysis were those for the precursors, which revealed that the Afrikaans press referred less often to the KAT-7 and MeerKAT precursors. Finally, as suggested by the findings of Chapter 6, the Afrikaans press focussed relatively more on the local context, as evidenced by relatively more frequent references to the local towns of Carnarvon and Williston.

7.13. The SKA as a symbol of globalised science in an African context in the news media

Within a Habermasian public sphere, the SKA can be seen as a 'science and technology movement' – with symbolic value that is socially constructed, in part through the news media. This is an essential element of Bauer's application of the notion of the public sphere to the field of science and technology in society (Bauer, 2002). The content analysis of news media outputs provides information that can help to understand this symbolic value, and together with previous chapters on science communication and science journalism, can, in the final analysis, provide insight into how this symbol is socially constructed.

One aspect of this symbolic value is that of the SKA as an *African* project. This value emerges clearly from the content analysis, in line with the suggestions of Gottschalk (2005) that, for public sector actors at least, the SKA provided a symbol of national prestige, affirmation of African science and technology capabilities, and a symbol of ‘soft power’ to the international community. While the overall dominant frame in the sample was that of the site bid, followed by the science and technology aspects of the SKA, within these dominant frames the SKA was in many cases also framed as an African project, and as a symbol of African science and technology. Sixty-eight percent of articles mentioned the African partner countries, and 43 percent framed the SKA explicitly as an African project (see Table 37). In addition, significant discourse was evident of the SKA as an affirmation of African as well as South African technological capabilities, and articles referred to external (global) perceptions of these capabilities as an indicator that the symbolic value of the SKA has reached a global public.

Several other aspects of symbolic value emerged from the grounded coding process. Smaller numbers of articles compared the SKA site bid to the 2010 football World Cup – thus by comparison establishing it as a symbol of national prestige and achievement on the global stage. This also arguably has broader associations, such as the bolstering of national unity. Some articles mentioned that the site allocation coincided with Africa Day (the 25th of May), thus associating the SKA with a symbol of African unity. Five articles specifically mentioned the growth in African astronomy as a broader issue, although only one article mentioned the historical perspective of astronomy in Africa, where it has been practiced for millennia. The notion of Afro-pessimism was raised, in all cases with reference to comments by Australian political figures that suggested that South Africa was not capable of hosting the SKA. In all such cases, the SKA was framed as a refutation of such Afro-pessimism. One example of the above discourses can be found in the quotation below:

But Africa would also have political purchase. A continent often written off as broken and doomed, and a backwater of scientific research is on the verge of landing one of the most important astronomical projects of the early 21st century. Much was said about last year’s Soccer World Cup as a blow to “Afro-pessimism.” The SKA could be a galvanising moment for its intellectual capital, self-confidence and prestige around the world. “I work in a world class field and now I can do it at home, I don’t

have to go overseas,” said Magnus, commissioning scientist at the Karoo Array Telescope (KAT-7), a prototype of the SKA. “If it comes to Africa, conversations will happen that never could have happened. “If you were to think about the way to impact people here with science, there’s no better way. Children already know there’s something big going on—it’s broadening their horizons. It’s very different from the daily toll of war, famine and poverty.”

Source: Appendix H P171: SA readies to host the most powerful telescope in the world 2011-09-15

Little explicit mention was made of the role of this symbol in the public sphere, although much was implied. In five articles, government actors encouraged the South African public to be supportive of the SKA, indicating a desire to leverage the politico-symbolic value of the SKA in the public sphere. Only a handful of articles explicitly mentioned public opinion internationally or in South Africa, and only two explicitly mentioned that the SKA may be associated with an enhanced public awareness of science in South Africa. However, looking beyond the codes specifically developed for references to the public sphere, a somewhat higher proportion (20 articles) referred to a ‘benefit’ that the SKA would attract more people to science and technology careers - thus implying increased public interest in science and technology.

Table 37: The SKA as a symbol of African science and technology

	% of sample
SKA framed as an African project	21
Affirmation of African S&T capabilities	10
Affirmation of South African S&T capabilities	9
External views of South African S&T capabilities	8
Africa as part of global S&T	7
Comparison to World Cup 2010	6
External views of African S&T capabilities	5
Africa Day	4
African growth in astronomy	2
Refutation of Afro-pessimism	2
Reference to Afro-pessimism	2

African astronomy historical perspective	0
TOTAL references to the SKA as a symbol of African science and technology	35

7.14. Discussion: news media representations of the SKA in the public sphere

The analysis of media content reveals the main contours of the manner in which the SKA is represented in the news media. Firstly, the analysis of dominant frames reveals a primary focus on the site allocation process, and a secondary focus on the science and technology aspects of the project – other ways of framing news stories about the SKA are much less common. However, framing is a complex process, and within these dominant frames, the SKA has also been framed as symbol of African science and technology achievement.

Key events in the periodization of the SKA have shaped the nature and intensity of coverage of the project. At the same time, institutional responses to key issues have shaped the locus of dominant frames. After the site allocation announcement in May 2012 there was a shift towards a broader range of dominant frames, moving beyond the site allocation and science and technology aspects of the project. The tone of articles was largely neutral or positive – only 7% focussed on the risks of the project without mentioning its benefits, highlighting the nature of the SKA as a ‘good news story’.

The most common sources of information were (quotes from) South African government (43%) and the SKA itself (42%), as well as indicated use of syndicated news feeds (41%). University scientists and firms play a relatively minor role, being quoted in only 8% of the sample. Other actors are marginalised – for example, only 2% of the sample quotes local stakeholders.

Representations of science research questions emphasise certain questions that appear to have greater news value – namely the Search for Extra-Terrestrial Intelligence (SETI) and ‘the origins of the universe’. Others, notionally equally or more important research questions, receive much lower levels of coverage – for example cosmic magnetism and the nature of gravity. This shows how news value, rather than scientific value, can influence the extent and focus of reporting on science research questions. Representations of technological aspects of the SKA were generally shallow – with most articles mentioning only one aspect of the

project's technology – although articles with science and technology as their dominant frame provided greater depth of coverage. References to the precursor instruments reveal a bias towards the South African precursors, with 37% of articles referring to the MeerKAT, 19% to the KAT-7, but only 6% to the ASKAP, the Australian precursor. The science outputs of the SKA have been drawn upon to frame the project as a South African and an African science and technology achievement

The Afrikaans media have played a key role in positioning the SKA in the public sphere. The Afrikaans language content analysis reveals that the Afrikaans press has published about the SKA relatively more often, has a slightly greater focus on the local context, and has a greater emphasis on SKA actors relative to South African government actors in its text references. These findings are in line with previous research indicating relatively greater science reporting capacity in the Afrikaans press (Van Rooyen, 2004) and the hypothesis that, as the predominant local language around the SKA, the Afrikaans medium would reflect greater news value and news outputs related to the SKA.

Chapter 8: Representations of the SKA in the social media: a Twitter feed analysis

8.1. Introduction

In the context of the notion of the public sphere (Habermas, 1989), Twitter fits more closely with the concept of ‘the conversations of the public’, where ideas and propositions are debated in an open environment. Thus, as observed by McQuail (2005:39), ‘the rise of the social media and other online channels of communication between individuals and society has broadened the scope and nature of “mass communication”.’ The emphasis here is on ‘broadening’ rather than ‘replacing’, as evidenced by Allgaier *et al.* (2013) and Peters *et al.* (2014), which argue that scientists continue to use the traditional news media more often than the social media, but perceive both of these channels to have a strong influence on the public sphere.

In Habermas’s conception of the public sphere, public matters were contested by institutions, as well as by private citizens, who engaged in the public sphere through the ‘conversations of the public’ (Habermas, 1989). These public conversations refer to a space that was central to Habermas’ first conception of the ‘public sphere’, as a notional space for deliberation and contestation over public matters that could be contested by public institutions as well as by individuals in their capacity as citizens. McQuail (2005:181) defines the public sphere as a notional space that is characterised by freedom of access, assembly, association, and expression – all of which are applicable to the space provided by the social media. At the same time, the social media undermine previously held notions of ‘mass’ in mass communication. McQuail (2005:57) defines a mass audience as being, *inter alia*, non-interactive and anonymous. However, the social media provide evidence that communication can reach large audiences while also being interactive and retaining identities.

Indeed, the space for such ‘public conversations’ has changed and grown as a consequence of the development of social media. The conversations no longer take place primarily in salons, between bourgeoisie males drinking tea. Of course, public conversations in this sense continue unabated, but through the social media they have also become globalised, codified, and integrated into other communications platforms. Thus, while Habermas’s notion of the public sphere has been criticised as ‘the idealising of a bygone and elitist form of political life’ (McQuail, 2005:182 quoting Curran, 1990), it seems as if this space has become less

elitist and has encountered a resurgence in the context of the social media. One advantage, however, with public interaction in the social media, is that conversations become measurable, making it possible to move beyond the discourse analysis of small samples, with the aim of teasing out analytical categories and latent frames, and moving towards the qualitative analysis of larger representative datasets that are available online. These factors have catalysed new interpretations of the social media using the conceptual tools of the public sphere approach, for example Fuchs (2014), which returns to the political economy aspects of the public sphere conception to critically engage with the role of the social media in society.

The analysis of representations of the SKA in the social media thus fill an important gap in the overall conceptual framework of this study, which in previous chapters has focussed on the traditional news media. The focus now shifts onto the social media, to better understand how ‘public conversations’ represent the SKA, and thus how the SKA is positioned in the public imagination. In this sense, the analysis reflects the shifting nature of mass communication, moving from audiences as media ‘receivers’ to audiences as media ‘users’ (Fourie, 2008: 101).

To take this further, the interactivity and identification that characterise the social media could be important drivers of their utility and growth. This implies a shift in the nature of structure and agency in the communication process. Fourie (2008:14) describes the analysis of structure and agency in terms of traditional media channels, a context in which media organisations play a structuring role, concentrating the production of messages into a small group of organisations. In the traditional news media individuals in the public have relatively little agency. However, within the social media, individuals arguable exercise more agency, and the structure in which this takes places is more dispersed. Again, this indicates a fundamentally different role for the social media within the public sphere. As noted by McQuail (2005:39), interactivity allows the public to play a greater role in message construction. However, at the same time, mass communicators have grown more sophisticated in their organisational and technological control of the mass media – including the social media. Overall, as noted by Singer (2006:265), the power of gatekeepers is diminishing in the modern information society, and the social media defy the notion of a ‘gate’ and challenge the notion that journalists or media organisations should play a gatekeeping role.

The outputs of the social media are conditioned by science communication and science journalism processes, but are also in part an emergent phenomenon, and a reflection of ‘public conversations’ in the public sphere. Large organisations and institutions continue to have voice in the social media – the evidence in this study illustrates that major media corporations have a dominant voice on the Twitter platform, to some extent perpetuating previous structures of media influence. However, in the social media, individuals share a more even platform with firms, and individual voices may also receive large audiences (as is also illustrated in this study). For example, Hall (2014) constructed a ‘Kardashian index’, with the aim of comparing the scientific presence of scientists (through citations) with the social media output of scientists (through Twitter followers), leading to an ongoing debate about a possible trade-off between these distinct profiles, the evidently lower social media profiles of women in science, and the disproportional representation in the social media of a small number of ‘science stars’ (http://news.sciencemag.org/scientific-community/2014/09/top-50-science-stars-twitter?utm_campaign=email-news-latest). Some of these individuals can make a significant impact on the social media on the basis of this high profile – for example, Neil deGrasse Tyson (astrophysicist) has over two million Twitter followers, and Brian Cox (physicist) and Richard Dawkins (biologist) each have over a million followers.

The study of social media outputs thus provides a meaningful counterpoint to the analysis of representations of the SKA in the news media. This chapter thus investigates representations of the SKA in the social media, with a focus on Twitter, one of the most prominent platforms for the social media. Twitter is an online social networking service, launched in 2006, that has since become one of the largest social media platforms globally. By 2012 the platform had over 200 million active monthly users, and in 2013 the firm listed on the New York Stock exchange for an initial valuation of \$31 billion. The core functionality of Twitter allows users to post status messages, known as ‘tweets’, that can be up to 140 characters in length. Users may ‘follow’ other users, which results in their tweets being directed to their Twitter accounts. Registered users may post tweets, and read those of others, but the general public may only read them. Users may propagate messages in a ‘viral’ fashion by forwarding the Tweets of others to their own followers, a process known as ‘re-tweeting’. This structure maintains the core function of the online social media, which is to connect users and allow them to exchange information on a selective basis. Twitter users can be individuals or organisations, which leads to a characteristically diverse social media environment, in which

individuals and organisations share a common media platform for the distribution of their messages to potential audiences.

The differences in structural composition between news media outputs and social media make direct quantitative comparison between the two datasets difficult. The average length of news media messages is far longer than twitter posts, which are limited to 140 characters in length. As such the average scale and scope of content is far smaller for each individual twitter post. At the same time, the number of items in the social media database is much larger – a sample of 1588 twitter posts (compared to 203 news articles in English and 71 in Afrikaans). For these reasons direct comparisons – for example the percentage of news articles that include a particular code and the percentage of twitter posts that include a particular code – are not valid. Such analysis therefore requires a degree of qualitative interpretation of patterns in each data set.

This analysis of social media outputs begins with an examination of the overall scale of outputs over time, and hypothesised causes of changes in outputs in relation to key events in the periodisation of the SKA project. This is followed by an analysis of social media data flows and network properties – for example the outputs of key contributors to the social media discourse and an analysis of message propagation through ‘re-tweeting’ activities. Having established the main parameters of the data set from an information flow perspective, the next section focuses on representations of key actors and messages. This is followed by analyses of representations of science and technology, the SKA as an organisation, policy, governance, and funding, and symbolic aspects of the SKA. The three main controversial issues associated with the project, namely the site allocation, development context, and fracking, are also explored.

8.2. Periodisation and changes over time

Representations of the SKA in the social media are clearly influenced by aspects of the project’s periodization. This influence is broadly similar to that evident in the news media sample, suggesting that similar drivers may determine the composition and volume of messages available in the social media on the one hand and the news media on the other.

Similarly to the news media outputs, the number of tweets referring to the SKA remained relatively low in the early months of the sample's timeframe, indicating a low level of interest in the social media during the period September to December 2011. Following a low point in December, outputs increased steadily in the early months of 2012, leading to a first peak in output in March 2012, when there were 188 Tweets, and a second, larger peak in May 2012 (see Figure 20), when there were 817. If one excludes these two months, the average per month is 58.3. The peak in March exceeds three times this average, and the peak in May exceeds fourteen times this average. These peaks mark clear aspects of periodization – the site allocation announcement was expected in March, but was then postponed. This triggered an increase in social media activity. When the site allocation decision was announced on the 25th of May, it triggered a spike in social media coverage that exceeded the sum of all the coverage of the other twelve months in the year under investigation. A closer look at the data reveals that of the 817 Tweets in May 2012, 528 were sent on the 25th of May, the day of the site allocation announcement. This 'spike within a spike' represents the high point of the SKA's presence on the Twitter platform, in line with what can be seen to be the most significant announcement and the highest level of news value to emanate from the project during this period.

Another vector associated with social media coverage of the SKA is the density of the networks attached to social media messages. In other words, looking at the number of followers reached by Twitter feeds. Since the data include the number of followers for each tweet, totals can be constructed for each month. This renders data that shows a similar pattern to that of the overall number of tweets - a relatively stable level of coverage with peaks in March 2012 and May 2012 (see Figure 21). However, another way to establish the density of a social media network with respect to a particular topic is to look at the ratio of followers to each Twitter post, and how this changes over time. If the ratio increases, it means that the messages are entering denser communication networks, and thus achieving proportionally greater visibility in the social media. The dataset makes it possible to calculate the average number of followers per tweet, broken down by month. This reveals an interesting pattern – the communication networks that mention the SKA grow denser over time. In other words, over the course of the year under investigation, the Twitter accounts that were sending out messages about the SKA tended to have larger number of followers, and were therefore more network-dense. This is indicated by a linear function derived from the data in Table 38 and illustrated in Figure 22. This suggests that the topic of the SKA gained traction in the sphere

of the social media, in that it was mentioned in increasingly dense social networks over the course of this period.

Table 38: Twitter coverage of the SKA

	Tweets	Followers	Ratio of followers to Tweets
September 2011	53	66679	1258,09
October 2011	42	34246	815,38
November 2011	56	31291	558,77
December 2011	17	6842	402,47
January 2012	58	56678	977,21
February 2012	89	126590	1422,36
March 2012	188	325583	1731,82
April 2012	73	126061	1726,86
May 2012	817	1381089	1690,44
June 2012	57	75013	1316,02
July 2012	68	134670	1980,44
August 2012	70	109072	1558,17
Total	1588	2473814	1557,82

Figure 20: Tweets September 2011 – August 2012

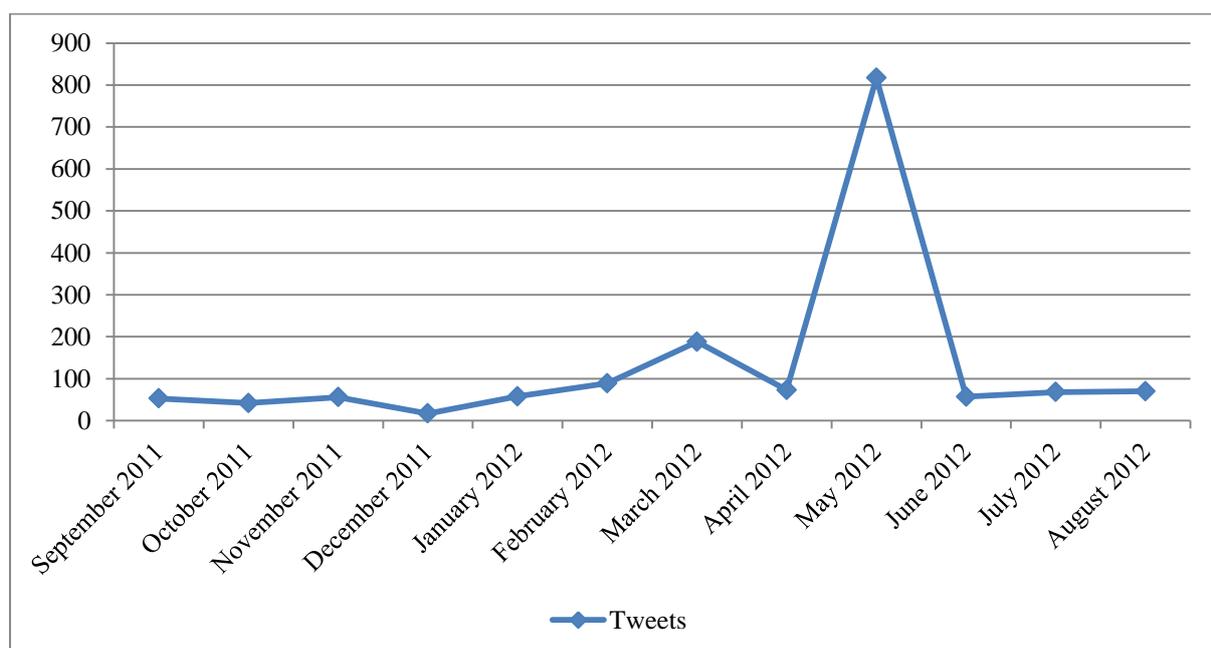


Figure 21: Followers reached: September 2011 – August 2012

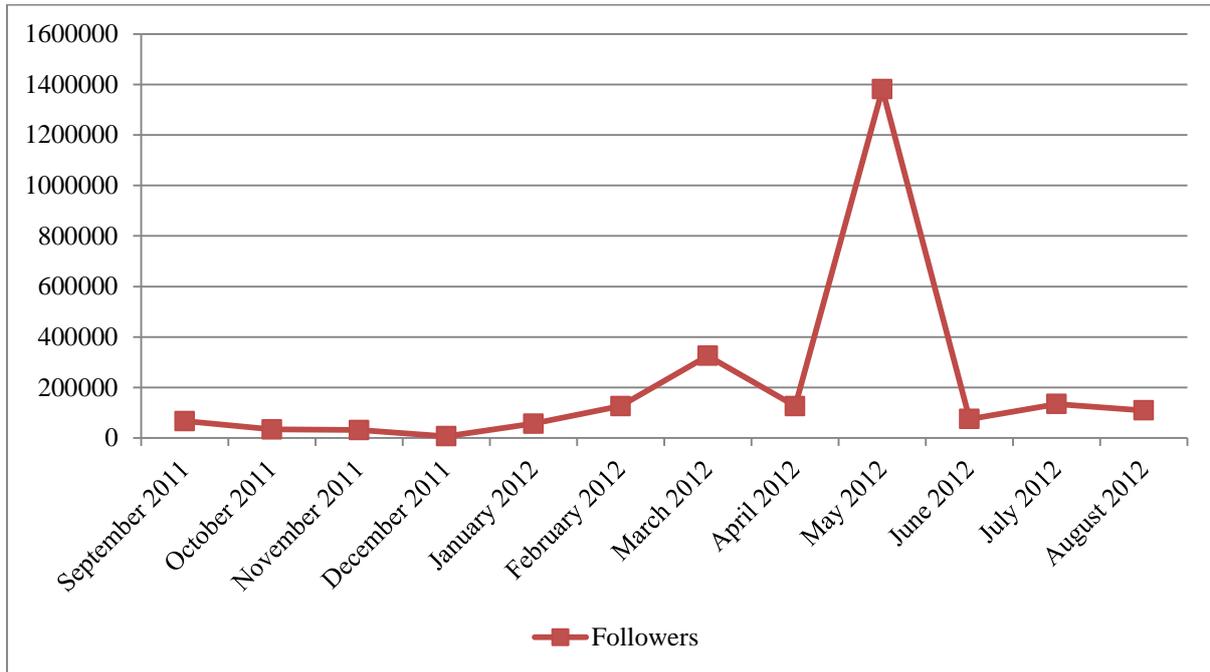
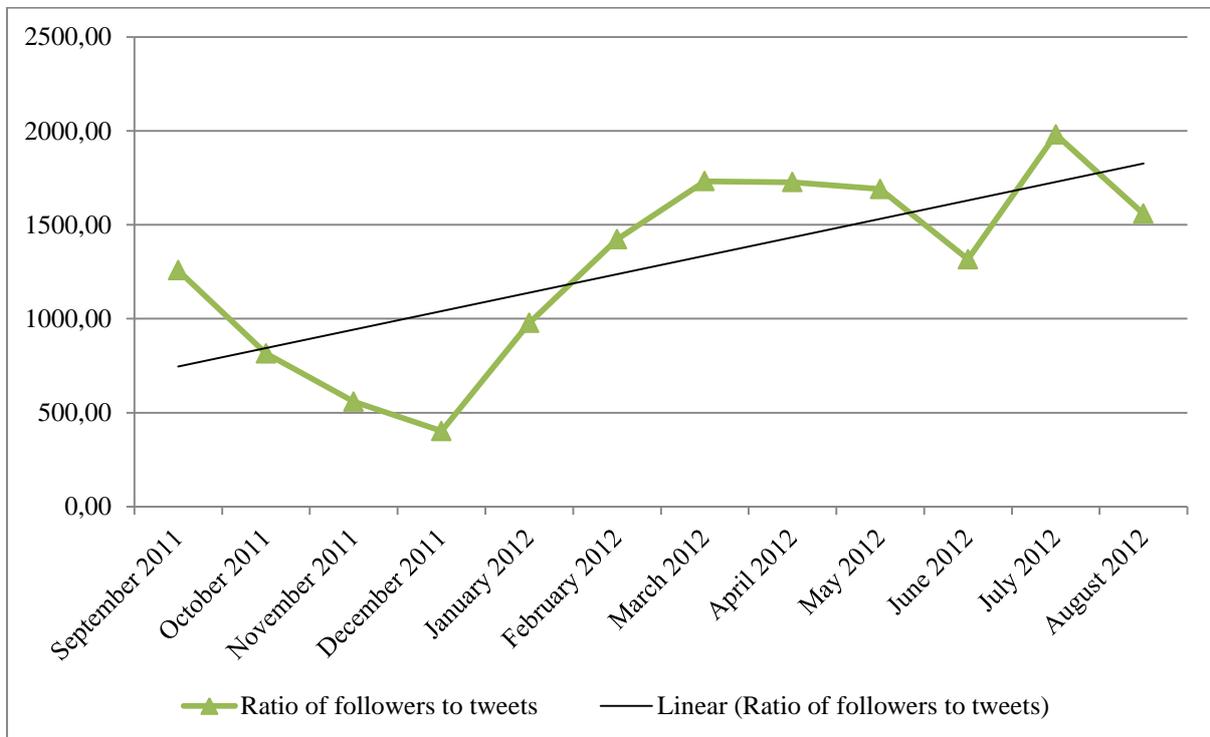


Figure 22: Ratio of followers to Tweets: September 2011 – August 2012



8.3. Actors

The analysis of representations of actors in the social media has a broadly comparable scope to that employed in the analysis of news media outputs. The initial list of actors developed both inductively and deductively for the analysis of news media outputs was also applied to the social media database. The coding process used text searches to identify where specific actors were mentioned, and this was followed by a manual coding process, which identified instances where non-standard spellings or references to actors were used.

Most of the Twitter posts in the sample did not mention specific actors other than the SKA. This is in line with the nature of the Twitter post, which allows 140 characters to express a short message – in most cases, this short message did not include a specific actor. The SKA as an organisation is of course referred to in each of the tweets, but this metric was established to mention references to specific individuals or components of the organisation. The percentage of posts that refer to specific actors is thus lower than the news media sample. However, the data does allow an analysis of which actors are referred to most frequently, which provides an indication of their prominence in the discourse related to the SKA and hence in the public sphere. Table 40 lists these main actors, citing all actors that were mentioned in the sample.

As in the news media analysis, these actors can be grouped by type, in order to illustrate which of the main sets of social actors are associated with the SKA in the social media. Table 39 provides a high-level summary of these representations. The most commonly mentioned actors were those from the public sector, primarily from the DST. The two most commonly referred to individuals, Derek Hanekom and Naledi Pandor, were both from the DST. Other South African government actors included parliament, Jacob Zuma, Julius Malema, the NRF, and provincial governments. Interestingly, both Zuma and Malema were mentioned more frequently than Bernie Fanaroff – perhaps an indication of the extent to which popular voices pay attention to leadership issues related to the SKA. The second most commonly referred to set of actors were those from European governments – this group consists largely of references to the AERAP (the African-European Radio Astronomy Partnership) and references to the EU in general. This is a result of a proactive social media strategies and campaigns by European actors, which led to regular social media posts being made, and retweeted, throughout the year under review.

Specific individuals from the SKA were mentioned 44 times. Senior management were amongst the most commonly referred to actors, including, Justin Jonas, Jasper Horrell, and Bernie Fanaroff. Other individuals within the SKA, including South African and international management and scientists, as well as Marina Joubert, the science communication consultant for the SKA in South Africa, were also mentioned, but less frequently. Science facilities were mentioned in 41 tweets – primarily referring to the HartRAO. This is a consequence of a social media campaign conducted by HartRAO. Only one mention was made of the SALT facility and one of the SAAO. Internationally, three references were made to the Large Hadron Collider (LHC) at CERN, all in the context of comparing the SKA to this large-scale basic science research project.

Universities and research institutes received relatively little attention, being mentioned in only 30 and 13 Tweets respectively. The most commonly mentioned university was Rhodes University, followed by University of Cape Town (UCT) and the University of Stellenbosch, and only one mention each of the University of the Witwatersrand (Wits) and the Durban University of Technology (DUT) respectively. The most commonly referred to research institute was ASTRON (which also was highly active on Twitter during this period). Less commonly mentioned were the Max Planck Institute, and the Council for Scientific and Industrial Research (CSIR). Firms were mentioned only 21 times, with the most commonly mentioned firm being IBM, followed by Intel, Shell, Denel, EMSS, Space-X, and SASOL. Elon Musk, the South African-born entrepreneur behind the multinational firms PayPal, Space-X, and Tesla, was mentioned twice. Only two Tweets mentioned an African public sector actor (the AU). Overall, thus, the evidence highlights that, along with the SKA itself, South African government actors are most prominently associated with the SKA, and all other actors trail significantly behind.

Given the focus on the SKA in the social media, a brief analysis of the messages mentioning the main SKA individual actors (Justin Jonas, Jasper Horrell, and Bernie Fanaroff) is presented below. This analysis shows how micro-level determinants related to individual actors can have a major impact on the scale and scope of messages that are posted into the social media, and subsequently propagated virally through re-Tweets. ‘Micro-determinants’ here refers to the influence of third parties or external events, for example appearances on other media platforms, conferences, symposia, or endorsement by popular personalities or organisations.

Justin Jonas

The most commonly referred to individual within the SKA is Justin Jonas, who is a professor at Rhodes University, specialising in radio astronomy, and also Associate Director: Science and Engineering at the SKA. Jonas was mentioned in 17 Tweets. A closer look at this set of Tweets reveals that the majority (14 of 17) are related to ‘TedxRhodesu’, an independently organised Ted Talks event (<http://tedxrhodesu.com/>) that took place in August 2012 – after the site allocation was announced. This underscores the potential of different social media platforms to interconnect and reinforce the popularity of messages. Most of the remaining messages (3 of 4) stem from an interview with *News Now* in January 2012, during the run-up to the site allocation decision. The tone of the messages related to Jonas is largely positive, mounting a challenge to Afro-pessimism, and also focussing on the social context of the SKA, looking at ‘War, Poverty and Radio Astronomy’.

Jasper Horrell

Jasper Horrell is the General Manager: Science, Computing, and Innovation, and thus plays a key role as one of the SKA South Africa’s senior management team. Horrell was mentioned ten times in the Twitter database. Again, there is a micro-determinant factor behind these representations – nine of the ten messages originate in a posting from an ICT symposium, Gartnersym (<http://www.gartner.com/technology/symposium/orlando/>). This again illustrates that, in the absence of a social media strategy and campaign, representations of particular actors become determined by micro-level social media activities of external individuals and organisations.

Bernie Fanaroff

Bernie Fanaroff has been Project Director of the SKA in South Africa since its inception, and is the most senior manager of the SKA in Africa. Surprisingly, while Fanaroff is mentioned more often than Jonas in the mainstream news media, he is mentioned less often on Twitter. Of the seven mentions detailed, four are related to Tweets and re-Tweets from Simon Gear, a television weather presenter, environmental consultant, and public commentator on environmental issues (<http://www.sdgconsulting.co.za>). Since Gear, as a public personality,

has a relatively large number of followers (2145), these Tweets achieved a relatively high level of public visibility. Interestingly, on the 25th of May, at the high point of media attention to the SKA, only one tweet mentioned Fanaroff. This illustrates, again, that representations in the social media are a reflection of the extent to which actors engage with the social media, and of social media micro-determinants, rather than the significance of the roles that individuals or organisations play in the SKA.

Table 39: Representations of actor types in the social media

Actor type	Total
SA Government	180
EU Government	51
SKA	44
Science facilities	41
University	30
Firm	21
Research institute	13
African Government	2

Table 40: Actors referenced in the Social Media sample

Actor	Total	Actor Type
Naledi Pandor	64	SA Gov
Derek Hanekom	59	SA Gov
EU	42	EU Gov
HartRAO	36	Science facilities
DST	19	SA Gov
Justin Jonas	17	SKA
Rhodes University	15	University
parliament	14	SA Gov
IBM	10	Firm
Jasper Horrell	10	SKA
AERAP	9	EU Gov
Jacob Zuma	9	SA Gov
Julius Malema	8	SA Gov

ASTRON	8	Research institute
Bernie Fanaroff	8	SKA
UCT	7	University
Universitty of Stellenbosch	4	University
African VLBI network	3	SKA
Intel	3	Firm
Max Planck Institute	3	Research institute
African Union	2	African Gov
Brand South Africa	2	SA Gov
CSIR	2	Research institute
Elon Musk	2	Firm
Large Hadron Collider	2	Science facilities
Michiel van Haarlem	2	SKA
NRF	2	SA Gov
provincial government	2	SA Gov
SAAO	2	Science facilities
Shell	2	Firm
Adrian Tiplady	1	SKA
Cjiekella Premier of the Northern Cape	1	SA Gov
Claude Carignan	1	University
Denel	1	Firm
DUT	1	University
EMSS	1	Firm
John Womersley	1	SKA
Kurt van der Heyden	1	SKA
Marina Joubert	1	SKA
SALT	1	Science facilities
Sasol	1	Firm
Sergio Colofrancesco	1	University
SpaceX	1	Firm
Wits	1	University

8.4. Information flows: Tweets and re-Tweets, organisations and individuals

Re-tweets are indicators of the viral propagation of a message – its propensity for being perpetuated within the Twitter platform. The data provided by SAASTA include data identifying re-tweets of each message, which makes it possible to quantify and analyse the extent to which original twitter posts were further propagated through the social media. There are however some limitations to the data in this respect. Twitter users that are based outside of South Africa, such as *The Economist* and ASTRON_LOFAR, were not included in the SAASTA database as they had not registered their Twitter accounts through a South African domain. Thus, although they had evidently created Twitter posts related to the SKA, these can be considered part of the international social media, rather than the ‘South African’ social media. Such a distinction is artificial in the context of globalisation, but was required as a data parameter in order to set an objective criterion for delimiting the scope and size of the database. However, the re-tweets of these users’ posts are included, where these re-tweets have been posted by South African actors. In such cases, the data illustrates how the South African social media have propagated messages originating from international sources within the national media, and hence the South African public sphere. This does however also constitute a limitation to the data, as some South African organisations have their Twitter accounts registered internationally through proxy or intermediary services, and therefore also do not appear as users in the SAASTA database.

Table 41 summarises the available information for all users who were re-tweeted 5 or more times. This provides a rich data source for understanding the contours of social media messages related to the SKA, including data describing users, actors, tweets, re-tweets, followers of tweets, followers of re-tweets, the ratio of re-tweets to tweets, and the ratio of audiences from tweets and re-tweets. The data are ordered according to the total number of followers reached by each user – but alternative ways of organising the data are analytically useful too.

Figure 23 shows users that have been re-tweeted, in order of audience size, which is in turn divided into the direct audience (those who received tweets from the user) and the indirect audience (who received re-tweets). The largest audiences are reached by large mainstream privately owned media firms, namely News24, TimesLIVE, and *Business Day*. Together, messages from just these three users reached 902 708 other users. This serves as an indication

of the integration of media platforms, with the large media firms controlling the news media market also having developed effective systems to penetrate the social media too.

A stark contrast is evident when comparing the audience composition of the SKA and the main media firms. While media firms have a direct audience forming the majority of their total audience, the SKA's audience consists almost entirely of an indirect audience. The SKA's messages therefore have a far greater propensity to be re-tweeted and propagated further across the social media landscape. The SKA is thus an outlier in the dataset, with a ratio of direct to indirect audience of 24,1, in comparison to between 0 and 3.5 for all other users. This means that for each user reached by a tweet from the SKA, on average 24.1 users were reached by re-tweets of that message. This is also evidence that an organisation with a well-directed social media strategy and implementation can reach a large online audience and compete with the corporate media to attract the attention of the public. Another example is that of HartRAO, which also has a relatively strong presence in Twitter, with 40 tweets and 18 re-tweets, reaching an audience of 58 191 users – a considerable reach for a relatively small radio astronomy facility.

Although the corporate media reach the largest audiences, and messages from the SKA have the greatest relative impact, there remains considerable space for individuals to have their voices heard. The only individual journalist to feature in this data set is Sarah Wild, tweeting in her personal capacity, but also in her capacity as a science journalist, and one of the leading science journalists covering the SKA. While the size of her audience is small in comparison to the corporate media, she does illustrate that an individual science journalist can make an impact in the social media. Another point of entry for individuals is open for those in influential positions. Derek Hanekom, who during the time period of the study was the Deputy Minister for Science and Technology (he was to take over as Minister in October 2012, shortly after the end of this study window period) was highly active on Twitter, while, in contrast, the Minister of Science and Technology, Naledi Pandor, was not active on Twitter. The data clearly illustrates the effect that such direct engagement with the social media can have. Hanekom is the second most re-tweeted Twitter user, after the SKA organisation itself. His four tweets during the year under review reached a total of 24 541 direct followers. In addition, re-tweets of these messages reached a further 33 650 followers. As such, the four tweets reached a total of 58 191 followers. These examples illustrate the substantial reach that Twitter posts can achieve for such high-profile individuals.

Overall, however, the majority of the most widely dispersed messages are produced by organisations rather than individuals. This shows that the social media, while introducing a greater degree of public participation and agency in the construction of messages, remains a channel of communication for organisations and institutions, and to this extent retains structural characteristics that may resemble more traditional media (as suggested by McQuail, 2005:39).

Figure 23: Twitter users and their audiences via Tweets and re-Tweets

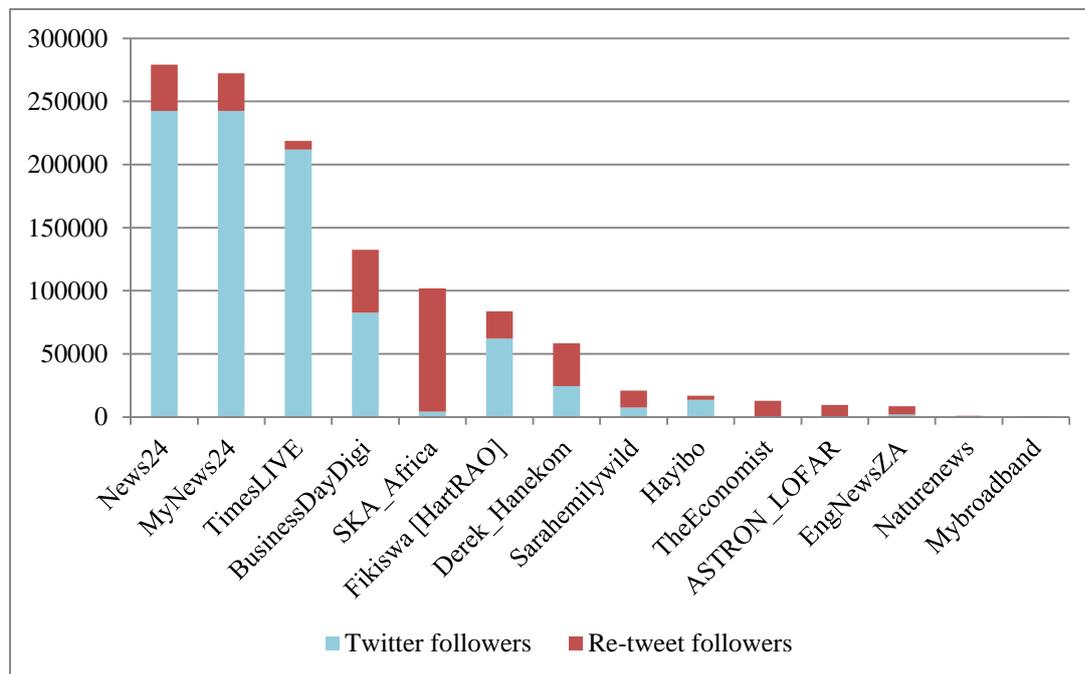


Table 41: Re-Tweets and message propagation

User	Actor	Tweets	Re-Tweets	Twitter followers*	Re-tweet followers**	Total followers#	Ratio of Re-Tweets:Tweets	Ratio of RE-Tweet audience:Tweet audience
News24	Media	2	6	242429	36845	279274	3,0	0,2
MyNews24	Media	2	9	242429	29820	272249	4,5	0,1
TimesLIVE	Media	8	17	211903	6894	218797	2,1	0,0
BusinessDayDigi	Media	8	22	82569	49819	132388	2,8	0,6
SKA_Africa	SKA	40	96	4057	97649	101706	2,4	24,1
HartRAO	Science facility	40	18	62181	21399	83580	0,5	0,3
Derek_Hanekom	GOV	4	37	24541	33650	58191	9,3	1,4
Sarahemilywild	Media	14	6	7549	13207	20756	0,4	1,7
Hayibo	Media	1	13	13496	3314	16810	13,0	0,2
TheEconomist	Media	0##	28	0	12718	12718		
ASTRON	Research Instit.	0##	13	0	9613	9613		
EngNewsZA	Media	1	8	1868	6616	8484	8,0	3,5
Naturenews	Media	0##	6	0	963	963		
Mybroadband	Media	0##	5	0	533	533		

*Calculated using the sum of followers for each tweet; ** Calculated using the sum of followers for each re-tweet; #Calculated using the sum of followers for Tweets and re-Tweets; ## Original tweets made from outside South African domain or outside the study time-frame

8.5. Science and technology

8.5.1. Science

As can be seen in Table 42, science aspects of the SKA were infrequently referred to. Approximately ten percent of the sample (167 tweets), made some reference to science. In 140 characters that may comprise a tweet, the focus thus appears to have been elsewhere – primarily in expressing a point of view about the site bid or the site allocation announcement. This suggests that, on the Twitter platform, that the SKA as a whole, as made more controversial and contested through the site allocation process, has captured the public discourse to a greater extent than the specific science aspects of the project.

The large majority of these were references to science in general (for example ‘a great science project’). Only 32 tweets, or about 2% of the sample, made reference to specific science aspects of the SKA. In some tweets, the SKA was compared to other large science projects, such as the Hubble telescope and the Large Hadron Collider at CERN. Five tweets referred to the Mitra science projects, all re-tweets of a single post from SKA South Africa. Of the main science research questions of the SKA, only the SETI question and the question of the origin of the universe received any coverage, with 5 and 2 tweets respectively mentioning these questions. Their (relative) prominence in the social media matches their relative prominence in the news media, where these were also the most commonly referred to science research questions – tentatively suggesting that media assessments of news value and gatekeeping processes resulted in the construction of messages that are aligned with the interests of the public, as represented on the Twitter platform.

Table 42: Reference to science aspects in the social media

	TOTALS:
<i>General science reference</i>	<i>135</i>
<i>Specific science reference</i>	<i>32</i>
Physics	14
Mitra	6
Research question: SETI	4
Comparison to LHC	2

Astrophysics	1
Comparison to CERN	1
Comparison to Hubble	1
Cosmology	1
MeerKAT research project: LADUMA	1
PAPER project	1
Research question: origins of the universe	1
TOTAL tweets mentioning science aspects	167

8.5.2. Technology

A smaller proportion of the tweets in the sample (144) made reference to technology, although this included more frequent references to specific technology aspects (88), of which ICTs and the receiver dishes were the most commonly mentioned (48 and 47 respectively). These representations are broadly similar to those made in the news media, where ICT aspects and the receivers and dishes were also the two most prominent technology aspects of the SKA, again indicating a correspondence between news media and social media outputs.

Table 43: References to technology aspects in the social media

	TOTAL:
<i>General technology reference</i>	63
<i>Specific technology reference</i>	88
Dish receivers	47
(ICT total)	48
ICT general	20
ICT data	12
ICT data transfer and bandwidth	11
Aperture arrays	10
ICT software	4
Telescope capabilities	3
Calibration	1
ICT processing power	1
RFI mitigation	1

ROACH board	1
South African innovation	1
TOTAL tweets mentioning technology aspects	144

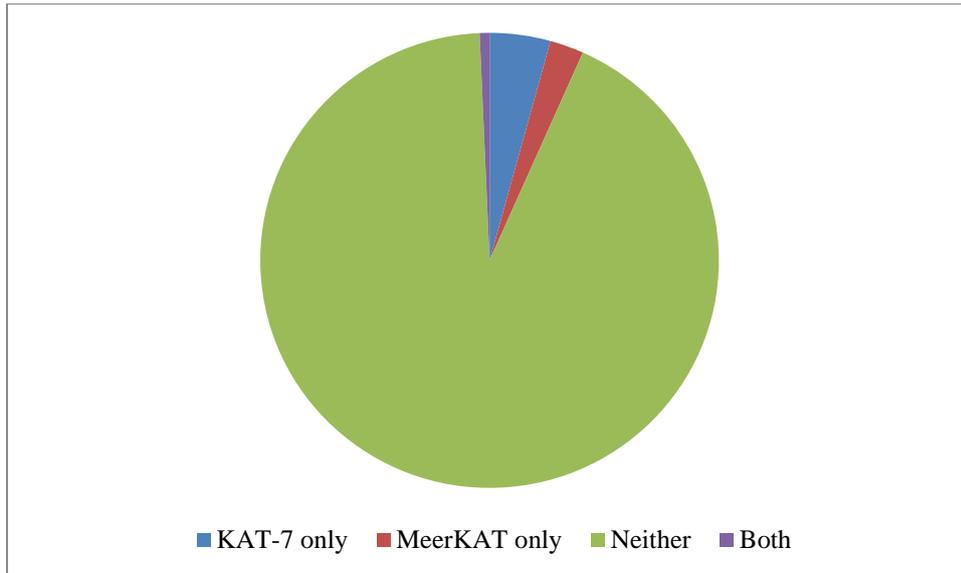
8.5.3. Precursors

The precursor instruments received a similar level of coverage to technology aspects of the SKA, being referenced in 143 Tweets, or about 9% of the sample. Within this sub-set, the KAT-7 was mentioned almost twice as often as the MeerKAT, and 15 tweets made specific reference to science outputs from the KAT-7.

Table 44: References to precursor instruments in the social media

	TOTALS:
KAT-7 text reference	79
KAT-7 science results	15
MeerKAT text reference	49
TOTALS articles with reference to precursors	143
KAT-7 only	68
MeerKAT only	38
Neither	1471
Both	11

Figure 24: Reference to precursor instruments in the social media



Overall, the science and technology aspects of the SKA were addressed in the social media in general terms, rather than through references to specific science and technology aspects, including the precursor instruments. This may be a function of the short space available in a tweet – in 140 characters the emphasis was in most cases on other issues, and primarily on the site allocation.

8.6. The SKA organisation

In the social media content database, the SKA is framed by the competition with, and later collaboration with, Australia and New Zealand. A total of 328 tweets (21%) made reference to Australia, while 90 (6%) made reference to New Zealand. Far smaller proportions mentioned other partner countries, including African partner countries. Only three tweets mentioned that the SKA is headquartered in the UK, indicating that this fact receives little public interest. Three tweets referred to the founding of the SKA organisation, and four contained recruitment messages from the SKA itself, making use of the Twitter platform in its capacity development efforts. The representations of the SKA that emerge from the social media are thus of an African project, rather than a developed country project with an African infrastructure site. The developed country headquarters are almost omitted from the discourse, and the Australian infrastructure site is framed as being a smaller and less significant component of the project. This again underscores the SKA as a symbol of African science and technology in a global context.

Figure 25: References to organisational aspects of the SKA in the social media

	TOTALS:
Australia	328
New Zealand	90
Global partner countries	27
African partner countries	23
Partner country China	16
Recruitment message	4
Jodrell Bank	3
Organisation founding	3
TOTAL tweets mentioning SKA organisational aspects	391

8.7. Funding, policy and governance

Issues of funding, policy and governance were peripheral in the social media. Only 70 articles, or 4% of the sample, made reference to issues of funding. The majority of these were to the monetary value of the project, with other funding aspects being peripheral. Only 11 tweets making reference to policy or governance issues. The most common reference was to the VAT exemption granted to the SKA, followed by the Astronomy Geographic Advantage Act.

Table 45: References to funding aspects in the social media sample

	TOTALS:
Monetary value of the project	54
Funding (general)	8
Funding and investment	4
Funding role of firms	2
Funding for MeerKAT	1
Funding for VLBI	1
TOTAL tweets mentioning funding aspects	70

Table 46: References to policy and governance aspects in the social media sample

	TOTALS:

VAT exception	11
Astronomy geographic advantage act	5
For radio astronomy	1
TOTAL tweets mentioning policy and governance aspects	17

8.8. Controversy and contestation

8.8.1. Site allocation

The site allocation process for the SKA infrastructure is the dominant issue referred to in the social media. More than 52% of the sample (873 tweets), made reference to the bidding process, to the split-site decision, or to some other aspect of the site allocation process. In the months preceding May 2012, the bidding process was a dominant theme, accounting for 366 Tweets. From the date of the site location announcement (25 May 2012), reactions to the split site allocation were dominant, occurring in 446 tweets.

The split site allocation was a contentious issue, and the tone of these responses was recorded and coded. Most of the responses were neutral in tone, comprised mainly of the sharing of news or information. Of those that did register a tone in relation to the announcement, most were positive (87) and only a few were negative (14).

Table 47: References to the SKA site allocation in the social media database

	TOTALS:
Site bid	366
Reaction to split site decision (total)	446
Reaction to split site decision neutral	345
Reaction to split site decision positive	87
Reaction to split site decision negative	14
Competition with Australia	63
Recommendation of the scientific committee in favour of SA	60
Sport metaphor	29
Delay	11
Possibility of split site outcome	7

Good conditions at SA site	6
Leak by the <i>Sydney Morning Herald</i>	3
Comparison to football World Cup	2
Australian reference to 'sympathy vote'	1
TOTAL tweets with reference to the site allocation	873

8.8.2. Fracking

The fracking controversy received only a small fraction of the coverage received by the site allocation process, thus positioning this as a marginal issue in the overall representations of the SKA. A total of 21 tweets mentioned fracking, 10 of which framed fracking as essentially in opposition to the SKA project, and the other 11 taking a neutral position. There were no pro-fracking statements in the sample. Only one tweet mentioned the moratorium that was imposed on fracking prior to the site allocation announcement.

Table 48: References to fracking in the social media

	TOTALS:
Controversy fracking	21
Fracking as oppositional to the SKA	10
Fracking moratorium	1
TOTAL tweets mentioning fracking	21

8.8.3. Development context

The development context of the SKA was also a peripheral issue in the social media. Only 15 tweets made explicit reference to the role of astronomy in a developing country context, and these largely consist of references to Justin Jonas's appearance on a TED Talks online lecture on this topic. The sample made very little reference to the site locality, with only three tweets mentioning Carnarvon, and none mentioning any of the other nearby towns. Fifty-five tweets mentioned its location in the Karoo, but without any further comment on any related development issues.

Table 49: The development context in the social media

	TOTALS:
Karoo text reference	55
Astronomy in developing countries	15
Northern Cape text reference	7
Carnarvon text reference	3
Astronomy in Africa	1
Williston text reference	0
TOTAL tweets referencing the development context	81

8.9. The SKA as a symbol of globalised science in an African context in the social media

The main preoccupation with the site bid and site allocation of the SKA positioned the project as a symbol of African science and technology. However, this framing was in most cases latent, for example as expressed by positive responses to the site allocation by South Africans. Comparatively few tweets made explicit symbolic references, totalling only 128 tweets, or about 8% of the sample. Thirty-three tweets explicitly framed the SKA as an African project, while smaller proportions referred to the SKA as a validation of African and South African science and technology capabilities. Some reactions to topical issues were more common, for example references to Africa Day, which coincided with the day that the site allocation announcement was made. Interestingly, the tweets did not have a historical orientation – only three posts mentioned any aspect of the project’s historical or political context.

Table 50: The SKA as a symbol of African science and technology in the social media

	TOTALS:
Framed as an African project	33
Reference to Africa Day	28
Reference to controversial Zuma art	24
Validates African capabilities	18
Reference to Lion's share	10
Astronomy in Africa	8
Explicitly refutes Afro Pessimism	6
Affirmation of SA capabilities	5

Historical and political context	3
External views of Africa	2
TOTAL tweets mentioning politico-symbolic aspects	128

8.10. Discussion: social media representations of the SKA in the public sphere

Representations of the SKA on the Twitter platform are influenced by aspects of the project's periodization in a manner broadly similar to that evident in the news media, revealing generally low levels of coverage throughout the study time period, with a smaller peak occurring in March 2014 and a large spike, accounting for the majority of the sample, in May 2012. This suggests that both the social media and news media have a common set of news values and drivers that lead to this distribution of coverage – in this case this seems to be a common reaction to the key news events related to the SKA's site allocation. The issue of the site allocation was by far the most prominent theme, being referred to by more than half of the sample. The response to the split site allocation of the SKA infrastructure was largely positive (87 Tweets), with only a minority (14 Tweets) voicing a negative response.

The 'viral' nature of the social media appears to have played a role in propagating messages about the SKA. Firstly, the social networks through which these messages have travelled grew denser over time, indicating a growing propensity for individual messages to reach larger audiences. Secondly, the role of re-tweets has been central.

The most commonly mentioned actors in the social media database were the South African Department of Science and Technology and European public sector agencies – prominently the AERAP (the African-European Radio Astronomy Partnership). The latter is a result of an online social media campaign that saw the regular dissemination of messages into the Twitter online platform by the AERAP organisation. Another example of a successful social media campaign is that of HartRAO, which also reaches a relatively large number of users through regular postings on Twitter.

On the other hand, the data make it clear that individuals, particularly those that hold senior positions in main actors, retain a high level of agency and may make a significant impact on the social media – for example, Derek Hanekom's four tweets reached an audience of

approximately 60 000 users. By contrast, Bernie Fanaroff, the most senior manager within the SKA in South Africa, received far fewer mentions, as he did not directly engage the social media through Twitter. Even on the critical day of the site allocation announcement, Fanaroff was mentioned only once in the 528 tweets sent on that day.

This again illustrates the balance of structure and agency that characterises Twitter and the social media more broadly, and which is in this case applied to communication about the SKA. References to the most prominent individuals from the SKA (Justin Jonas, Jasper Horrell, and Bernie Fanaroff) were strongly influenced by micro-determinants that shaped the propagation of related messages through the social media, illustrating how factors such as personal engagement with Twitter, uptake in other media segments, media events, and endorsement by third parties can greatly increase the reach of messages.

The balance between the voices of large organisations and individuals is again apparent when one investigates the flows of information that characterise the dataset. This reveals that the largest audiences are reached by large privately owned media firms. However, this does not imply that other organisations, or individuals, are rendered voiceless. The messages sent by the SKA have a far greater propensity to be propagated further across the social media landscape (in comparison to messages from other actors), and as a result they have reached a comparatively large audience. HartRAO, a relatively small radio astronomy facility, has reached a relatively large audience through active engagement on Twitter. High-profile individuals, for example Derek Hanekom, can reach large audiences, even with only a handful of Twitter posts. One of the leading science journalists covering the SKA, Sarah Wild, also reached a substantial audience. The social media, in this case Twitter, thus remains a public sphere, in the Habermasian conception, in that individuals may engage on a more or less even platform to publically debate issues in their civic capacities.

The science and technology aspects of the SKA were addressed in the social media in general terms, rather than through references to specific science and technology aspects. This may be a function of the short space available in a tweet. Of the science research questions of the project, only the SETI question received more than one mention – again establishing this as the most prominent research question of the project in the popular imagination. References to specific technology aspects of the SKA were also infrequent, with a focus on the dish receivers and ICT aspects.

The SKA, as an organisation, is largely represented as an African project, rather than a developed country project with an African infrastructure site, and as a validation of African and South African science and technology capabilities. This again underscores the SKA as a constructed symbol of African science and technology achievement.

Chapter 9: The stars in our eyes: the SKA as a socially constructed public symbol of globalised science in an African context

In closing, this chapter undertakes a broader reflection on the communication processes behind representations of the SKA in the media, as well as of the outputs of those processes. This reflection takes into consideration the main theoretical approaches towards mass communication and science communication, with a focus on the public sphere heuristic as developed by Bauer (2002), in line with the overarching conceptual framework of this study.

9.1. The SKA as a case study of mass communication

The case study of the mass communication process which took place in the run-up to and in the final allocation of the SKA to South Africa and Australia provides an opportunity to reflect on the manner in which this communication fits with commonly accepted definitions. The evidence suggests that communication through the news media adheres to conventional definitions of mass communication (e.g. McQuail, 2005:56), showing the characteristics of the mass distribution and reception of messages, uni-directional flow of information, an asymmetrical and calculative or market relationship between communicator and audience through an impersonal process, and standardised content. However, this is not the case with regards to the social media, as measured through the analysis of Twitter feeds. The social media allow broader public participation, and shift the notion of audience from media ‘consumers’ to media ‘users’, as expressed by Fourie (2008:101). This results in a more interactive engagement with the public, as pointed out by McQuail (2005:39).

This is arguably part of a gradual movement towards a more open public sphere. However, in line with Allgaier *et al.* (2013) and Peters *et al.* (2014), traditional media channels continue to be commonly used by SKA scientists, in parallel with the social media engagements. It is evident that, with respect to representations of the SKA, the large media corporations that control the majority of the news media channels are also the source of the majority of messages in the social media – reinforcing the notion of media integration and increased sophistication of media organisations to operate in both traditional media channels and new media channels. In line with Fuchs (2014), this opens the possibility of these corporations using their position of power to undermine the openness of the public sphere.

The notion of the ‘mass media’ as an institution, as defined by McQuail (2005:58), as well as the notion of an ‘audience’, as defined by McQuail (2005:57) and Fourie (2008:101) apply to the news media, but do not apply fully to the social media. In both cases, however, media integration means a clear distinction between the two is false, and that mass communication, the mass media, and media audiences can be more accurately imagined as integrated institutions characterized by flows of messages through both the traditional and the social media.

9.1.1. Structure and agency

The SKA as a case study also allows a reflection of the interaction between structure and agency in the communication process. As outlined by Fourie (2008:114), these two aspects are inter-related and can exist in tension. The messages about the SKA that enter the public sphere through the South African media are constructed by social actors through a complex network of co-ordinated science communication structures, in which there are also spaces for individual agency at selected points. Firstly, internal communication structures exist in all the main actors, including the SKA, universities, and government agencies. These structures condition the construction of messages through a variety of mechanisms, both formal and informal. Gatekeeping functions (as explored more fully below) are active in the surveillance, selection, and culling processes that allow messages to enter the public sphere with institutional approval – and these are largely constructed according to the strategic and tactical orientation of each organisation. In this sense, communication related to the SKA is highly structured.

However, there are positions within the system where individuals maintain a high level of agency with respect to engagement with the media. University-based scientists maintain a level of academic freedom that allows them to engage independently with the media. Also, scientists and engineers within the SKA are mandated to communicate with the media within the bounds of their area of expertise. Journalists and editors also exercise a considerable degree of agency with regards to story selection.

In the social media, as represented by Twitter, there is a higher level of agency for individuals, who are free to post any information online, although powerful actors, including the dominant media corporations, as well as other actors such as the SKA and research

institutes, continue to exert influence and structure upon message construction. Nonetheless, the voices of individuals can be powerful, for example those of Derek Hanekom, then Minister of Science and Technology, and Sarah Wild, science editor of the weekly paper, the *Mail & Guardian*. Overall, the evidence suggests that the social media, in this case Twitter, remain public sphere in the Habermasian conception, in that individuals can engage on a more or less even platform to publically debate issues in their civic capacities.

Due to a generally high level of alignment across the main actors in terms of strategic requirements for communication and the tactical and operational aspects of message construction, there has not been a great deal of tension between aspects of structure and aspects of agency. The main exception here has been the reportedly ongoing struggle by science journalists to advocate for increased coverage of science – including of the SKA. News publications have poorly developed internal structures and capabilities for processing science news, and this exists in tension with the desire of science journalists to move their stories through internal media gatekeeping processes into the public sphere. Here the core of the tension is over perceptions about news value – where science journalists aim to convince gatekeepers that their stories have news value for the public, and gatekeepers adopt a conservative position, which considers science to have relatively low news value. This suggests that a greater engagement with the evidence in this regard (e.g. Reddy *et al.*, 2012) would be of utility in helping to resolve this tension.

9.1.2. Social responsibility theory of the press

The social responsibility theory of the press has played a central part in the evolution of mass communication theory since the publication of Siebert *et al.* (1956). However, the theory has also been seen as outdated (McQuail, 2005:172). In the case of the SKA, issues of social responsibility, at least with regards to the communication of the SKA, have not emerged as significant features of either the communication process or media outputs. Key actors are reportedly largely concerned with their own strategic interests, with the aim of positioning the SKA in the public sphere accordingly. Key informants did not report a desire to frame the SKA in a manner which took account of issues of social responsibility as conceived by Siebert *et al.* (1956). This is, however, distinct from a common concern for the social responsibility of the SKA project *per se*, which was a significant feature in both the communication process and the resultant outputs.

This finding could perhaps be explained by the largely non-contentious nature of the SKA. The project does not challenge political authority or corporate interests, and is therefore not a strong candidate for challenge or censure by either public or private actors. At the same time, the main communication actors have no interest in factually misrepresenting the SKA. Thus, there are no major forces acting against media freedom or accurate reporting, and the SKA, at least with regards to issues of the social responsibility of the media, does not occupy a strongly contested terrain.

9.1.3. Gatekeeping and news value

Processes of gatekeeping play a key role in construction of media outputs related to the SKA. This is largely aligned with the core propositions of the gatekeeping literature (e.g. Shoemaker and Vos, 2009). Outside of the news media, gatekeeping functions tend to exist at the apex of organisations, including the SKA, the DST, and the NRF. Lower-level gatekeeping functions also exist within the science communication structures within each of these actors, which are largely hierarchical, with gates at each level of the hierarchy. Within universities, gatekeeping occurs more often at a more devolved level – largely under the control of individual academics and departments.

In the social media, gatekeeping theory has less application. Indeed, the evidence supports the view of Singer (2006:265), who argues that the social media defy the notion of a ‘gate’, in that there are few limits on what messages can or should enter the social media. Although some non-media organisations, for example the SKA organisation and public sector actors, do impose gates to the provision of content for the social media, most organisations do not have such gates, and the general public are free to generate messages on social media platforms, including Twitter.

The most significant arena for gatekeeping is the news media. Evidence of gatekeeping in the news media indicates that it is initially driven by news value, which is the main criterion by which news editors assign editorial space to stories about the SKA. Other criteria which affect gatekeeping are institutional culture, organisational attributes, and the personal decisions of journalists and their editors. Science journalists undertake surveillance with a view to identifying stories about the SKA with the greatest news value. They then undertake

a selection process, which results in stories which they perceive to have the greatest news value being selected for passing through the initial gate of the science journalist. Each journalist uses his or her own sense of news value and story interest to select particular aspects from the spectrum of possible stories to construct about the SKA. Editors within the news media make further culling decisions, also largely on the basis of news value, but also conditioned by institutional culture and by personal preference, in line with the propositions of DeFleur and Dennis (2002).

There are several clear examples of this process in the evidence. Of the six main science research questions of the SKA, the question of SETI occurs far more often in media messages than the other research questions. The topic of SETI is perceived to have greater news value than other science research questions, even though it may take a lower priority from a scientific point of view. This also illustrates how news value, rather than scientific value, can influence the extent of science reporting.

Another example is that of the site allocation process. This was perceived by science journalists as having a high level of news value, as it included discourses of competition with Australia, national prestige, and international controversy. This has become attached to strongly patriotic discourses, such as those normally employed for national sporting rivalries. Science communicators reported a spike in media attention at the time of the site allocation announcement, and this increased media attention is clearly reflected in the media content analyses – to the extent that it is evidently the most significant driver of changes in the overall intensity of message production (i.e. the number of news articles and Twitter posts) as well as the dominant frame of messages.

By comparison, aspects of the SKA project that might be seen to be vital from an operational point of view, such as international collaboration over technical parameters and funding agreements, received relatively little coverage, and were also seen by science journalists to lack news value. On the other hand, the overall monetary value of the project was commonly, albeit briefly, mentioned (in 48% of the news media sample, and 54 tweets in the social media sample), indicating that the sheer size, in financial terms, of the project has significant news value.

Another aspect of news value may be the politico-symbolic value of the SKA in the public sphere. Both in terms of process, and in terms of outputs, it is clear that that SKA has become a symbol of African science and technology achievement, a symbol of African participation in globalized science, and a validation of African capabilities in science and technology. This politico-symbolic value has shaped the construction of messages by key actors, the news value of messages as perceived by journalists, as well as the generation of social media content by the broader public and institutions. In all cases, this has acted as a driver for the production of generally positive messages that frame the SKA as an African project and as a symbol of science and technology achievement for Africa and South Africa.

9.2. The SKA as a case study of science communication

The SKA, as a case study of science communication, fills several gaps in the literature on science communication, namely an absence of studies of representations of science in an African context, a relative lack of studies of representations of science in the online social media, and a lack of studies of representations of astronomy in the media (Schäfer, 2012). In concluding the study, these gaps are returned to, and the manner in which they have been filled is expressed in more detail.

9.2.1. Astronomy in the media

The literature on science communication is often concerned with controversial science topics, such as genetic modification and climate change. Madsen (2001) suggests that astronomy is not, *per se*, a controversial science topic, and is thus less subject to contestation in the media. The evidence for this study, however, shows how an astronomy project can indeed include aspects of controversy. In the case of the SKA, it is not the scientific or technological aspects of the project that have been controversial, but rather the specific issue of site allocation. However, unlike controversies related to topics such as genetic modification and climate change, the controversy does not entail contestation between interest groups in the national public sphere. Instead, there has been a focus on the site allocation as a controversial issue in the international public sphere, in which the South African media have largely provided messages in support of the South African site bid, and sought to position the SKA in the global public sphere in a manner that contests the site allocation with Australia.

9.2.2. Science journalism in South Africa

The context of science journalism in South Africa, as described by science journalists reporting on the SKA, is in line with that described by Claassen (2011a), and Van Rooyen (2004). Science journalism is seen to be a marginalized area within the news media, and science journalists must routinely advocate for editorial space, and deal with the challenges of weak institutional structures for science journalism, constrained capacities of editors and journalists to engage with science content, and the perception of weak news value for science stories. It therefore evident that, as argued by Claassen (2011a), South African news media organisations have a systemic bias against science news coverage, as conceived by Soroka (2012). This results in generally low levels of science news coverage, and challenges for journalists seeking to publish stories about the SKA.

9.2.3. The Afrikaans language media

The Afrikaans media have played an important role in positioning the SKA in the public sphere, particularly in the communities surrounding the SKA infrastructure site, in which Afrikaans is the predominant language. Media content analysis shows that the Afrikaans news media have published about the SKA relatively more often, perhaps as a result of relatively greater capacity for science journalism, as suggested by Van Rooyen (2004). The Afrikaans news media sample revealed a slightly greater focus on the local context, and a greater emphasis on SKA actors relative to South African government actors. However, the periodisation of Afrikaans-language media outputs was generally similar to the English language media, indicating broadly similar drivers behind the production of messages about the SKA.

9.2.4. Relationships between scientists and journalists

The extant literature on the relationship between scientists and journalists has identified this as a relationship that is often problematic (e.g. Royal Society, 1985; Nelkin, 1995; Claassen, 2011a), characterized by occurrences of miscommunication, conflicting roles, and strained relationships. However, in the case of the SKA, relationships between SKA scientists and journalists were generally positive and trust-based, with only occasional accuracy issues. Scientists and science communicators have developed a network of science journalists with

whom they work, underpinning by informal and personal relationships. Similarly, public sector actors and university-based scientists have cultivated small networks of trusted science journalists with whom they regularly engage. Since the number of science journalists in South Africa is small, the main journalists are all well known to the main institutional science communicators. The positive relationships with journalists can thus be attributed to the strategic cultivation of long-term trust-based relationships.

Another explanatory factor is the ‘good news’ nature of the SKA as a story and as a symbol, which aligns the incentives of journalists and scientists in terms of how the SKA is framed and represented in the media. Journalists view the ‘achievement’ of the SKA to have news value, while scientists have an incentive to frame the SKA in this manner too. The case of the SKA therefore suggests that, given the right circumstances, the relationship between scientists and journalists can be less problematic, more aligned, and characterized by greater levels of mutual trust and cooperation.

9.2.5. Tone

The tone of media outputs was largely neutral or positive. Only a small minority of the news media sample (7%) focussed only on the risks of the project and not on the benefit. In the social media sample, the response to the split site allocation of the SKA infrastructure was largely positive. Overall, the SKA has been thus been framed as a ‘good news story’.

9.2.6. Representations of science and technology

Representations of the science aspects of the SKA are clearly driven by news value, for example the relative focus on the SETI research question. In the news media, representations of technological aspects of the SKA were generally shallow, with most articles mentioning only one aspect of the project’s technology. References to the precursor instruments reveal a bias towards the South African precursors, with 37% of articles referring to the MeerKAT, 19% to the KAT-7, but only 6% to the ASKAP, the Australian precursor. The science outputs of the SKA, specifically those emanating from the KAT-7 instrument, have been drawn upon to frame the project as South African and an African science and technology achievement. In the social media, references to science and technology aspects were infrequent (10% of the

sample). In the short space (140 characters) available for a Twitter post, the focus was generally on the site allocation rather than the science and technology.

9.3. The SKA in the public sphere

Bauer (2002) conceives of the public sphere as a system in which actors, positioned in relationships with each other, interact to produce messages about public matters, and thus influence public opinion, public policy, and the perceptions and decisions of private actors. This actor-network approach has provided a useful analytical tool for understanding the communication processes behind representations of the SKA in the media. The overall structure of this actor-network system, representing actors, interactions, and communication structures relevant to the public sphere, is summarized in Figure 7.

9.3.1. Communication structures, information flows, and systemic alignment

Within an actor-network operationalization of the notion of the public sphere, the SKA as a case study provides some insights into how messages are constructed by social actors. In this regard, it is useful to draw on the concepts of information theory, as pioneered by Shannon and Weaver (1949), including insights about sources of information, the transfer of information, and receivers of information. For the news media, the most significant source of information is the SKA itself, primarily through the channels of the SKA's science communicators and through personal relationships with scientists and senior management. This highlights the importance of the SKA's own science communication efforts in positioning itself in the public sphere. Universities and public sector actors were usually secondary sources of information gained mostly through formal institutional communication channels. However, the most commonly quoted actors in the news media sample were the South African government (43%) and the SKA itself (42%), indicating that the SKA provides a greater proportion of contextual information, while government actors receive prominence in terms of quotations. Syndicated news feeds were also an important source of information for news media outputs, being used by 41% of the sample. University scientists and firms play a relatively minor role, and other actors are marginalised – particularly local stakeholders, who were only quoted in 2% of the sample.

One of the key findings with regards to the science communication of the SKA is the high level of alignment across actors, including the SKA itself, as well as public sector actors and universities. This includes alignment of incentives, objectives, communication structures (both formal and informal, both codified and tacit), and information flows. The main actors outside the media all face the strategic imperative to position the SKA in the public sphere in a manner that will grow public support and support amongst key stakeholders. The senior leadership of each of these actors maintains close personal and institutional relationships that facilitate co-ordination across actors, and of the communication system as a whole.

At a lower level, there is intensive collaboration through well-developed organizational linkages across the science communication strategies and structures in each of these actors. The SKA, at the international level, has a detailed a formal communication strategy, while in South Africa the strategy is tacit and applied, but broadly understood. These strategies explicitly aim to position the SKA within the public sphere, with the main objective of growing financial, political and public support amongst stakeholders and the general public. The communication strategy of the South African project office of the SKA is focused on the South African public sphere. This necessitates the balancing of multiple mandates to local and international stakeholders, as well as the imperative of seeking public support. The main features of the South African strategy are the focus on milestones as opportunities for media engagement, and the establishment of gatekeeping functions at the level of senior management, particularly regarding messages related to sensitive issues of funding and politics.

Universities and government actors have no specific codified strategy for communicating about the SKA, but this falls under the broader rubric of their institutional communication strategies. All the universities in the sample host an internal communications function that provided resources and structures for communication activities, primarily focused on connecting scientists and the media, rather than providing information to the media directly. University-based scientists work on SKA science and engineering projects, and thus take on dual roles. This establishes close operational links between the SKA and universities, including both formal and informal communication linkages. Like the other actors, the main motivation for university-based scientists and science communicators is to better position their institutions in the public sphere, and thus focus on positive and low-risk messages about the SKA.

Government actors also aim to positively position the SKA in the public sphere, in this case with a focus on the justification of public expenditure. The DST, the main source of information from the public sector, has explicitly framed the SKA as a national science and technology achievement that places South Africa on the global scientific stage. The relationship between the DST's communications function and the SKA's communications function is central to the communication of the SKA, particularly with respect to the exchange of information and the co-ordination of media outputs and activities.

9.3.2. Politico-symbolic value in the African context

The African context of the SKA has a significant effect on the manner in which it is framed in the media. As communicators within key actors aim to strengthen the position of the SKA in the public sphere, and as science journalists respond to their perceptions of news value, they position the project as a symbol of 'globalised science in an African context', framing it in terms of skills development, technological progress, inspiration for the youth, and improved international perceptions of African and South African scientific and technological capabilities. The SKA is not represented as a 'Western' project, but rather as an international project with a focus on Africa, and as a part of the 'global scientific and technological frontier', as expressed by Fagerberg and Verspagen (2007), Martin (2008) and Alder (2010).

The analysis of communication processes and media outputs supports the views of Gottschalk (2005), which posits that astronomy in South Africa has a politico-symbolic value in the public sphere, and that this has led to a high level of political support, manifested in funding and policy support for astronomy and the SKA. This politico-symbolic value of the project is leveraged in the public sphere by science communicators from the main actors, and most strongly by government actors. These actors frame the SKA as an African project, as a validation of African science and technology capabilities, as a refutation of Afro-pessimism, and as evidence of African membership of the global scientific and technological community. The SKA, as an organisation, is largely represented as an African project in which South Africa has leadership, rather than a developed country project with an African infrastructure site. The developed country headquarters are almost omitted from the discourse, and the Australian infrastructure site is framed as being a smaller and less significant component of the project. These framings are clearly evidenced in news media outputs, as well as social

media outputs, suggesting that the SKA also occupies these frames in the broader public imagination too.

9.3.3. Conflict and controversy in the public sphere

The overall dominant frame of media representations of the SKA in both the news media and the social media was that of the site allocation process, with a secondary focus on the science and technology aspects of the project. Other frames were much less common. After the site allocation announcement in May 2012, a shift occurred in the framing of the project, with a decrease in dominant frames related to the site allocation, and a corresponding diversification into other ways of framing the project, including skills development and science and technology aspects. Other controversies related to the SKA, namely the possibility of shale gas fracking, and issues related to the development context, received relatively little coverage in the news media and the social media.

The site allocation announcement was a watershed moment for science journalists reporting on of international rivalry between South Africa and Australia. The focus shifted away from the theme of international rivalry between South Africa and Australia, which in period prior to the announcement provided a high level of news value, and shifted onto the science and engineering aspects of the project, as well as a broader set of themes and frames. This created a challenge in terms of making these aspects of the project more accessible to the public, and advocating for space in the news media. This may be an explanatory factor for the decline in overall news media and social media outputs related to the SKA subsequent to the site allocation announcement.

9.4. Concluding thoughts

This study has addressed critical gaps in the literature by hopefully providing novel insights into the construction and output of media messages representing a case study of globalized science in an African context. By drawing on mass communication theory and science communication theory, it has been possible to model communication processes and outputs using a conceptual framework of the public sphere, conceived as an actor-network model.

The SKA is a milestone in the history of science and technology in Africa and in South Africa. On a continent that is often constructed in the media as a scientific and technological laggard, the SKA has been framed as a symbol of African scientific and technological achievement. This has been the consequence of a high level of alignment of strategies, incentives, and communication structures across the main actors in the communication system, as well as the galvanization of discourses that have supported South Africa in its international rivalry with Australia, which has formed a proxy discourse for issues related to African prestige, capability, and pride. As is the case with international sporting rivalry, a South African victory, however partial, has captured the public imagination, generated news value, and countered discourses of Afro-pessimism. The impact of the SKA on the public imagination, and the public sphere, is clearly far wider and deeper than only its science and technology accomplishments and contributions.

Appendices

Appendix A: Questionnaire template for interviews with journalists

Organisational profile:

- Name of organisation:
- Media sub-sector(s):
- Size of organisation:
- Size of their public/readership:
- Demographics of their public/readership: language, geographical range, age, race, income, gender, etc.:

The following questions refer to the science communication process as related specifically to the SKA:

The internal science communication process:

- What are the main sources of information related to the SKA?
- How do you undertake surveillance for this information?
- Do you use syndicated news-feeds? Are these local or international?
- What criteria are used to select media outputs related to the SKA for publication?
- What aspects of the SKA would you consider to have ‘news value’?
- What media outputs related to the SKA does your organisation generate? For example, is the focus on the science, the technology, the politics, the funding, the skills, the impact on the local site, etc?
- Are messages in each of these areas normatively positive and/or negative? To what extent, and driven by what determinants?
- What process is followed to produce these representations? At what points are ‘gatekeeper’ functions relevant to this process? Who decides what content is chosen for publication?

- Are there any particular controversies related to the SKA that you have covered in media outputs?

Role of science actors:

- Could you characterise your relationships with scientists in general?
- How have scientists influenced the way you have produced media outputs related to the SKA?
- Is there a difference in your engagement with SKA-based scientists and scientists based at universities, Science Councils, and other research institutes?
- Is there a difference in your engagement with South African and foreign scientists?
- How do you think the relationship between journalists and scientists could be improved with respect to the mass media communication of the SKA?

Role of government actors:

- Is there any role of government policy or regulation in shaping media outputs related to the SKA?
- Have you engaged with the national Department of Science and Technology?
- Have you engaged with any other government departments or agencies?
- How do you think the relationship between journalists and government could be improved with respect to the mass media communication of the SKA?

Role of economic actors:

- Do any of the following economic actors influence the way your organisation represents the SKA in the media:
 - The SKA organisation
 - Media companies
 - Companies that are suppliers to the SKA
 - Other companies
- What is the role of advertising, marketing, lobbying and PR firms in shaping these messages?

Role of other actors:

- Are there any other influences on the way in which you have represented the SKA in the media?

Open ended question: any other pertinent issues that are relevant to the science communication of the SKA?

Appendix B: Questionnaire template for interviews with scientists

Organisational profile:

- Name of organisation:
- Department/School/Division:
- Position:
- Research field:

The following questions refer to the science communication process as related specifically to the SKA:

Scientists' role in the communication process:

- Can you characterise your relationships with journalists in general?
- Have you ever engaged with a journalist or media organisation in relation to the SKA?
- Can you characterise this relationship?
- Have you supplied information about the SKA to a journalist or media organisation?
 - What has been the nature of this information?
 - How was this information selected?
 - Was this information accurately represented by the journalist?
- How do you think the relationship between journalists and scientists could be improved with respect to the mass media communication of the SKA?

Role of other actors:

- Has the government, through any of its departments, agencies, policies, or regulations, influenced the way in which you participate in the science communication of the SKA?
- Have any companies or corporations influenced the way in which you participate in the science communication of the SKA?

- Are there any other influences on the way in which you have played a role in the communication about the SKA in the media?

Open ended question: any other pertinent issues that are relevant to the science communication of the SKA?

**Appendix C: Additional questionnaire for journalists submitting written responses:
sources of information**

SOURCE	USED? HOW?
The SKA	
SKA senior management and scientists	
SKA website	
SKA Twitter feed	
SKA press releases	
SKA international office	
SKA communication manager	
SKA science communicator (Southern Science/ Marina)	
SKA events	
SKA African partner countries	
Universities	
University communications office	
University-based scientists	
SARCHi chairs	
Scientific journals	
Public sector actors	
DST	
CSIR	
Other government actors	
NRF	
Private sector actors	
Firms	
Media actors	
Twitter	
Google alert	
Science alerts	
Syndicated news feeds	

Other journalists	
-------------------	--

Appendix D: Media content analysis coding system

Actor Adrian Tiplady

Actor AERAP

Actor African Renaissance Fund

Actor African VLBI network

Actor ASTRON

Actor Astronomy Desk DST

Actor AU

Actor BAE systems

Actor Berkeley

Actor Bernie Fanaroff

Actor Brand South Africa

Actor Caltech

Actor Carnarvon local stakeholders

Actor Caroline Zunckel

Actor China as strategic partner

Actor Chris Evans

Actor Cisco

Actor Derek Hanekom

Actor DOME

Actor DST

Actor DST SARChI chairs

Actor DUT

Actor Elon Musk

Actor EMSS

Actor EU

Actor firms

Actor Google

Actor HartRAO

Actor IBM

Actor Intel

Actor Jacob Zuma

Actor Jasper Horrell

Actor Jocylyn Burnell
Actor John Womersley
Actor Junita Klopper-Lourens (DA)
Actor Justin Jonas
Actor Katherine Blundell
Actor Large Hadron Collider
Actor local farmers
Actor Marina Joubert
Actor Michael Gaylard
Actor Michael Kramer (Max Planck Institute)
Actor Microsoft
Actor Miller Matola
Actor Naledi Pandor
Actor NASA
Actor NASSP
Actor New Zealand
Actor Nithaya Chetty
Actor NMMU
Actor Nokia-Siemens
Actor NRAO
Actor NRF
Actor Oxford
Actor Phil Diamond
Actor Phil Mjwara
Actor Rhodes University
Actor Rob Adam
Actor Saalex Galileo
Actor SALT
Actor SANSA
Actor Sasol
Actor Shell
Actor Stratosat Datacom
Actor Tshepo Seekoe
Actor Tshwane University of Technology

Actor UCLA

Actor UCT

Actor UFS

Actor UKZN

Actor UNISA

Actor University of Manchester

Actor University of Mauritius

Actor University of Pennsylvania

Actor University of Pretoria

Actor UWC

Actor Val Munsami

Actor Vishnu Vejjala

Actor Willem Esterhuyse

Actor Wits

August 08 2012, 08:21

Author Duncan Alfreds

Author Kalvin Kemm (nuclear physicist)

Author Keith Campbell

Author Pippa Green

Author Sarah Wild

Benefits attract international skills

Benefits attract people to S&T careers

Benefits foreign direct investment

Benefits inclusive information society

Benefits increase public awareness of science

Benefits job creation

Benefits showcase SA S&T capabilities

Benefits skills development

Benefits skills development (bursary schemes)

Benefits socio-economic development (general)

Benefits strengthen SA S&T capabilities

Benefits technological spin-offs

Challenges funding

Challenges skills development

Challenges telecommunications in the local area
Controversy SAAO Phil Charles disciplinary action
Development context astronomy in developing countries
Development context Carnarvon economic growth
Development context Carnarvon expectations
Development context Carnarvon local skills development
Development context Carnarvon property prices
Development context Carnarvon text reference
Development context Karoo
Development context limitations to development impact
Development context local economic development
Development context negative impact on local communities
Development context Northern Cape text reference
Development context Williston
Fracking as a potential threat to the SKA
Fracking benefits
Fracking moratorium
Fracking not yet certain whether fracking will pose risks for SKA
Fracking opposition between SKA and oil companies
Fracking risks
Fracking role of the Astronomy Geographic Advantage Act
Fracking SKA as a a safeguard against local fracking
Frame African S&T achievement
Frame development context
Frame fracking controversy
Frame funding and investment
Frame public policy
Frame SA S&T achievement
Frame sci tech & eng
Frame site site bid and site location
Frame skills development
Funding by the South African government
Funding contribution by Australian government
Funding contributions of partner countries

Funding implications of split site allocation
Funding international supply chain competition
Funding local tenders
Funding monetary value of the project
KAT-7
KAT-7 science research results
MeerKAT
MeerKAT capabilities
MeerKAT funding
MeerKAT observation booked up in advance
MeerKAT research projects
Mitra
Policy Astronomy Geographic Advantage Act
Policy government support (general)
Policy Strategic Infrastructure Programme
Policy VAT relief for SKA
Public sphere government encouraging public support
Public sphere international media and public opinion
Public sphere public awareness of science
Public sphere public opinion
Quote actor from SKA SA
Quote Adrian Tiplady
Quote ANC
Quote ANC press release
Quote Australian government actor
Quote Bernie Fanaroff
Quote Bob Carr
Quote Brian Boyle (Australian SKA)
Quote Carnarvon local stakeholder
Quote Caroline Zunckel
Quote Chris Evans
Quote Claude Carignan
Quote DA
Quote Daphne Lekqwathi SKA SA outreach leader

Quote David Block
Quote Derek Hanekom
Quote DST
Quote firm actor
Quote government actor national government
Quote government actor provincial government
Quote IBM firm actor
Quote Jacob Zuma
Quote Jasper Horrell
Quote Jocelyn Burnell
Quote John Womersley
Quote Juanita Kloppers-Lourens (DA)
Quote Junita Kloppers-Lourens (DA)
Quote Justin Jonas
Quote Katherine Blundell (Oxford)
Quote LJ Du Toit EMSS
Quote Michael Kramer (Max Planck Institute)
Quote Michiel van Haarlem
Quote Miller Matola (Brand South Africa)
Quote Mjwara
Quote Nadeem Oozeer SKA scientist
Quote Naledi Pandor
Quote Naledi Pandor RE SMH leak
Quote Nithaya Chetty
Quote NRF spokesperson
Quote Phil Diamond
Quote Phil Mjwara
Quote research institute scientist
Quote Richard Schilizzi SKA scientist
Quote Rob Adam
Quote Sarah Blythe
Quote Sergio Colofrancesco
Quote SKA international statement
Quote SKA SA

Quote Thomas Auf Der Heyde DST
Quote trade union
Quote Tshepo Seekoe
Quote UASA (trade union)
Quote university science communicator
Quote university scientist
Quote Val Munsami
Quote Vishnu Vejjala
Quote Willem Esterhuyse
Science astrobology
Science astrophysics
Science cosmology
Science exoplanets
Science Higgs Boson
Science inaccuracy
Science MeerKAT research projects
Science observation
Science PAPER project
Science physics
Science research questions cosmic magnetism
Science research questions dark energy
Science research questions dark matter
Science research questions formation of first stars and galaxies
Science research questions fundamental physics and cosmology
Science research questions gravity
Science research questions origins of the universe
Science research questions SETI
Site bid advisory committee recommendation for South Africa
Site bid Australian economic/political stability
Site bid better infrastructure in SA
Site bid competition with Australia
Site bid competition with Australia sport metaphor
Site bid good astronomy conditions at SA site
Site bid internal SKA process

Site bid leak by Canberra Times
Site bid leak by Sydney Morning Herald
Site bid leak by Sydney Morning Herald SA response
Site bid lower costs in SA
Site bid majority of site in SA
Site bid Nature leak
Site bid political aspects
site bid political insecurity in SA
Site bid possibility of sharing site
Site bid reference to sympathy vote
Site bid rhetoric indicating slit site possibility
Site bid security in SA
Site bid strong SA astronomy capabilities
Site location announcement
Site location announcement (delay)
Site location announcement (reaction to)
Site location announcement split site
Site location split site (general)
Site location split site (science implications)
Site location split site benefits
Site location split site cost implications
Site location split site risks
SKA African partner countries
SKA ASKAP
SKA Australia as a partner country
SKA Australian site
SKA construction timeline
SKA global partner countries
SKA international partner institutions
SKA Jodrell Bank
SKA partner country China
SKA UK HQ
Source AFP
Source Reuters

Source SAPA

Symbolism Africa affirmation of S&T capabilities

Symbolism Africa as part of global S&T

Symbolism Africa Day

Symbolism Africa external views of S&T capabilities

Symbolism Africa growth in astronomy

Symbolism Africa reference to Afro-pessimism

Symbolism Africa refutation of Afro-pessimism

Symbolism Africa SKA framed as an African project

Symbolism African astronomy historical perspective

Symbolism comparison to SALT

Symbolism comparison to World Cup 2010

Symbolism SA affirmation of S&T capabilities

Symbolism SA external views of S&T capabilities

Technology aperture arrays

Technology dish receivers

Technology electricity power supply

Technology ICT data processing

Technology ICT data transport and bandwidth

Technology ICT general

Technology interferometry

Technology RFI mitigation

Technology ROACH board

Technology South African innovation

Technology telescope capabilities

Appendix E: Key informant interview and written response details

Interview: Academic A, Rhodes University and SKA, 5 November 2013

Interview: Academic A, Stellenbosch, 18 December 2013

Interview: Academic A, UCT, 12 February 2014

Interview: Academic A, UKZN, 7 November 2013

Interview: Academic A, UWC, 25 November 2013

Interview: Academic B, Rhodes University and SKA, 14 November 2013

Interview: Academic B, UCT, 13 November 2013

Interview: Manager A, British High Commission, 8 October 2013

Interview: Manager A, NRF, 29 November 2013

Interview: Manager A, SKA innovation partner firm, 13 November 2014

Interview: Manager B, DST, 25 April 2014

Interview: Manager B, International Astronomical Union, Office of Astronomy for Development, 31 October 2014

Interview: Manager B, SKA business development, 25 November 2013

Interview: Manager C, Science and Technology Facilities Council (UK), 6 October 2013

Interview: Manager C, SKA human capital development and communication, 3 December 2013

Interview: Manager/scientist A, MeerKAT, 14 November 2013

Interview: Manager/scientist D, SKA science and innovation manager, 20 November 2013

Interview: Researcher A, CSIR, 13 November 2013

Interview: Science communicator A, Consultant, 23 March 2014

Interview: Science communicator A, SKA (HQ in UK), 13 November 2013

Interview: Science communicator B, Freelance, 29 January 2014

Interview: Science communicator B, HartRAO, 28 November 2013

Interview: Science journalist A, Afrikaans regional daily, 27 January 2014

Interview: Science Journalist B, Freelance, 5 December 2013

Interview: Science Journalist C, English national weekly, 27 November 2013

Interview: Science journalist G, Freelance, 20 January 2014

Written response: Manager/scientist A, HartRAO, 21 January 2014

Written response: Science and environment correspondent D, English regional daily, 9 April 2014

Written response: Science journalist F, Afrikaans regional daily, 24 April 2014

Written response: Science, technology and crime correspondent E, Afrikaans regional daily, 15 April 2014

Appendix F: Interview qualitative analysis coding framework

	TOTALS:
Audience of publication	3
British High Commission communication process	2
British High Commission communication strategy	2
Controversies	53
Controversy: alien life	5
Controversy: development context	18
Controversy: fracking	11
Controversy: site allocation	19
Firm communication activities	1
HartRAO role of government in communication	1
HartRAO relationship with journalists	1
HartRAO role of firms in communication	1
IAU OAD communication activities	2
Influences on reporting - general	1
Journalist focus of coverage	0
Journalist history of SKA coverage	7
Journalist interaction with Australia	1
Journalist position as science journalist	7
Journalist process - proactive and reactive reporting	1
Journalist relationship with CSIR	1
Journalist relationship with firms	1
Journalist relationship with government	2
Journalist relationship with government - possible improvement	1
Journalist relationship with private sector actors	0
Journalist relationship with scientists	3
Journalist relationship with scientists - possible improvement	1
Journalist relationship with SKA - possible improvement	1
Mass media	91
Misrepresentation	1

News value	10
News value periodisation	2
Newsroom process	5
Newsroom process: gatekeeping	7
NRF communication process	1
NRF relationship with journalists	1
NRF types of messages	1
Other actors	20
Role of African partner countries	1
Role of Afrikaans media	2
Role of government	4
Role of the military	3
SAJA	6
Science journalism in SA	2
SKA	60
SKA channels of communication	1
SKA communication process	18
SKA communication process - areas for improvement	1
SKA communication process - nexus of government firms and SKA	3
SKA communication process camera RFI as a challenge	1
SKA communication strategy	11
SKA international communication process	7
SKA international communication strategy	2
SKA international relationship with journalists	1
SKA relationship with journalists	8
SKA relationship with journalists - possible improvement	3
SKA role of Southern Science	3
Sources of information - African partner countries	1
Sources of information - DST	2
Sources of information - early period	2
Sources of information - government	3
Sources of information - international	1

Sources of information - online	4
Sources of information - other journalists	1
Sources of information - parliament	1
Sources of information - personal contacts in general	1
Sources of information - scientists	0
Sources of information - SKA communication	2
Sources of information - SKA events	3
Sources of information - SKA international	2
Sources of information - SKA senior management	4
Sources of information - Southern Science	1
Sources of information - university scientists	2
Sources of information SKA personal contacts	1
Symbol construction	11
Symbolism	11
Tone	0
Universities and scientists	20
University communication process	8
University engagement with the media: general	1
University relationship with journalists	7
University relationship with journalists - possible improvement	2
University relationship with SKA	2
TOTALS:	515

Appendix G: Informed consent form



UNIVERSITEIT•STELLENBOSCH•UNIVERSITY
jou kennisvenoot • your knowledge partner

STELLENBOSCH UNIVERSITY CONSENT TO PARTICIPATE IN RESEARCH

Globalised Science in an African Context: Representations of the Square Kilometre Array in the Media

You are asked to participate in a research study conducted by Mr. Michael Gastrow, a Ph.D student from the Department of Journalism at Stellenbosch University. Results from this participation will be used in his PhD dissertation. You were selected as a possible participant in this study because you are a key informant with regards to the science communication process of the Square Kilometre Array telescope.

1. PURPOSE OF THE STUDY

The purpose of the research is to understand the science communication process and the resultant representations of the Square Kilometre Array telescope in the mass media.

2. PROCEDURES

If you volunteer to participate in this study, we would ask you to participate in an interview. The interview will be approximately 45 minutes in duration. The interview will be conducted at a location convenient to you.

3. POTENTIAL RISKS AND DISCOMFORTS

There are no reasonable foreseeable risks, discomforts or inconveniences that may result from participation in this research.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

There are no direct benefits to participants expected from the research.

However, there are indirect benefits to society, to the extent that science communication plays an important role in social and economic processes, and that understanding this role could convey benefits at the intellectual level and the policy level.

5. PAYMENT FOR PARTICIPATION

There is no payment for participation in the research.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of 1) anonymisation processes and 2) secure data encryption and storage.

The anonymisation process involves removing any details that might identify you as an individual from any research outputs that might enter the public domain.

All audio recordings and transcripts will be stored in an external encrypted hard drive kept at a secure location. Only the PhD candidate (Mr Michael Gastrow) will have access to this data.

All interviews will be recorded on a digital audio recording device and transcribed for use in the research. You will retain the rights to review and/or edit any resultant recordings and transcripts. Transcripts will be used to inform research for the PhD dissertation and for no other purpose. All recordings and transcripts will be erased after ten years.

The PhD dissertation will become publically available after completion. However, confidentiality will be maintained at this stage as a result of the anonymisation process.

7. PARTICIPATION AND WITHDRAWAL

You can choose whether to be in this study or not. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study. The investigator may withdraw you from this research if circumstances arise which warrant doing so.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact:

Mr. Michael Gastrow (PhD candidate):

Office: (021) 4667836

Cellphone: 0827744417 (for after hours or emergencies)

Email: mgastrow@hsrc.ac.za

Prof. George Claassen (PhD supervisor)

Office: (021) 8513232

Email: gnclaassen@sun.ac.za

9. RIGHTS OF RESEARCH SUBJECTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research subject, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE
--

The information above was described to me by Mr. Michael Gastrow in English and I am in command of this language or it was satisfactorily translated to me. I was given the opportunity to ask questions and these questions were answered to my satisfaction.

I hereby consent voluntarily to participate in this research. I have been given a copy of this form.

Name of Subject/Participant

Name of Legal Representative (if applicable)

Signature of Subject/Participant or Legal Representative

Date

SIGNATURE OF INVESTIGATOR

I declare that I explained the information given in this document to _____
[*name of the subject/participant*] and/or [his/her] representative _____
[*name of the*
representative]. [*He/she*] was encouraged and given ample time to ask me any questions.
This conversation was conducted in English and no translator was used.

Signature of Investigator

Date

Appendix H: List of documents for media content analysis: English language sample

- P 1: 'Africa is indeed rising' 2012-05-25 iol.co.za
- P 2: 'We are ready for SKA' 2012-03-30 timeslive.co.za
- P 3: \$2bn SKA to shine light on dark secrets 2012-05-29 timeslive.co.za
- P 4: 2011 Cabinet class earns bad reports 2011-12-12 news24.com
- P 5: 60 new research chairs to boost science, tech 2012-02-14 allafrica.com
- P 7: Africa- Boost for Continent Telescope Network 2012-06-04 allafrica.com
- P8: Africa- International Radio Astronomy Project to Benefit Africa 2012-03-30
allafrica.com
- P 9: Africa needs skills for SKA 2012-07-09 news24.com
- P10: Analyst's warning on SA construction shares 2012-07-26 moneyweb.co.za
- P11: Bad report card for Cabinet's Class of 2011 2011-12-12 City Press
- P12: Beam me up SKA 2012-06-01Publication iol.co.za
- P13: Big science coming to Africa 2012-03-30 Media Club South Africa
- P14: Brand South Africa hosts international media 2012-09-30 Media Club South Africa
- P15: Budget Speech 2012 2012-02-22 moneyweb.co.za
- P16: Cabinet approves digital TV timetable 2012-03-22 fin24.com (division of News24)
- P17: Celestial rivalry 2012-04-04 fin24.com (division of News24)
- P18: China key player in SA SKA bid 2012-02-23 news24.com
- P19: Choice of SKA host country delayed 2012-08-08 Business Day
- P20: Cool things invented in South Africa 2012-07-11 mybroadband.co.za
- P21: Decision time on site for giant radio telescope 2012-05-25 Reuters Africa
- P22: DA's annual Cabinet report card hands Zuma an 'F' 2011-12-12 Mail & Guardian
- P23: DA gives Zuma an F 2011-12-12 iol.co.za
- P24: Time for Ramos to take a stand 2012-08-08 Business Day
- P25: Decision time on site for giant radio telescope 2012-05-24 Reuters Africa
- P26: Digital TV to have public hearings 2012-08-14 City Press
- P27: Disappointment as SKA decision is delayed 2012-04-04 City Press
- P28: Space programme would have benefits 2012-08-08 Business Day
- P29: Education 'key' to SKA rollout 2012-07-10 news24.com
- P30: Engineers skeptical about govt's skills drive 2012-06-18 moneyweb.co.za
- P31: ET, home phoned 2012-05-29 news24.com
- P32: What does the Square Kilometre Array do 2012-05-24 Reuters Africa

- P33: Farmers want access to telecoms 2012-06-13 bizcommunity.com
- P34: Fracking worries abound 2012-02-04 City Press
- P35: Freedom of expression, dignity must both be upheld 2012-06-01 bizcommunity.com
- P36: Funding critical to SA science - NRF 2012-07-11 news24.com
- P37: Gallery- the KAT-7 radio telescope 2011-12-15 Media Club South Africa
- P38: Giant SKA in the sky 2012-05-28 iol.co.za
- P39: Girls are a gauge of society 2012-06-05 timeslive.co.za
- P40: Government did us proud on SKA- UASA 2012-05-25 timeslive.co.za
- P41: Govt did excellent job with SKA - union 2012-05-25 news24.com
- P42: Great astronomy, with or without SKA 2012-01-05 Media Club South Africa
- P43: How the SA, Australian SKA collaboration will work 2012-05-26 moneyweb.co.za
- P44: IBM gets SKA tender 2012-04-02 moneyweb.co.za
- P45: Investment hopes ride on SKA decision 2012-02-15 news24.com
- P46: Investment hopes ride on Square Kilometre Array 2012-02-15 timeslive.co.za
- P47: Is it further to Limpopo than Mars 2012-08-06 timeslive.co.za
- P48: Justin Jonas - War, Poverty and Radio Astronomy 2014-02-24 sagoodnews.co.za
- P49: Karoo town starry-eyed 2012-07-22 fin24.com (division of News24)
- P50: KAT-7 observation boost for SKA 2012-03-15 news24.com
- P51: Key scientists favour SA to host SKA - report 2012-03-09 news24.com
- P52: Many of Zuma's ministers flunking -- DA 2012-08-06 Business Day
- P53: MeerKat being built irrespective of SKA 2011-12-14 timeslive.co.za
- P54: More broadband for South Africa 2012-02-09 Media Club South Africa
- P55: More in the kitty for MeerKAT and SKA 2012-05-28 timeslive.co.za
- P56: More women scientists needed- Naledi Pandor 2012-08-31 timeslive.co.za
- P57: Mozambique- Exact Location of SKA Telescope Sought 2012-06-26 allafrika.com
- P58: Mozambique- Further Details Emerge Over the Country's Role in SKA Telescope 012-06-01 allafrika.com
- P59: New campaign for South Africa 2012-07-09 bizcommunity.com
- P60: New chapter in SA story lists figures, now we must make them work 2012-02-23 iol.co.za
- P61: No room at the trough-Indaba palava kicks MPs to the kerb 2012-02-07 Mail & Guardian
- P62: No stopping MeerKAT 2012-02-13 news24.com
- P63: No way for the array in RSA news24.com

- P64: Pandor- SKA changes Africa character 2012-08-31 news24.com
- P65: Pandor urges more women into science 2012-08-31 news24.com
- P66: Paper boosts SA SKA site 2012-04-03 news24.com
- P67: Partners mull expansion of existing Karoo radio astronomy project Engineering News
- P68: Massive motor failure costs Hulamini R110m 2012-07-31 moneyweb.co.za
- P69: Post Office launches SA astronomy stamp series 2012-06-07 bizcommunity.com
- P70: Quiet cellular antenna technology for SKA 2011-10-28 mybroadband.co.za
- P71: Research output rises, papers double 2012-08-15 Media Club South Africa
- P72: SA needs square array to light up future 2012-15-09 Business Day
- P73: SA's eye-on-the-sky triumph 2012-05-26 iol.co.za
- P74: SA ahead in SKA race - Australian media 2012-03-10 City Press
- P75: SA assists with Nasa's Mars mission 2012-12-22 Media Club South Africa
- P76: SA holds breath as SKA decision looms 2012-08-08 Business Day
- P77: SA ideal for SKA - Derek Hanekom 2011-12-13 news24.com
- P78: SA in an African space race 2012-10-03 moneyweb.co.za
- P79: SA joins international star-scanning institute 2012-05-13 Mail & Guardian
- P80: SA joins world astronomy body 2014-02-24 sagooodnews.co.za
- P81: SA leaps ahead of Australia in SKA race 2012-03-10 Mail & Guardian
- P82: SA officials lobbying for SKA 2012-04-02 news24.com
- P83: SA plans giant twin telescopes timeslive.co.za
- P84: SA ready to host the SKA - Pandor 2012-03-29 news24.com
- P85: SA seeks to strengthen radio astronomy partnerships with China 2012-02-21 Engineering News
- P86: SA set for massive infrastructure drive 2012-02-10 sagooodnews.co.za
- P87: SA to push for Square Kilometre Array decision 2012-05-15 timeslive.co.za
- P88: SA upbeat on radio telescope siting 2012-02-16 timeslive.co.za
- P89: SA waits for telescope bid decision 2012-08-08 Business Day
- P90: SKA changes character of Africa - Pandor 2012-08-31 City Press
- P91: SA, Australia in celestial spat for new telescope 2012-04-03 moneyweb.co.za
- P92: SA, Australia joint hosts of SKA 2012-05-25 Media Club South Africa
- P93: SA, Australia share SKA 2012-05-25 moneyweb.co.za
- P94: SA, Australia to share SKA project - report 2012-05-25 Engineering News
- P95: SAs SKA bid gets new campaign 2011-11-15 Media Club South Africa
- P96: Searching for chameleons in the dark 2012-07-11 Mail & Guardian

- P97: Shared SKA's future will be in past 2012-05-27 iol.co.za
- P98: SKA- Aus silent on report favouring SA 2012-03-10 news24.com
- P99: SKA- Plundering the depths of space 2012-05-28 Mail & Guardian
- P100: SKA- SA gets the lion's share 2012-05-25 City Press
- P101: SKA- Split site now under consideration 2012-04-19 news24.com
- P102: SKA- There is no Plan B, Pandor says 2012-03-29 City Press
- P103: SKA 'unlikely to win Nobel prize' 28-05-2012 City Press
- P104: SKA - who gets what 2012-05-31 Media Club South Africa
- P105: SKA an achievement for South Africa, Africa- ANC 2012-05-26 timeslive.co.za
- P106: SKA announcement briefing 2012-05-25 City Press
- P107: SKA board to deliberate on project site in April 2012-02-17 Engineering News
- P108: SKA breathes life into sleepy hollow 2012-07-24 timeslive.co.za
- P109: SKA breathes new life into SA outback 2012-07-24 City Press
- P110: Small town sees brighter future with telescope Business Day
- P111: SKA data to be processed by Skynet project 2011-09-14 mybroadband.co.za
- P112: SKA debate still raging 2012-03-23 moneyweb.co.za
- P113: SKA decision delayed 2012-04-04 moneyweb.co.za
- P114: SKA decision likely delayed - Pandor 2012-03-29 news24.com
- P115: SKA decision unexpected, says Pandor 2012-05-25 iol.co.za
- P116: SKA international radio telescope project gets new governing agency 2011-11-24 Engineering News
- P117: SKA split between SA and Australia 2012-06-26 City Press
- P118: SKA is a big science project for SA 2012-04-02 news24.com
- P119: SKA may scupper fracking plans 2012-05-29 news24.com
- P120: SKA Phase 1 will involve the construction of many scores of dishes 2012-05-29 Engineering News
- P121: SKA project aims to inspire SA's future scientists 2012-07-24 Mail & Guardian
- P122: SKA project to bolster training of SA artisans 2012-07-13 iol.co.za
- P123: SKA reaches new heights 2011-10-03 mybroadband.co.za
- P124: SKA skills benefits roll in for SA 2012-07-08 moneyweb.co.za
- P125: SKA split unexpected- Pandor 2012-05-25 news24.com
- P126: SKA success may threaten fracking plans 2012-05-30 fin24.com (division of News24)
- P127: SKA success may threaten gas plans 2012-05-30 moneyweb.co.za
- P128: SKA Telescope - What is it What Implications 2012-05-25 news24.com

- P129: SKA telescope decision may be delayed 2012-03-29 moneyweb.co.za
- P130: SKA telescope to be built in SA and Australia 2012-05-25 moneyweb.co.za
- P131: SKA to be built in SA, Australia 2012-05-25 news24.com
- P132: SKA to be shared between SA and Australia, geographically and industrially 25-05-2012 Engineering News
- P133: SKA to unlock dark secrets 2012-05-28 news24.com
- P134: Skills needed for SKA to succeed - scientist 2012-07-09 City Press
- P135: South Africa- Decision Time for SKA 2012-05-24 allafrica.com
- P136: South Africa- Drumbeat for Fracking Drowns Out Reason and Rationality 2012-07-12 allafrica.com
- P137: South Africa- SKA - Be Grateful Karoo Residents Didn't Object 2012-05-29 allafrica.com
- P138: South Africa- SKA Could Be Announced Tomorrow 2012-05-24 allafrica.com
- P139: South Africa- SKA Host Decision 'To Be Negotiated' 2012-03-22 allafrica.com
- P140: South Africa- Telescope May Have to Be Shared 2012-04-10 allafrica.com
- P141: South Africa continues as a valuable brand 2012-06-06 bizcommunity.com
- P142: South Africa eyes SKA telescope with bated breath 2012-02-15 Mail & Guardian
- P143: South Africa seeks to bring in astronomers 2011-12-19 timeslive.co.za
- P144: South Africa to host majority of SKA project - Pandor 2012-05-25 Engineering News
- P145: South African SKA site bid submission marks start of final lap in the process Engineering News
- P146: Space ambitions 2011-12-20 fin24.com (division of News24)
- P147: Square Kilometre Array thrills astronomers 2012-07-09 timeslive.co.za
- P148: Square Kilometre Array to be built in South Africa and Australia 2012-05-25 timeslive.co.za
- P149: Square Kilometre Array to create Northern Cape jobs 2012-05-28 timeslive.co.za
- P150: Star turn for Parliament opening 2012-02-07 news24.com
- P151: State agency to boost SA astronomy 2012-08-06 Business Day
- P152: Rediscovering South African belief 2012-08-14 sagoodnews.co.za
- P153: Telescope breathes new life into Karoo town 2012-06-25 iol.co.za
- P154: Telescope project to soldier on 2011-12-14 mybroadband.co.za
- P155: Telescope zeroes in on benefits 2012-07-09 timeslive.co.za
- P156: The DA scorecard 2011-12-13 iol.co.za
- P157: The real heroes behind SKA, SpaceX 2012-06-03 moneyweb.co.za

- P158: The SKA sets universities abuzz 2012-06-22 Mail & Guardian
- P159: Top IT conference for Cape Town 2012-07-17 bizcommunity.com
- P160: UPDATE 1-Giant radio telescope gets split location 2012-05-25 Reuters Africa
- P161: Working group established to explore SKA implementation options 2012-04-04 Engineering News
- P162: World's biggest 'eye on the sky' clears key hurdle 2012-06-12 timeslive.co.za
- P163: Zuma-we are equal to the task 2012-02-10 Media Club South Africa
- P164: Zuma hails Pandor, SKA team 2012-05-25 news24.com
- P165: Pandor hits out at SKA pessimism 2012-03-16 Business Day
- P166: Locals join the hunt for missing link 2012-07-06 Mail & Guardian
- P167: Pandor- We need a decision regarding SKA 2012-05-15 Mail & Guardian
- P168: Pandor rankled by SKA announcement delay 2012-04-04 Mail & Guardian
- P169: Playing the waiting game on SKA debate 2012-03-23 Mail & Guardian
- P170: SA makes astronomical advances 2011-12-23 Mail & Guardian
- P171: SA readies to host the most powerful telescope in the world 2011-09-15 Mail & Guardian
- P172: Sabres are drawn in SKA wars 2012-03-30 Mail & Guardian
- P173: Scientist, unionist - and now star of the SKA show 2012-07-06 Mail & Guardian
- P174: SKA funding hangover looms 2012-05-31 Mail & Guardian
- P175: Dates of SKA announcement still uncertain 2012-03-29 Mail & Guardian
- P176: Dear Africa 2012-05-25 Mail & Guardian
- P177: IBM lands \$42-million SKA tender 2012-04-02 Mail & Guardian
- P178: The Zuma portrait and black (male) sexuality 2012-06-01 Mail & Guardian
- P179: Stars wars as SA battles for SKA 2012-04-26 Mail & Guardian
- P180: Staring into space- SKA's noble (not Nobel) quest 2012-05-28 Mail & Guardian
- P181: SKA to be split between SA and Australia 2012-05-25 Mail & Guardian
- P182: SKA - a proud moment for South Africa 28-05-2012 sagoodnews.co.za
- P183: SA Australia to share SKA telescope 2012-05-25 Business Day
- P184: SKA Meerkat to boost specialist companies 17 05 2012 Business Day
- P185: Pandor to elucidate SAs space ambitions today 2012-16-05 Business Day
- P186: Split site may be the solution for SA and Australia 2012-05-07 Business Day
- P187: Telkom deaf to Northern Cape, say farmers 2012-20-04 Business Day
- P188: SKA delay could end in a draw 2012-04-05 Business Day
- P189: Another delay in choosing site for R23bn SKA 2012-04-04. Business Day

- P190: SA remains optimistic despite SKA decision delays 2012-03-29 Business Day
- P191: Square Kilometre Array benefits rolling in 2012-07-08 timeslive.co.za
- P192: SKA debate still raging 2012-03-23 iol.co.za
- P193: SKA announcement makes way for talks 2012-03-23 Business Day
- P194: Report leak in SA will hurt SKA bid 2012-03-14 Business Day
- P195: Boffins take long view on SKA rumour 2012-03-12 Business Day
- P196: IBM lends its artificial intelligence expertise to SKA project 2012-03-08 Business Day
- P197: Impatience and politics lead to SKA site split 2012-05-27 timeslive.co.za
- P198: Recommendation brings SA closer to hosting SKA 2012-03-09 Business Day
- P199: The State of the Nation speech 2012-02-09 moneyweb.co.za
- P200: SKA accused of shunning SA firms 2012-08-10 Business Day
- P201: SKA skills benefits roll in for SA 2012-07-08 moneyweb.co.za
- P202: SKA telescope to turn brain drain in SA into brain gain 2012-07-25 Business Day
- P203: Much at stake in race to host SKA 2012-05-25. Business Day

Appendix I: Afrikaans media content analysis coding system: non-interpretive codes representing occurrences in the text

English language code (occurrence in the text)	Afrikaans translation search terms (if required)
Actors referred to in the text	
Actor Adrian Tiplady	
Actor AERAP	
Actor African Renaissance Fund	
Actor African VLBI network	
Actor ASTRON	
Actor AU	Afrika-Unie
Actor BAE systems	
Actor Berkeley	
Actor Bernie Fanaroff	
Actor Brand South Africa	
Actor Caltech	
Actor Caroline Zunckel	
Actor Chris Evans	
Actor Cisco	
Actor Derek Hanekom	
Actor DOME	
Actor DST	Departement van Wetenskap en Tegnologie
Actor DST SARChI chairs	
Actor DUT	
Actor Elon Musk	
Actor EMSS	
Actor EU	Europese Unie
Actor Google	
Actor HartRAO	
Actor IBM	

Actor Intel	
Actor Jacob Zuma	
Actor Jasper Horrell	
Actor Jocelyn Burnell	
Actor John Womersley	
Actor Junita Klopper-Lourens (DA)	
Actor Justin Jonas	
Actor Katherine Blundell	
Actor Marina Joubert	
Actor Michael Gaylard	
Actor Michael Kramer (Max Planck Institute)	
Actor Microsoft	
Actor Miller Matola	
Actor Naledi Pandor	
Actor NASA	
Actor NASSP	
Actor Nithaya Chetty	
Actor NMMU	Nelson Mandela Metropolitaanse Universiteit
Actor Nokia-Siemens	
Actor NRAO	
Actor NRF	Nasionale Navorsingstigting
Actor Oxford	
Actor Phil Diamond	
Actor Phil Mjwara	
Actor Rhodes University	Rhodes Universiteit
Actor Rob Adam	
Actor Saalex Galileo	
Actor SALT	
Actor SANSA	
Actor Sasol	
Actor Shell	

Actor Stratosat Datacom	
Actor Tshepo Seekoe	
Actor Tshwane University of Technology	Tshwane Universiteit van Tegnologie
Actor UCLA	
Actor UCT	Universiteit van Kaapstad
Actor UKZN	Universiteit van KwaZulu-Natal
Actor UNISA	
Actor University of Manchester	Universiteit van Manchester
Actor University of Mauritius	Universiteit van Mauritius
Actor University of Pennsylvania	Universiteit van Pennsylvania
Actor University of Pretoria	Universiteit van Pretoria; Tukkies
Actor UWC	Universiteit van die Wes-Kaap
Actor Val Munsami	
Actor Vishnu Vejjala	
Actor Willem Esterhuyse	
Actor Wits	Universiteit van die Witwatersrand
Development context	
Development context Carnarvon	
Development context Williston	
Precursors	
KAT-7	
MeerKAT	
SKA organisation	
African partner countries (Zambia, Mauritius, Madagascar, Ghana, Kenya, Botswana, Namibia)	Zambië, Mauritius, Madagaskar, Ghana, Kenia, Botswana, Namibië

**Appendix J: List of documents for media content analysis: Afrikaans language sample
(Die Burger)**

- P 1: Aan't sterre tel 2011 10 15
- P 2: Afrika moet die SKA kry, se Europa 2012 03 23
- P 3: Afwagting laai op vir aankondiging oor SKA 2012 05 25
- P 4: Ander kant van die SKA munt vir Karoo 2012 03 21
- P 5: Armes kry subsidie van 70 vir digitaal 2012 03 23
- P 6: Aussies veg vuil teen SA 2012 02 16
- P 7: Australië en SA wil na die sterre reik 2012 02 25
- P 8: Beraad op pad oor verdeelde land 2012 05 31
- P 9: Bernie is 'n denker leier en sterreman 2012 08 24
- P10: Bernie is werklik slim 2012 08 24
- P11: Besluit oor SKA nie gou geneem 2012 02 01
- P12: Besluit oor terrein vir SKA sloer 2012 03 24
- P13: Blitsiger rekenaar ontwerp vir SKA 2012 04 07
- P14: Die kampioen 2012 08 24
- P15: Die Karoo Science Fiction 2012 07
- P16: Dit is 'n aanwys vir Carnarvon, die Noord Kaap en die Karoo 2012 05 26
- P17: EU wil wetenskap in Afrika uitbou 2012 03 17
- P18: Seëlreeks plaas SA in ruimte 2012 06 09
- P19: H Baron 2012 02 25
- P20: Haai haai SKA rumba in SA se Sterland 2012 06 12.
- P21: Hidrouliese proses het wel verdienste 2012 05 03
- P22: Hoera vir SKA 2012 05 26
- P23: Hou voete op die grond 2012 06 05
- P24: Hulle moet 20 staatsdiens beloftes vervul 2012 02 11
- P25: Karoo goedheid midde die sneeu chaos 2012 07 18
- P26: Komitee se verslag is glo gelek 2012 03 14
- P27: Kwelpunte oor SKA pla nie vir kabinet 2012 06 02
- P28: Laat SA se ster skitter met die SKA projek 2012 05 29
- P29: Lang pad na sterrekyk 2012 06 09
- P30: Lees vandag Skiet sterre 2012 06 05

- P31: Meer lidlande sal vertrouwe in SKA laat groei 2012 06 01
- P32: MeerKAT bouwerk vorder fluks 2012 03 31
- P33: MeerKAT word gou kaatjie van die baan 2012 04 21
- P34: Minister vol lof vir Meneer SKA 2012 07 19
- P35: Nabygeleë sterrestelsel waargeneem 2012 03 16
- P36: Navorsing kan sterker ekonomie in SA skeep 2012 05 16
- P37: Nog geen besluit oor kampus in N Kaap 2012 07 04
- P38: Nog 'n deurbraak vir KAT7 teleskoop 2012 03 16
- P39: Op ons App 2012 05 26
- P40: Opening kos R6 2012 02 08
- P41: Paradigma skuif kom vir Afrika se ruimte agentskap 2012 05 26
- P42: Plan van aksie vir SKA hersien 2012 05 29
- P43: Politiek was vals klawer op SKA orrel 2012 05 31
- P44: Politieke besluit kan SKA benadeel 2012 04 19
- P45: Professor glo deur vriend vermoor 2012 01 14
- P46: Raadpleeg streek oor bou van SKA DA 2012 06 12
- P47: Reuse skottels in Karoo 2011 11 01
- P48: SA kry straks SKA volgens gerugte 2012 03 10
- P49: SA oorweeg om eie satelliete te lanseer 2011 10 04
- P50: SA sterker kandidaat 2012 03 10
- P51: SA was vroeër wetenskapkomitee se voorkeurterrein organisasie 2012 05 26
- P52: Sakeleier en Ambassadeur word vereer 2012 08 27
- P53: Sakelui kan nou reeds kaartjies koop vir Sakekamer se gala aand promosie 2012 08 03
- P54: SKA bod Laat ons na die sterre reik 2012 03 19
- P55: SKA doelwit nou na jare in sig 2011 09 17
- P56: SKA kry 'n enorme nefie in SAmerika 2012 06 13
- P57: SKA kry wye steun uit landbougeledere 2012 04 04
- P58: SKA organisasie gestig 2011 12 01.
- P59: SKA behoort in die Karoo nie skottels 2012 07 14
- P60: SKA radioteleskoop gee hoop 2012 04 04
- P61: SKA word dalk gedeel 2012 04 05
- P62: Skaliegas nie naby SKA projek ontgin 2012 08 30
- P63: Skaliegas raak nie SKA projek 2012 08 30
- P64: Skryf teen mynplan 2012 06 27

P65: So werk die SKA se radioteleskoop 2012 04 07

P66: Spanning laai op oor SKA 2012 03 30

P67: Teleskoop stuit kundiges se uittog 2012 08 27

P68: Van Zyl is Sakeleier van die Jaar 2012 08 25

P69: Verslag oor SKA se ligging voorgelê 2012 02 23

P70: Vorming van heelal se eerste sterre in Karoo bestudeer 2011 10 22

P71: Wen met SKA projek 2012 02 11

Appendix Q: Selected quotations from key informant interviews

Q.1.

It is important to have a very strong presence and very strong relationship with the local communities because they want to see the advantages of having a big thing like the SKA close to them so this is one aspect and this the public in general because we are the ones who are paying for this project. We want support from the science community because these will be the users of the telescope, so of course they need to fully endorse it, which is why we are working with them on the main drivers, and the engineering community because these are the one who will be building the telescope. So there is a very strong interaction between all these groups.

(management interview – SKA international: 13 November 2013)

Q.2.

I have my network of journalists which I have been working with for 10 years now. Being a journalist first then being a science communicator so I have my first level contacts, they ones that I know personally and I know I can count on them and even before the release is disclosed just to brief them on the news and to give them some information before it goes public because I know I can trust these guys and so on. I have a further list of journalists which I inherited from my predecessor that I am using to spread the news, it is a big mailing list of many people some of them, most of them I do not know. I didn't really have the time because it is just be in the office, we will hopefully have a deputy shortly and then hopefully his office will round up but I didn't have the time to do what I would like to do which is strengthen the relationship with specific journalists in media.

(management interview – SKA international: 13 November 2013)

Q.3.

Then we discuss it at the teleconferences with colleagues about what is coming and how do we want to communicate on this. So do we want a big splash, or do we just want a local announcement? Do we want to send it off the main international mailing

list? This is discussed within this group, and then most of the time, from the central office, I communicate on most news and most of the things that are happening in most of the countries, and most of what is happening is in Australia or South Africa, but also in other countries. Then each partner can decide if they want to co-release the news or don't do anything if it is not relevant to them.

There are different levels of communication. Personally here in the central office I have two levels of communication when it comes to reporting on progress and main activities. One is what I call the press release, which means I practically send it to the media using different routes and different channels and different mailing lists and so on. Another one is what I call an announcement, which is for what I call less relevant news and this one goes just on the website, so I don't send it practically to the media, it goes to the website. Then the media or whoever can subscribe to the RSS feed line so they know there is a new announcement on the web.

(management interview – SKA international: 13 November 2013)

Q.4.

I see the social media as a channel to direct people to the main website where they can find more in-depth information. So you can just draw their attention on something specific like a conference or something happening in the project or so on and then hopefully these people will be attracted and go to the website and find some more information not only about this specific site but also about the SKA in general. So I would like to intensify the communication via social media.

(management interview – SKA international: 13 November 2013)

Q.5.

I give access to the SKA Facebook page to my working group members so they are free to upload more news and pictures and so on and this is a way of being more dynamic in the social media. So Marina Joubert for example, she has access to the main SKA Facebook page in addition to the SKA South Africa. So she has access to it and she can post anything she likes basically and the same for the Australian

colleagues and the other colleagues around the world to make it more attractive, more dynamic to reflect what is going on because many things are going on on this planet.
(management interview – SKA international: 13 November 2013)

Q.6.

I am not telling them to tell me each time they post the Facebook page or on Twitter saying we did this cool stuff for the SKA today, because I do not have time for that basically. The main things like the press releases and so on I want to have a proper coordination so I want the institution involved to contact me and/or their consortium lead just to be the interface and then we can work together on increasing the impact.
(management interview – SKA international: 13 November 2013)

Q.7.

Now we really need to get full support from the science community and industry. We have a strong level of engagement from these communities, but we do need to reinforce the communication exercises and the communication activities in these groups, so we really need to target these groups now. I guess the strategy really focuses on these groups and even now, it will be more obvious in a later stage, we want to engage with the general public as well; we want to raise awareness, we want to inspire people on these sorts of things. The strategy will slightly evolve when comes the time of engaging with a broader audience, but you have to do it one step at a time and we have limited resources so you have to prioritise.
(management interview – SKA international: 13 November 2013)

Q.8.

It is so big and spread out around that world that it is complicated to keep track on what is going on and that we are all in the same page. This is particularly important for us in the communication department because we all want to make sure we have the most up-to-date information and we are all aware of the latest progress and so on. Which is why I have these groups and I try to keep a regular interaction between these groups and regular meetings and so on. We report on progress and report on this sort of thing to make sure we are all on the same page.

(management interview – SKA international: 13 November 2013)

Q.9.

We are constantly vigilant about what we are projecting and what kind of message we are trying to put out there and what we believe ourselves about this project and maintain the best possible ideas about that and then we end up with good results, that has been our experience.

(SKA manager D: interviewed 20 November 2013)

Q.10.

I think they have to be incredibly careful at what they do. They have a number of masters that they can't piss off. They have DST, they have international, they have people on the ground, and they have the community of Carnarvon. They can only report on what is fact and what has happened, because everything else is... it's not that it's in the air but it's still all under negotiation.

(science journalist C: interviewed 27 November 2013)

Q.11.

What we want to be continuously demonstrating is that we are effectively using the finances that are given to us to do what it is that we've been mandated to do. In other words, to build the MeerKAT telescope, to drive innovation and to develop, you know, capacity around radio astronomy, so we need to be continuously demonstrating delivery and also benefits and so we use the milestones of the project to illustrate that as well as, you know, sort of CSI [corporate social investment] events, etc. And we invite media to the events and to the milestones and you know, try and keep them informed on everything that's happening.

(SKA manager C: interviewed 3 December 2013)

Q.12.

People know very well that they can only talk about their area of work, so engineers can only talk about the engineering they are doing, for example. The more strategic level, the director and associate director are the only ones that are allowed to communicate, you know, around issues of the site bid, around issues of funding, issues around governments, etc.

If staff are requested by media to write something or to be interviewed, they need to go through me for permission and I will also only grant permission if I know the kinds of questions that are going to be asked. It's not that we've got anything to hide, it's just that not all the staff are aware of all of the aspects of the project, certainly not from a funding level and a governance level, and the type of the site decisions... there are a lot of questions around what do you feel about the site decision and those are things that some people are not qualified to answer. And so we, in the same way, some of us are not qualified to answer questions about the engineering specifications of MeerKAT, for example. But staff certainly are aware of that, to the point where they come to me first for permission on whether they can talk to media and then they need to tell me what the media want to talk about.

(SKA manager C: interviewed 3 December 2013)

Q.13.

Anything that goes out into the media that we have control over, Bernie will approve and if I'm not sure whether somebody can be interviewed then I will get approval from Bernie. So, certainly Bernie is our project director and our associate director is Justin Jonas, who I believe you've met with, so that's kind of where the buck stops....

(SKA manager C: interviewed 3 December 2013)

Q.14.

It is pretty smooth in general, I think we have had fairly good relationship with the press. We haven't had many articles that are openly hostile towards us, I guess it will happen at some point as it is inevitable and at that point there will be friction. I think in general the issues are quite good.

(SKA manager D: interviewed 20 November 2013)

Q.15.

It's mostly journalists who don't actually do their research beforehand, and it's often people who haven't been following the project, and then we're suddenly in the media and then everyone wants a piece of us. I've had phone calls like this, 'you know we want to do an article on this thingy project that you're doing about astrology or something' and my first response is, 'please go and read our website. You know, it's got downloadable brochures, it's got info there, and then come and tell me what aspect of the project you want to know about', and there's been a case where there was a journalist contracted by someone to do an article on the project and I honestly don't know where she got her information from but I had to rewrite the whole article, which she's not happy about, but it was her first involvement with the project. So again, it's important that the right people talk to journalists because the project is so complex. As I say, it's not just the SKA only, it's not just The MeerKAT, it's not just the student program, it's at the whole of Africa, it's a very complex project to talk about in three lines.

(SKA manager C: interviewed 3 December 2013)

Q.16.

You do get two completely different ways people do it. We had Professor Michael Cherry from the South Africa Journal of Science, he sends months on an article and write 8 pages and you want to keep it as a reference almost. We had a lady from Quest Magazine, and we did a lot of the writing and it was a brilliant feature eventually but that is almost an addition that gets dedicated to your project. We sent a lot of information but then she does the writing and we check it afterwards for anything. And then you get the News24 type person that will come sit in your office at 10 o'clock and at 10:30 there appears an article and you call the person and say that is not what I said and they say they will change it. So that is the two sources.

(SKA manager A: interviewed 14 November 2013)

Q.17.

We know which reporters will report quite accurately. We tend to invite those ones to develop a relationship with the reporters and feed them the stories to make sure they go out properly. So keep an eye over the process, but you cannot control what people will write in the end, and sometimes we get some really strange articles that are way off, then we have to issue statements saying that is not true.

(SKA manager D: interviewed 20 November 2013)

Q.18.

My feeling is that to communicate science, you yourself need to know some of the science and then you should just be building on some of the knowledge that you have. I mean, Sarah Wild is a perfect example, I mean she's actually a physics graduate from Rhodes, so she understands the science. I mean, not everybody is a physics graduate, but at least be able to read and understand something. At the very least, understand the difference between astronomy and astrology.

(SKA manager C: interviewed 3 December 2013)

Q.19.

They want their reputation to remain intact, and so it makes sense for us to do the same, because at the end of the day the government is who is supporting us, and have supported us brilliantly over the years. So we also want to retain that support, so I suppose subconsciously the way they influence us is just by ensuring we report positively. I mean, not that there are negative things to report, but if there were things, it would not be in our favour to report on negative issues. But we've got a very excellent relationship with government. You know, the DST is very supportive, the ministry is very supportive and so it's actually easy to work with them from a communications point of view.

(SKA manager C: interviewed 3 December 2013)

Q.20.

Drafting press releases is one thing I do in collaboration with the SKA office, so Marina. We had this press release on this recent paper coordinated though the SKA

and issued simultaneously by UCT, Oxford and DST, because it had to coincide with the minister's speech and he mentioned this so it had to be very well coordinated....

There is a press office in the university – It's called the communications and marketing department I think. They sometimes have to issue brochures saying do you have anything to report. We normally approach them when we have something noteworthy, an interesting paper, and they have good contacts with the SKA office. From the past experience of the number of joint press releases they would judge to see what's appropriate, and they will issue one together. One was released recently jointly with DST and SKA. It in fact reached globally.

(academic B UCT: interviewed 13 November 2013)

Q.21.

The science faculty marketing committee would like to highlight the efforts and the investment by the university in this project. There's also a lot of funding coming in from UCT and they would like to see how they fit in to the big picture, so if there is something interesting to report, some new science aspect or whatever, they are mostly focused on new observations, new publications that are relevant to SKA, then yes we will go through those channels.

(academic B UCT: interviewed 13 November 2013)

Q.22.

They are largely reluctant when something lands on the desk. On the up side, when information is required they will approach us, or if some senior member of the university executive brings something to their attention then they will approach us. I think from their side it is more of a reactive than a proactive, and I think from our side when we just have snippets of information we do bring it to their attention. This is not unique to our corporate relations sector; I think it is reflective of how communication sectors at universities work.

(academic A, UKZN: interviewed 7 November 2013)

Q.23.

In the college, which is the structure in which our school sits, there is an outreach manager and outreach personnel in the offices. They also interface with the corporate relations division. So typically what happens if there is a media story, we contact the college people, or even use our outreach person to contact the college people. They draft the press release, depending if they have the capacity to do so or the time to do so, and then they engage with the public relations outreach and media people to finalise the press release and then it goes out of the university via the corporate relations. That is how we engage with journalists; we do not engage with them directly, we do not initiate direct discussion.

(academic A, UKZN: interviewed 7 November 2013)

Q.24.

Most of the journalists are confident [and] very well prepared. So it has been very easy to interact in terms of explaining what we each individually do, so I have been impressed in the limited number of journalists who want to write about the SKA in South Africa and its deployment and what it is doing and so forth because they have stepped up the plate in terms of understanding what the scientific issues are. So the relationship has been fairly easy.

(academic A, US: interviewed 18 December 2013)

One of the members of the Stellenbosch journalism department, which seems he might be a member of, a young person writing an article, wrote not a particularly good set of articles and I had to insist that I reworded some of the stuff and then he allowed me to make some rewording, this particular student, then he said that he had to have a journalist licence which I fully accepted. When he asked me for a third interview I refused because his accuracy wasn't efficient.

(academic A, US: interviewed 18 December 2013)

I think it is very impressive, I think that when the articles that appears in the SKA they are very informed. I think there is a selective breed of people that are writing in the SKA, in my experience there are very few people who have done a bad job of

writing, and it has always been written in such a way that people understand these things. So for example; there were several articles done on our research group with David Davidson, he is the SARCHi chair, and they appeared in virtually every national newspaper. I had people who I knew back at university in Natal in 1986 who phoned me up or wrote to me and said ‘WOW, just seen this article, that is fantastic’ and the articles that were written were quite accurate articles and what I mean they were impressively accurate. They explained the purpose of the science, and I think people want to know about medicine and how their bodies work, so people are fascinated about science and how the galaxies and universe works. So people are interested in it naturally and I think it is a natural synergy that smarter journalists are writing about interesting topics tend to do quite a good job on it.

(academic A, US: interviewed 18 December 2013)

Q.25.

I do a lot of media engagement with the SKA media office itself, so Marina Joubert you probably came across, she frequently asks me for input. If there has just been a conference she asks me to write reflections about that, when I went to a sabbatical in Cambridge she interacted with me and wrote an article about that. So I frequently do things through that office. I get phone calls from various media institutions and I respond to those directly. I’ve also been asked frequently to contribute to engineering magazines and I respond to one or two of those. I get asked to advertise in the company magazine because of my ...[00:58] . To be honest I was so overwhelmed and couldn’t afford to advertise because I would not be able to handle the work that came my way. So that is the kind of engagement with the media.

(academic A, US: interviewed 18 December 2013)

Q.26.

I think if we had a couple of science correspondents who were really sharp in all the newspapers across the country, it could really help. It could help project the science case properly and it will also help keep the public technically informed. I think it is important for our public to understand technical things because you can put them to

layman's terms and perhaps we a little bit short on the quality of those types of people because I have only met a handful.

(academic A, US: interviewed 18 December 2013)

Q.27.

Generally when I have something to report I request to see what's been written up just to make sure and check everything for basic facts and so on. And it's always been fine. I have not had any gross representation of any of the facts... It's always good practice just to request to see whatever, and if people are working on a very tight deadline then I have had one journalist that was simply very lazy you know and "can you send me some drafts" and so I wrote him some text and that's exactly how it appeared. And sometimes you get these last minute requests for 6 o'clock in the afternoon saying can you speak on the radio this evening, and if one of us can do it then we do but it's not always possible with these last minute things. So, where possible we assist and where not I refer them to other people in the area.

(academic B, UCT: interviewed 13 November 2013)

Q.28.

From a scientist point of view, when you write a press release, you have to think very hard on how you would avoid any misinterpretation, so you must be very careful what you write. I have written a couple of press releases, and some fly and some don't fly, and the ones that don't fly are the ones that are just too complicated, people just don't understand the language or importance of the observation. So I think it would be good for the scientist to have some sort of training/workshop on how to do that efficiently, write press releases or how to explain things clearly.

(academic B, UCT: interviewed 13 November 2013)

Q.29.

It's not as if there is always one person that you can call... One of my contacts used to work at the SAAO, he is an astronomer, where he was actually the liaison person for the press as well. So he got to know some of these people, but even so it looks as if

it's hard for him to get quick response from them [journalists]. He actually said he knows *the Burger* person better and think she is called Elsabé Brits, and I've seen some things she does and I get the impression she makes an effort to try an understand things and does a reasonable job. But again she has to write about all sorts if science, so it's tricky. I don't think she is a scientist I could be wrong.

(academic A, UWC: interviewed 25 November 2013)

Q.30.

In our case I think the link with newspapers and journalists have been very good, some of it is initiated from outside when we have activities, programmes, conferences, visitors or the project like SCAR, we do approach newspapers and give them information. Sometimes the newspapers themselves approach us and we find it is quite a fruitful interaction and within our publicity and communication sector of the university there are people who have links with newspapers and they sort of complete this triangle and we find that information does flow quite smoothly.

(academic A, UKZN: interviewed 7 November 2013)

Q.31.

If there is anything astronomy-related that comes in our media releases that lands on the newspapers' desk, in KwaZulu-Natal say, then they will come to our unit to get more information, to get a quote, and to get our input. So for example, when the SKA project was awarded and 60% of it was awarded to South Africa there was a lot of media interested in speaking to us. We have also had a series of public talks by very famous astronomers from abroad and we have actually posted a kind of advertorial, advert advertising that, so it is not just free publicity but there are occasions when we have put an advert in the paper to get the news out to the public about a series of public talks and various other things.

(academic A, UKZN: interviewed 7 November 2013)

Q.32.

Naturally we deal with issues internally in the NRF, a lot of that is highly contained as you can imagine but there would come a point where we need to communicate with broader community. NRF serves that community so this is very much part of our job so we got to invest in the community but we cannot do this in an unconstructive way in an unconstrained way. We have got to address that very carefully. So it does come through me, I mean astronomy related matters. If I am unsure I will usually check with the CEO but by on large I speak on behalf of astronomy.

(government agency manager A: interviewed 29 November 2013)

Q.33.

On astronomy related matters I am not so hung up, so if they are talking with the CFO or usually if they are talking with an executive director it is fine... I think if they came to somebody lower down I will not be adverse to the idea of them speaking to the press, but I think the policy of the organisation is to escalate that upwards to a person who is going to be more knowledgeable. Nobody is going to want to talk to an official in the NRF about astronomy because that official is likely working on something that is quite specific like a grant proposal and more often than not that matter will be an internal matter and nobody is going to provide information about that. So the executive directors are free to speak and certainly at their level of the corporate executives.

...When I was at the astronomy tower meeting earlier this year and also one last year, there was a flurry of activities around that. Corporate communication put out a media blast on the event and then people started frantically calling... and called me up into an interview or asked to speak to other eminent scientists attending the meeting or call me on my cell phone, so it kind of just happened spontaneously.

(government agency manager A: interviewed 29 November 2013)

Q.34.

There is a phase running up to the site bid and then after that the message needs to start changing. It used to be more us trying to win the site bid and showing what

Africa can do. It is now more about global collaboration and making the project more successful.

(SKA manager D: interviewed 20 November 2013)

After flogging for their country for several years they obviously have to change the way they communicate, which they did but some cases take more time you know when you have been using the same message for so many years it is hard to change and switch in a day. You can still see in a few occasions that both Australia and South Africa some media reporting in the SKA as being an African project or a Australian project. So this was a top priority of all of us... because it is in the interests of both countries to reflect the reality and the reality is that it is a global telescope... So this is the main message that we all have to spread, and this is what the strategy is about, we are all under the same umbrella, and two sites for the telescope, and people working together in the same direction as opposed to people working in one direction in Australia and people working in one direction in South Africa.

(management interview – SKA international: 13 November 2013)

So when the decision came, even our press release talked about us winning the lions share and the major slice of the SKA... Now that the things have calmed down, the new message is more one of there are two continents involved and both are going to play a very important role... We try to stay away from messages like we won the bid, we just say that the project is shared between South Africa and Australia and this is what will be built there and this is what will be built here and these are the reasons why.

(SKA science communicator A: interviewed 23 March 2014)

Q.35.

It was a really crazy, busy period, and it was during that time that we set our policies on who can we communicate to. It was a difficult time to prepare for, because although we knew what the site preference was... we didn't know what the actual decision was going to be until... about the day before, and we had a plan in place with international office and their timing went wrong, so it was a bit difficult. The site was shared, but that was the first thing that went out, that the international project,

although we had agreed with them that we'd all launch at the same time and our minister, Naledi Pandor, was going to a media briefing, the international project actually announced first that the site bid was split, and so our media heard about that, and so there was no opportunity to highlight that our site had been chosen. It was also a lot of pressure on us from the international project to be shown to be working together, rather than us punting the fact that we had the preferred site.

So there were those sorts of challenges, but I think everybody knew that at the end of the day that we had won, so to speak. And then it was, we did have the media plans and the communications all ready, etc. so from that point of view it went well. We were just inundated, you know, our phone didn't stop ringing for days on end and there were media requests etc. But I think for some reason Beverley has something, that we didn't take as much of the opportunity as we could, but there were restrictions and limitations and we had to be careful about how we communicated and what we communicated, because we didn't want to piss off the international office by only focusing on the fact that we won the bid, although the minister did do some of that.

(SKA manager C: interviewed 3 December 2013)

Q.36.

Once the regional decision was made the Australians did exactly what we were going to do if we lost the site bid. They played the political side. We going to withdraw from the SKA, we are going to lose these resources, we have put in all this effort, we have got the ASKAP, all of those things, we can't not get anything. And that is exactly what we would have done. So I don't really think that the report in the media had would have changed that. It is though important to, if you go read the documents and then, there are still a few conditions on the split site decision. In terms of ASKAP the technology still needs to be proven, that's a very risky technology itself. And that there is a cost fact so maybe there may be a reduction in scope.

(SKA manager A: interviewed 14 November 2013)

Q.37.

We are so competitive with them on so many levels, especially sport, so it would be just human nature, what are the chances? What are their strengths and what are our strengths and what are the predictions? So it just kind of played out to a fever pitch about who is going to win this bid and I think that is the kind of thing that gets the media and people interested in and worked up and so on. The process was a very intense kind of thing but I did think it was good, it did create a lot of public awareness around the project and I think it was maybe a tool that we used that naturally happened that actually played in our favour of public awareness and in public interest.
(SKA science communicator A: interviewed 23 March 2014)

The Australians almost did us a favour because they always advertised that they were the natural choice, that we were the underdogs, and so I think, without us having to punt how well we've done, and the fact that we've come from nowhere to win.
(SKA manager C: interviewed 3 December 2013)

Q.38.

It was a bit like a cricket test match and many of the scientists were keen to indicate that this is not because we hate the Aussies - because we play cricket or rugby against them that does not mean this should be similar.
(academic A, UWC: interviewed 25 November 2013)

Q.39.

I believe they were very confident they were going to win site location. In fact they spread the message to an extent that they essentially already won it, that's a matter of having to go to the motions now to get it official. And I think in the process what happened was they had politicians who may have gotten some heat from not have winning the whole thing.
(SKA manager A: interviewed 14 November 2013)

Q.40.

We all adopted the policy that we weren't going to respond, because then it just gets silly, and it becomes unprofessional. And we knew that it wasn't true, and we had proven that time and time again, and we've been dealing with the Australians way of communicating and the things that they communicate for many years and one thing we've learnt is that you stay on the factual side of things, so you know, we've been to conferences before where Australia has given presentations, which basically all they were saying was that Australia was the right place to put the SKA, Africa is not capable, and we're all sitting in the audience, and all we did was go up and present the facts of what we've done of the site and we did that time and time again. In the beginning people thought Australia was the natural choice, over time when you're actually delivering and you're actually giving facts, it's hard for people to disagree. So in the end I think that we remained dignified, we remained honest and we just communicated the facts and we didn't respond to that sort of slander or that sort of unnecessary nonsense, shall we say.

(SKA manager C: interviewed 3 December 2013)

We did reasonably well to stick with the facts, of course we saw all these statements and they were inflammatory and we were a bit 'miffed' at times, but I think in general we had a pretty cool and measured response. We didn't try to fight the media battle in the same way. We focused on really getting stuff out and actually getting on with it and in the end I think sense prevailed, and people looked at what was available and where the science were, what power was there, what infrastructure was there, what progress have you made, what the costs were, and South Africa was the best place to put this thing. We actually did a better job with the site bid in the end. I think the committee actually realised that.

(SKA manager D: interviewed 20 November 2013)

Q.41.

In 2011 in mid-July, which was the last SKA forum conference before the decision was going to be made, each country had an opportunity to do a presentation and we had a presentation done by Bernie and Naledi Pandor and from their side, they had two of their scientists and then they had the prime ministers of New Zealand and Australia basically, with a pre-recorded speech and it was everybody in the audience,

now you're talking to educated scientists and engineers. We were actually embarrassed for the Australians because it was so choreographed, it was like a stage production and there was no real meat in it and then Bernie and Naledi Pandor stood up, spoke so eloquently and so wonderfully and blew everybody away and then Bernie stood up and presented what was actually happening in South Africa around the site, just the facts, what we've been doing and it went down so well. So it's just the way we move and absolutely I think the world has come to see, not only through SKA, is that we have huge amounts of talent in this country and in Africa and we're just now getting the opportunity to showcase that.

(SKA manager C: interviewed 3 December 2013)

Q.42.

Naledi was very clear that we weren't going to get into a mud swinging thing. We won on our own, an international panel chose us. It was not because of any aid... well politically we played that up a bit, but if you look at the reasons for why South Africa was chosen it is pretty technical. There was no mention of oh by the way this will help develop Africa, there was none of that.

(SKA manager and university scientist B: interviewed 5 November 2013)

South Africans took the higher ground, we were in close communication with the government and the minister and she actually gave us a clear indication that it was not South Africa's job to respond to the mud swinging coming from Australia. So we were, in NRF and the government, very particular to it and I think at some stage the astrophysics were one to get involved in this as well and I am glad that sanity prevailed and that we didn't really release any public statement that was attacking Australia in any way.

(government agency manager A: interviewed 29 November 2013)

Q.43.

In the last month or 2 before the announcement it became quite tense because they were very convinced that, we got the impression that they were very convinced that

they would win it... After the announcement came I saw a few articles at the time that said Australia had won the bid, so they also announced it as a victory.

(SKA science communicator A: interviewed 23 March 2014)

Q.44.

It was an upset that it got leaked and I do not know how it got leaked but that pushed them to make the announcement, they couldn't really hold it much longer; they had to go one way or another now.

(SKA science communicator A: interviewed 23 March 2014)

Q.45.

They know what the AGA act says and they've got to comply with it. That's the official line of the SKA... I don't think it gets reported all that well... fracking is just one of those things where people are not objective. I come from the Northern Cape; it would be horrible to mess up the Karoo. I feel very strongly about that. But I don't think things get reported accurately. ...People either play up that there is no risk or the greenies play up that there is a huge risk.

(SKA manager A: interviewed 14 November 2013)

If there were to be full blown fracking in the Northern Cape, yes it would affect radio astronomy, it would affect a lot more than radio astronomy, but we're lucky in that we're protected by the astronomy geographic act, so this is what we explain to people, a) that fracking is still kind of in the evaluation stages, so the evaluation stage is basically looking at the effects that large scale fracking could cause and we're involved in that process, you know, so we are involved in understanding the impact of it, and if after that it is stressful in that they find that there is gas and they decide to go ahead, we can still call on our AGA Act [Astronomy Geographical Advantage Act], which is authorised by the minister, to prevent any activities that could affect radio astronomy so we could still fall on that. So the media have asked about it but again, we just focus on the facts and the truth and you know, we're quite positive that we won't be affected.

(SKA manager C: interviewed 3 December 2013)

I have heard conflicting opinions within the SKA myself, from fracking will be a great source of power for us and doesn't actually cause a problem to it would cause radio interference.... If it does interfere on a radio frequency level then that would be cause to stop the fracking in these areas that are protected by acts.... So I think that is why the topic is being pushed, for the people who are against fracking the SKA could be an excuse to stop fracking.

(SKA manager B: interviewed 25 November 2013)

Q.46.

I think the question is much bigger than the SKA. I wouldn't trust the astronomy advantage act to protect the SKA absolutely. The Australian site it is also under threat of mining and so on, I think those are just ongoing things. There is pressure to bring in foreign money to the country. I think foreign countries have leverage on the South African government to a certain extent. So the SKA is an interesting space where this gets negotiated. Generally the environmental issue is that the fracking contaminates water, ground water, and what is the Karoo without its ground water? So the threat is bigger than just to the SKA, but does the groundwater have a champion in the government? Does the SKA have a champion in the government? Yes most definitely, so that is what gets discussed.

(SKA science communicator B: interviewed 29 January 2014)

Q.47.

The SKA is very complex, so there are things we have to talk about, for example justifying the expenditure of tax payers' money on science and research and we get that question a lot, you know... why are we doing this? What are the benefits to society? Why is government investing so much money? You know, those are tricky questions and they can, you know, they can lead to tricky situations if they are not carefully answered.

(SKA manager C: interviewed 3 December 2013)

Q.48.

It is an issue to manage expectations from the community verses what the project can deliver because the project can create some job opportunities and some income and so on but it is not going to give work and houses and hospitals to everyone in the Northern Cape and sometimes that is an expectation in the community.

(SKA science communicator A: interviewed 23 March 2014)

What we communicated from the minister down is that we're not taking away from any other department, no budgets have been cut to fund the SKA project. Every department in South Africa has their allocated budget to work with. We submit a budget and treasury decides if, how, when, if they're going to gather finance. So that's the first thing. The other thing is make it quite clear that we are not a job creation project per se.

(SKA manager C: interviewed 3 December 2013)

There was this expectation that the SKA was going to solve the unemployment problem and the homeless problem and all of this and the educational problems in South Africa. One needs to keep this in perspective... It is no use bothering Paul Diamond about how he is going to solve unemployment problem in South Africa. It is a terribly unfair question.

(government agency manager A: interviewed 29 November 2013)

Q.49.

You look at the amounts of money being spent on the project it is nothing being spent on the developmental projects. So we are not taking any money away in any big fraction from the developmental projects, hospitals, schools, anything they spend a lot more money than we do. All those roll-out projects like that, they do not need R&D or anything like that, and they just need delivery. So that is just the delivery process, eventually we will get to the point where the delivery is done and then what?

(SKA manager and university scientist B: interviewed 5 November 2013)

Q.50.

We're not going to create millions of jobs, for example for unskilled labour. We are sort of a project that focuses at the higher end of education and research and that's the main benefit, that we are providing high-level skills for the economy. And, you know, these skills drive innovation and innovation drives development in any country. So that's the main benefit and of course then there are benefits to local communities, etc. And that's our justification - you need research, you need innovation to drive an economy. It's a bit abstract sometimes, which is why you can't have anybody just answering it, because the public won't be happy to know that, well, some of them might, but that's why you need somebody to talk to those kinds of questions. Also again, we're answerable to the cabinet and to the president and so it is very important for someone like a director to take a vested interest in what is communicated.

(SKA manager C: interviewed 3 December 2013)

The SKA is an incredible vehicle for producing quality scientists along the lines that we have already talked about and we do need more innovation and more technical ability in South Africa to solve the problems of a lack of education and lack of basic needs and so on. If we do not invest in high-tech skills or abilities or high level education in South Africa, you would be forever redacted to a nation that is giving out hand-outs and is trying to basically survive the reality.

(government agency manager A: interviewed 29 November 2013)

Q.51.

When you take a child and you enthuse them, they get inspired they learn maths, they learn science, and they end up opening their own business, making a difference, growing the economy.... You know it's essential, the inspiring factor.

(SKA manager B: interviewed 25 November 2013)

People realise that you need a flagship project, you need to look after people's basic needs, that is for sure, but you also need programmes that inspire people and will make the nation great. You won't make a nation great by feeding everyone or by giving everyone basic education. You have to provide something that people will look to and go 'Wow, lets invest here, or let me study hard and learn about maths and

science so I can be involved in this project'... If we are just feeding ourselves and things that is ok but it is not enough in my view, we are not here just to survive, we want to thrive as a country and also be part of a world community.

(SKA manager D: interviewed 20 November 2013)

At all the public talks I give... I always have a start-up slide that goes back to the 1996 paper on science and technology which said 'we have to pursue fundamental science in South Africa because to not do it would forever tie us to the stone of feeding and clothing ourselves'. It had to become part of South Africa culture.

(University scientist and SKA manager B)

Q.52.

If you have a high proportion of scientifically literate people in the audience the way it is read more different and there will be any different attitude to whether this is good for us or not. So the message needs to be told, and I think the government has done in very good job here in South Africa highlighting the economic benefit... There is a civic duty of publicly funded science and technology to actually address all the stakeholders, including the taxpayers. It is a growing element and it is also possibly why scientific organisations these days have more investment in their communication, and here you have Marina and Garnier, and you have people that are actually hired to reach out and it is not about spending it is about reaching out and it is about getting involved in the community.

(SKA science communicator B: interviewed 29 January 2014)

Q.53.

A big challenge for the project was the fact that those farmers in the Footprint area wouldn't be able to get mobile phones and that was a big challenge for them to handle that and still get the support of the local community. It is just a fact of the project that you have to mitigate the radio frequency wave. They work quite hard through the local farming organisations like AgriNoord-Kaap to work with the farmers, and they had to buy some of the farms so some people had to move. There was a lot of sensitive issues as well.

(SKA science communicator A: interviewed 23 March 2014)

Q.54.

In Carnarvon they put up a tent on the school grounds and they invited the locals in. Every time it is between 4000 and 6000 people show up from the local community, so they are very interested and generally supportive. At the last one we had in November 2013 a few things came up with the expectations in the community and Bernie stood up there and said that the project will do what it can to create education opportunities for the local people and that is our angle, upliftment through education, but he does not have a budget to build houses or to build hospitals or clinics, he cannot use the SKA money to do that. So he did explain that with a lot of empathy and he did make it very clear.

(SKA science communicator A: interviewed 23 March 2014)

If you are at where the SKA is, it is fractionally closer to Carnarvon, and Carnarvon is a slightly bigger town compared to the other three. So people from the other towns are so sick of Carnarvon, Carnarvon, Carnarvon... They have made a lot of investments in Carnarvon at all levels, ranging from the local crèche to the primary school, I think there is a lot of money in the secondary school... they opened a knowledge centre in the library, they opened the cyber lab at the high school. A lot of the investment doesn't come from the SKA South African budget but from the corporate social investment budget from the partners. So the companies that get big contracts, they invest in the local town. There is a really big drive when they need unskilled labour or semi-skilled labour to use the local community.

(SKA science communicator A: interviewed 23 March 2014)

Q.55.

We have attracted the attention of the International Science Community, so the radio astronomy community and the engineering around that and we've attracted it in a positive way, so it's been positive recognition, people want to come here. And all of this is being funded by government, so government should be taking the credit for sort of deciding early on to invest in science, and I think that the returns on the investment

is something that they should use and do use and it's good. I mean this is a good news story about how investment pays off, so I'm sure the politicians do use it in their favour and so they should, you know, their foresight in investing in the project is something to be noted and they should be credited for it.

(SKA manager C: interviewed 3 December 2013)

Q.56.

The politicians believe the symbol themselves and see the value of it, and so fortunately we are internally not at odds with the direction they are putting on this thing. People see it will be of national benefit and it brings us onto the world stage, lots of things. We don't have to push hard to get into the political system, the politician are here, they are talking to us regularly and we share that idea about things. I think that is where the project kind of started as well, I think we realised that Africa could do this thing, but now we are realising that Africa can do a lot more, so that is quite encouraging. The vision is unfolding as we go. Initially it was just going to be hosting a site, then oh we better build instruments, and we can build instruments, and in fact we got world leading skills, and we happen to be leading in a lot of the international efforts now. Where do we take big data business, technology development, instrumentation development, there is just a whole international investment in the country, research labs being set up it is an endless good news story.

(SKA manager D: interviewed 20 November 2013)

Q.57.

That is often a problem in talking in general in South African science journalism where you have science and health, science and environment, science and education, where those other parts of the job will always trump science. Mine was science and technology which means focused on that pin head of growing out that space.

(science journalist C: interviewed 27 November 2013).

Q.58.

People do not think that science is relevant. We have science stigma in South Africa. Your stories will always be bounced off for politics and economics. I cannot tell you the number of times I have had Julius Malema bounce stories off pages for me, he really is one of the banes in my life....

There is a perception, and part of it is valid, that people are more politicised and more interested in politics than they are in science. We do not have 'science' water cooler convocation. You very seldom end up in conversations where people are talking about science in their lunch breaks, or I read this really cool thing about the fact that they encoded Shakespeare's sonnets into DNA. Those are not conversations you hear or hear often in South Africa. You hear convocations about that the ANC did this, the DA is saying that, COSATU, and the split in the tri-apartheid alliance, those are common themes, because we are a highly politicised society, more so than others.
(science journalist C: interviewed 27 November 2013)

Unfortunately in today's world how many people are interested in reading about some new KAT being erected, which is quite interesting to scientists but people in the street seem to be more interested in Miley Cyrus.
(academic A, UWC: interviewed 25 November 2013)

Q.59.

South Africa is in a unique situation if you look at our other partners, so you got Australia and you got the UK; both of them have a really high science base and good science education. It is less difficult to sell science in those countries than it is to sell it here. For example, I was working at a newspaper where no one at my news room knew what the Higgs Boson was, and this was in a very educated news room. When I punted the Higgs Boson as a front page story they laughed at me... That was on the front page of the *New York Times*, of the *Washington Post*. That is how big that story was internationally... It ended up being the anchor story which is 300 words. I had to explain a 9 billion Euro project and that was the combination of that project and decades of work and it got laughed at when nobody knew what it was.
(science journalist C: interviewed 27 November 2013)

Q.60.

It is very tough in South Africa because newsrooms do not dedicate resources to science reporting. So there is either journalism, where you copy and paste press releases and that, or people who are interested and have expertise in another area but just have to cover science. And people who are science journalists and covering science, often having to work in PR Companies. So I do not think Marina has a journalism training, she has communication training*, but I know a lot of journalists who have companies like Marina's because they cannot live off science journalism, and if you come as a science journalist it is not like you are given sport but if you are at a sports journalist you always have a job. So there is a big bias and I think that contributes to the lowering of science reporting in the country, not because it is taking press releases out, because it is, but there is no critical thinking. With a lack of skill in the newsroom, you have a lot of people that are publishing things as science, but they are not science, and that has a very sad impact, especially in South Africa, it is just not right.

(SKA science communicator B: interviewed 29 January 2014)

* The former Director of Southern Science, the South African SKA's science communication consultant, in fact has both a postgraduate science qualification and a postgraduate journalism qualification

Q.61.

Science journalism in this country faces a lot of challenges. And it is worth bearing in mind when considering the coverage of the SKA. We are lucky that SKA is a popular subject, because it has national pride And the government and the SKA organisation has done a really good job but I think a lot to that comes from government statements and their previous minister of science and technology, Naledi Pandor, who is such an incredible speaker and such a convincing advocate for the project. She has really sold it to the hearts of South Africans and to international communities.

(SKA science communicator B: interviewed 29 January 2014)

Q.62.

There's a difference between a science journalist and a science communicator. A science communicator will generally be a freelancer, have their fingers in lots of pies, do work for lots of people... I could never accept a story from you about the DST, ever, because you receive money from them. How can I take a story from a science journalist who has done an annual report of the organisation and then they're going to pitch a story to me on that organisation? It's entirely unethical. How can I stand by the fact that you've taken money from them and now you're writing about them?

I do a lot of talking, I do a lot of workshops, and I have to do it all for free, because I can never have it linked to my name that I took money from you and then I wrote about you... I've been asked to do writing for the SKA, and I responded and said absolutely not. Because firstly I know way too much and how can I, my first job is to look for the stories... I can't do that.

(science journalist C: interviewed 27 November 2013)

Q.63.

Generally the PR-type people that are in SASJA, it is kind of a cross river, how do you define PR and science communication? Generally people, and I put myself in that list, for many years I was working for North West University and raising awareness for their research projects, but that is science communication, not PR in the traditional sense. So it is one of those grey areas which cause a lot of discussion. In theory you could put it under PR but most of the people, if not all of the people, that are SASJA members, are communicators in that they will work for an institution or university. None of them are PR for big pharmaceutical companies, you know that kind of thing.

(science journalist G: interviewed 20 January 2014)

Q.64.

Science communication people... would post information on behalf of the scientists if necessary or they would post a release which gave contact details of the scientists. The journalist would then contact the scientist directly; the conversation would move off the Google group, I mean the journalist who is writing a story, unless they are inexperienced, is not going to keep the conversation going on the Google group.

(science journalist G: interviewed 20 January 2014)

Q.65.

You could not get the bigger picture of this if you do not include the Afrikaans media on what we have written because of where the telescope will be situated, in an area where people do not understand English at all. I mean if you go to one of the imbizos where Bernie, the Minister, and everyone else speaks Afrikaans, there is not a single word of English spoken. I literally have to sit there and translate for the English newspaper journalists because every single word is spoken in Afrikaans. The SKA have appointed an Afrikaans-speaking person to communicate with the communities because they will not relate to an English-speaking person.

The SKA have a monthly newsletter in Afrikaans for all the communities there. I think it is called Karoo Nuus or something, SKA news. Marina does it, so the SKA newsletter that they see is not the one that the communities that's in Afrikaans because the people there do not speak English. They don't read the English newspaper, they read *Die Burger* and they read *Volkblad* that gets distributed to them. That is what the Afrikaans press is doing in a way to form opinion, it is extremely important. I'm sorry but *Business Day* is not recognised, *Die Burger* is, or the *Argus* or *Mail & Guardian* or whatever. That is why the in-depth articles that I wrote with infographics to explain how the SKA will look, what it is, was bought by the SKA from the newspaper so they can use it in their newsletter to explain, in Afrikaans, to the people what they are up to because if you do not have the buy-in from your local community ... The *Engineering News* can write as much as they want or ...[another journalist] can write as much as she wants in the *Mail & Guardian* it is not going to make a shits difference in the Northern Cape.

(science journalist A: interviewed 27 January 2014)

Q.66.

My main sources are the SKA themselves, which is Marina Joubert, who would tell me something and I would follow it up or I pick up the phone and do it myself. I would phone Tracy Cheetham, who is the infrastructure manager, and say "Hi. How is

it going? It has been three months, what are you building now and where are you standing with the signal processor building and all the roads and everything”. So I phone the source of myself ... And then I have people there that I have built up as contacts myself to send me photos of something that I want, who is working for the SKA. So through the years I now have 20 people at the SKA; I can phone Adrian, I can phone Bernie, Jonas and if it is a data issue I can phone people in Cape Town.

(science journalist A: interviewed 27 January 2014)

If I want a comment from Bernie Fanaroff* I have his cell number, he knows who I am, so it's generally very easy and readily accessed.

(science journalist B: interviewed 5 December 2014)

* Director of the South African SKA project office

Bernie is a very good source, and so is Justin Jonas, and I would talk to people in and around it, as with any story, and I tend to do quite long interviews when I interview people. I generally don't phone people, so often my interviews, I don't know, even for a small story, I'd probably only be on the phone with somebody for twenty minutes, maybe longer, sometimes half an hour, forty minutes and I mainly only take two quotes out of that interview that go into the following day's story, but it's just having a conversation, a few ideas from them, from those conversations directly or further down the line when I'm working on another story that's information I would draw on.

(science journalist B: interviewed 5 December 2014)

I once again have a unique position because I studied radio astronomy at Rhodes with Justin Jonas and Adrian Tiplady, both of whom were my tutors. So where I get my information from for the SKA, I'll either get it through DST or someone will tell me something or I'll get it from one of the university professors working on it, I may get a phone call from Bernie telling me that something is happening. I might end up in conversation with somebody in the SKA organisation or I'll find something interesting.

(science journalist C: interviewed 27 November 2013)

Q.67.

My main gatekeeper would technically be Marina Joubert, who is handling their coms. Why would I go to Marina? When Marina would then have to phone the person to check if the person could speak to me when I could just phone the person. That's not to say that Marina's not good at what she does, but for me it would be adding unnecessary complexities to a phone call.

(science journalist C: interviewed 27 November 2013)

Science communication is primarily driven by the PR agency, which is Southern Science, which is extremely effective at pushing material out at journalists, like organising the site and just set up for them to come, for example. So, there's a lot of very reactive reporting that's going around the square kilometre array at the moment and a lot of my reporting is probably reactive too... within that though, it's selective, so we won't cover every new development that's discovered about the telescope and try rather to pick the bigger, more significant developments and then you fill in the detail that's been pushed out by the PRs.

(science journalist C: interviewed 27 November 2013)

Q.68.

In 2005, they took four journalists to the Karoo with the Premier of the Northern Cape and the Minister for three days and we visited the site. There is absolutely nothing, there is this one little container where they did the earliest radio frequency tests, Justin was there, Annette Loots was there, Bernie was there. We flew to Carnarvon to the gravel strip. Bernie said the one evening that all the journalists must attend this one lecture and we went, we were not very keen on it. He then gave a lecture on what radio astronomy is and what SKA is really all about. It was extremely handy and I learnt a lot that evening.

We were in a guest house we were staying two to three hours away, but that was where I learnt about radio astronomy and what the SKA is about. It was very long ago, 2005/2006, and we then got to know the people and that is where we started building our contacts.

That gave me the background to understand what the SKA is about and then they started telling us about the MeerKAT, no sorry it was still the KAT. Then I did the first reporting interview with Annette about the KAT, and an interview with Justin about the SKA. Before that I did a full page interview with Justin about the SKA and what it was going to be about, then they told us about the KAT... So it was very good background, taking us to the site and telling us what it was about and giving us material to work on.

(science journalist A: interviewed 27 January 2014)

Q.69.

Every time I have been to the site my stories have been used and they have been used very well. Also every time I have written an in-depth article on the SKA it has been used. I must say, when I have been to the site I have written more than one story and they have used more than one.

(science journalist A: interviewed 27 January 2014)

Q.70.

I don't have a lot of interaction with the SKA head office in Manchester, but on occasion when I have been working on stories and want more information I go directly to them and they're not as fast... I found them not as quick to come around as if I'm chasing someone here in South Africa, you know, I'm working through a press office so they don't know me from a bar of soap and may well be fielding requests information from people all over the place.

(science journalist B: interviewed 5 December 2014)

I also have connections with the international SKA where if I want to ask a question about the international SKA organisation I can pick up the phone and phone Phil Diamond, who is the director-general of the SKA organisation.

(science journalist C: interviewed 27 November 2013)

Q.71.

Yes there's engagement with international African countries. It's very very difficult to talk to anyone. I mean I've managed to make connections with a Ghanaian and Kenyan official to talk about African VLBR and that's about it and that was hard. It took about four weeks of emailing them..

(science journalist C: interviewed 27 November 2013)

Q.72.

I speak to locals but I'm really trying to push my external engagement, because you get fed a certain line in South Africa and it's very 'ra ra' South Africa and I've come to a point in my career where I'm struggling to give that up and I really want to give that up and the only way I get better is by starting to reach out internationally and make my stuff narrative internationally.

(science journalist C: interviewed 27 November 2013).

Q.73.

There have been a number of instances in which I've been sitting with a scientist and I've had to stop them and say 'if you carry on talking, this goes badly because I can't not report on it, when I am mandated to. They do not have authority to and I don't want to get them into trouble, because I don't think it's fair. It's the same reason I refuse to interview a Master's or PhD candidate, because they're not ready for me. I can take on a CEO, I can take on a minister. It's not fair for me to take on a scientist who hasn't had exposure to the media, because they don't know how to deal with it.

(science journalist A: interviewed 27 January 2014)

Many scientists in South Africa face general reporters who are not used to writing on science and they are nervous about talking to reporters for fear of being inaccurately reported and made to look silly. So, often when I interview someone for the first time, there's quite a lot of work that needs to be done to try and get the person to trust me. They probably don't read the paper I work for, why should they trust me when I say things like, 'No, I'm not sending you my story to read and proof read before it goes into the press, it's against editorial policy, it's a fireable offence' and that's not very nice for the scientists on the other end... to have a reporter saying 'I'm doing an

interview and trust me, I'm a professional and I know what I'm doing. Give me some credit. If I can't understand something I will come back and ask you with email and follow up with more questions'. But I can see it from their perspective as well, so often there's a little bit of a dance there about who's going to have control over that process and often the compromise is me saying 'well look, I appreciate where you're coming from, I do get it, how about if I phone you back with what I'm going to directly attribute to you' and then they're often quite surprised, they're like 'oh, you actually just read back to me what I actually said.' I just was wanting to make a point that I think sometimes it's very harsh for reporters who are trying to report on science and it isn't easy and it's daunting going into a subject that you don't know anything about and I think it's true for any reporter going into something that they don't know much about.

(science journalist B: interviewed 5 December 2014)

Q.74.

There's a lot of politics around it and I think people are quite cautious and careful about what they say about some things and other things they are happy to chat about, so if you want to talk to a scientist involved in the SKA in South Africa about the kinds of questions the telescope might help scientists answer... easy. If you want to have a discussion about what's really going on inside the board and where people are tussling over, with the telescope there was something about the governance structure for example... very hard to get any of it on record, so I think that's no different to any big project, or any big endeavour where there's politics.

(science journalist B: interviewed 5 December 2014)

Q.75.

I think the DST has great communications. I have a good relationship with the DST communications team. Good professional relationship..... From Veronica to... Veronica is, oh actually I shouldn't lead with her... Thabi, who is the minister's spokesperson, Tommy Makode who is head of comms, Veronica who works under him... I find them all to be incredibly helpful and facilitating. They are all still

government and whatever association you have their first port of call is to do their jobs and push the DST line. I don't know if there's a very strong line, because DST unlike other departments is populated by technocrats for the most part. Phil Vokade, the DG, used to be in the National Laser Centre, a lot of their DGs were in science institutions or the NRF before. They are competent. The people who haven't been competent with political appointees, and from what I discovered, because there is that pressure to do very well and work hard. I'm very proud of my department actually... They spent 99.5% of their annual budget, they've had clean audit I think for nearly ten years now... that's almost unheard of.

(science journalist C: interviewed 27 November 2013)

Q.76.

I find the DST very good to work with. I don't actually quite know how I could improve my relationship with them. If I phone, someone answers. If Tommy doesn't answer I call Thali, if Thali doesn't answer I call Phil, if Phil doesn't answer then I start harassing the person I need to speak to, whether it's a deputy director-general and I manage to wangle, even though I don't think they know it I have Derek's cell phone number. So if I want to escalate something or go nuclear then I can always call the minister.

(science journalist C: interviewed 27 November 2013)

Q.77.

Don't tell us when something happened three days ago, images are actually very important and access to WIFI. You know they took us on a trip to the SKA last year when the president was there and they put us in accommodation 38km from the town and there wasn't even a land line. None of us could file... They do everything around their convenience and they always put all the dignitaries and then the media and what they don't click is the way I talk to the nation is through the media. They do not need to like me, that is fine, but they need to realise that the journalist is the one that communicates your message for free. Go to any ad company and say you want to have a 30 second ad on TV. It will cost you a couple million to make the ad and a couple million to broadcast and then you have this poor sod tagging along for free, for

free you get your news out, imagine that, and you treat them like shit. I went to Tommy and I said please don't put us 80km out again. The next morning they were supposed to pick us up on a specific site and then they took us to town to a specific site and they said be here at 7 o'clock that is where the transport will leave from to the site. They didn't come and collect us and I had to hitch a ride to the site and when I got there I said to Tommy that he forgot me and he said oh did we, and that was the response. It was a trip from hell.

(science journalist A: interviewed 27 January 2014)

Q.78.

So there was a story ran this week about a debate or discussion going on about the SKA government's structure that came out of a conversation I had a couple weeks ago and I didn't have the time to do it until recently. And then when I have the time I look at their websites and I look to see what's coming up and I run a Google alert which looks at the Science in South Africa and I pick up stuff from that as well. And I watch twitter, watch everyone else.

(science journalist B: interviewed 5 December 2014)

Q.79.

It is not sexy enough, it is not interesting enough. In science people are not interested in incremental gains. It is one of the things that make keeping the SKA alive so difficult because you are inching forward, you cannot always make a big announcement. A big announcement will get you a place on page one, but naturally it was done on a Friday and you cannot get a page one on a Friday, that was on the 25th of May last year.

When people see science they want to be wowed by it, they don't want to know the background, back-aching inch by inch grind that science actually is. So how do you do that? The SKA at the moment is negotiating the host agreements and the partnership agreement, how do you make that sexy when it is a bunch of governments sitting around deciding who is going to get what and how do you make people interested in that when there is no science yet? At the moment they are building roads

on the SKA site and putting up infrastructure, infrastructure is not sexy unless someone stole it.

(science journalist C: interviewed 27 November 2013)

Q.80.

It all comes down to audience. For example, the *Mail & Guardian* is a very politicised, left-wing newspaper and the *Business Day* is economics, so in *Business Day* your top intro will always have money in it. So we are trying to speak to a certain sector reader... I wouldn't be able to write what I do for the *Daily Sun*. So my middle class audience I expect to be interested and I can sneaky sneaky jump science on them. People who will go and buy *Popular Mechanics* or *New Scientist* will go and buy it, it is the rest of the population when you want to fit your science in between the economics and the politics lead where they will have science stealthily put on their plate without them knowing or find it interesting and they will learn something almost by accident.

...[At the *Mail & Guardian*, the focus is on] social impact. There's the narrative. At the *Mail & Guardian* we focus a lot on narrative stories, so for example I had, on my pages... I now have two science pages a month... I ran an SKA spread about South Africa schizophrenia... world class science meets poverty. That is structured in a narrative way, the way the story is told is narrative, and it's told from the perspective of the people in the SKA. That's very different to *Business Day* where *Business Day* would have been, what's the money?

(science journalist C: interviewed 27 November 2013)

Q.81.

The big thing that was interesting for me with this project, it was something that caught the imagination of ordinary people from the start, and also the media. It was never a difficult sell. If I can make a comparison; when I used to work at SAASTA and you have a topic like nanotechnology or hydro fuel you really had to work on the media to get them to report on that. With the SKA from the start if we had sent out invitations to a media event or something, it would be 24 out of the 25 people we

invited would show up, so it would even be some people that we didn't invite would show up, and it is unheard of. I have done media liaison for lots of other scientific topics and it was always a battle to get three or four journalists to show up for something, but with the SKA it was always easy to get them interested and easy to get them there and it was the first time that I had worked on a project where the media would proactively want more information. It is almost like after two or three years of working on the SKA it went through a public awareness about the project and it wasn't necessary for us. It is not a good thing to be responsive only but responding to media inquiries you could have a media profile all the time in some way. Obviously it is better to be proactive and focus on the things you want to focus on. And also the interest has been from around the world from quite early on, anything from Poland to Russia to Japan to China and of course there was a lot of media enquiries from Australia from the time of competition because they wanted to know what is happening over here and so on.

(SKA science communicator A: interviewed 23 March 2014)

It was quite easy to generate news early on. I can remember a few news conferences we had at the Rosebank offices in Johannesburg where we couldn't fit the people in. They had to stand in the passages and listen through the door, so that was nice in a way, and there were a lot of media enquiries from abroad as well. So that made it easy in a sense. It has really been a full-time job just handling the requests that come your way.

(SKA science communicator A: interviewed 23 March 2014)

Q.82.

The SKA isn't any different than any other story in the paper. The SKA stories must stand on its own legs and compete with all the other stories... The news values and news worthiness of the SKA stories aren't different from any others. It gets judged by the same standards. It has to be current... The news value that is important for any other story is important for the SKA stories. Proximity, if there is human interest, the hard news factor, the curiosity. All those things that are the basic for journalism is the same for the SKA.

(science journalist A: interviewed 27 January 2014)

I guess it's the same criteria I use for any story, which is trying to understand what the significance of it is, so if you can't come up with a satisfactory answer to that question, then so what? Why would my readers care about this? And it's probably not a story. And then I think about the audience that I write for and what their interests might be, and yet that being said, you can craft an angle or craft an answer to the question 'so what' if you think more broadly about what's happened.

(science journalist B: interviewed 5 December 2014)

Q.83.

So now the only reason South Africa is interested with the SKA is because it is here and because we beat Australia and we like beating Australia. It is a sort of national pride but we have a tendency to fall behind national pride without actually knowing why.

(science journalist C: interviewed 27 November 2013)

I think in terms of the communication there were 2 very distinct phases. What fuelled the media interest in the first five to seven years was the fact that there was this competition, first with several other countries, then eventually with Australia. The media as you know loves that kind of thing, what are our strengths and what are our chances and what do people predict and what are the Aussies saying. So the competition element was a big thing in the first phase. Then post the announcement of the site bid outcome we had to go into a completely different phase about what is going to happen now and try to get the idea across of collaboration instead of competition and also start focusing on the science and what will exactly happen.

...I do not think that we will get the same level of public interest in the science as the site bid decision. But also the thing that we have to keep doing is bringing it back to everyday life, like the things that the scientists are finding here now, they are doing the science but at the same time they are developing systems to handle huge masses of data and we will be able to use it in future. You have to try bring it back to everyday life otherwise it is going to become abstract and very removed and people will lose

interest. I would love for the SKA to keep telling people that it is useful and what is it actually doing.

...It was an easier sell in the competition than it is now, I mean that last month before the announcement was made, if we invited the media they all came plus 20 more that we didn't invite. But now it is going to be harder. It is still easy now because it is spectacular, the physical constructions and the physic things that are being built and it is beautiful and so on especially the visual side. I think the hard sell is going to come with the science that the SKA are doing because I sat through a few sessions at the SKA science conference in February in Stellenbosch, it is very technical and very hard to turn that into news and even in the development phase of planning the science, the press release that I did when they has the first science paper was with KAT 7 and it actually got news coverage around the world and I have learnt that in media your partners are very important.

(SKA science communicator A: interviewed 23 March 2014)

Q.84.

It's a way to make it sexy because aliens are sexy.

(science journalist C: interviewed 27 November 2013)

People often ask us proper questions, well the scientific normal questions first and then at the end they throw that one on because that is what they really want to ask.

(SKA manager D: interviewed 20 November 2013)

That's what attracts attention, attract funders for example. If anything is going to pick up signals from anything extra-terrestrial, it will be the SKA, so the chance is there... There are people who ask, and the answer is that there is a possibility.

(SKA manager C: interviewed 3 December 2013)

The public latches onto it very quickly and some governments, like the United States, is very keen to explore this so funding is available for programmes that seek to discover extra-terrestrial life.

(government agency manager A: interviewed 29 November 2013)

Q.85.

There was a big double page spread. It was the first time the SKA got lots of coverage in the *Sun*... It is something like “are we all going to love the aliens”... This article was very typical of a tabloid newspaper looking for an angle, so the whole angle on the SKA was about aliens. But I will be honest with you, if you look at the science goal for the first phase, like MeerKAT, the extra-terrestrial life is a long-term peripheral science goal.

(SKA science communicator A: interviewed 23 March 2014)

Q.86.

There is an internal protocol, which is not clear that people would necessarily follow. The idea is that there is not an immediate media splash, but it will get out there pretty quickly I’m sure. The scientists who discover this thing would need to communicate with other observatories to confirm the signal, because you get a lot more confidence in your detection if it is detected in multiple different observatories. So you can realise it is not your own system effecting your system. So the protocol is that you must distribute the news to other observatories and they co-observe and then you release a cautious joint statement at some point. If some signal was detected it would have a huge effect on the psyche of mankind.

(SKA manager D: interviewed 20 November 2013)

Once the SKA starts going science in 2024 we will need to have a protocol in place for announcing all its science breakthroughs; whether it is finding signs of life or whatever else because there are other things that could be major news.

(SKA science communicator A: interviewed 23 March 2014)

I do not see that one should be too worried if there was such a discovery and if it is in fact it will be a media blast from all around the world. Personally I do not see how there will be any controls from [government actor] to manage that. But I am certainly not holding my breath.

(government agency manager A: interviewed 29 November 2013)

Q.87.

I don't think I have actually ever been commissioned to write a story. Everything that is in the newspaper that is written by me are stories that I have found. Almost always got through press releases, I spend my time digging, so then I will collect a diary, I will pitch my story, I will say what isn't a story and what is a story in science. Part of the problem is... so then I will go to the news desk, the news desk will then take my stories or not, if it's business, the business team will take my story or not because I don't have a supplement... because they say that they cannot find advertising to give me those pages. It's a constant and long running battle to try and get dedicated science pages.

(science journalist C: interviewed 27 November 2013)

Nearly everything I produce is self-generated, so I choose the content for publication. The only exception has been a national supplement on the SKA project to which I contributed, but I was not in charge of this project and had no input into the design and overall content.

(science journalist D: written response received 9 April 2014)

Never a PR agency involved... My newspaper has never told me anything on how to report. There are no influences at this paper, not only on the SKA but on anything, it is never done.

(science journalist A: interviewed 27 January 2014)

Q.88.

Usually we cover the SKA when a milestone has been reached in the project.. like winning the bid, the first MeerKAT dish installed etc.

(science journalist E: written response received 15 April 2014)

[My messages are generally] very positive, to the effect that SA is capable of being a bastion for science and technology.... My own personal excitement and enthusiasm for the project I am sure causes some manner of bias, but I think the same applies to

all SA science reporters when it comes to the SKA, simply because of our national pride for winning the bid.

(science journalist E: written response received 15 April 2014)

Mostly the SKA is portrayed positively because it is a major achievement for the country. It is considered a good news story in a country where politics and crime are always on the front page.

(science journalist F: written response received 24 April 2014)

Q.89.

I have literally looked at everything. I've looked at the science, the five thousand antenna for MeerKAT. I've looked at the technical side, I've done multimedia, video. I've done huge info graphics. I've done question/answer with Bernie, I've done question/answer with Justine. My focus is literally everything.

I would say [the tone] is generally positive, positive and informative. I think if you have been a reader of Die Burger for the past eight years and you have read it daily, you would know the very technical details of the SKA. You would be up to date, you know the progress of it, and you would know how it works, you would know about it. Radio antenna, you would know what Gregorian offset is, you would know what is going on on site, you would see the progression of the site, everything. I would say it is objective and straight forward, what you see is what you get. If there was corruption I would report on it, but I haven't come across anything.

(science journalist A: interviewed 27 January 2014)

Almost all of these news stories and features are positive; I can't recall any piece I have written that I would consider "negative".

(science journalist D: written response received 9 April 2014)

Q.90.

Science communication is primarily driven by the PR agency, which is Southern Science, which is extremely effective at pushing material out at journalists, like

organising the site and just set up for them to come, for example. So, there's a lot of very reactive reporting that's going around The Square Kilometre Array at the moment and a lot of my reporting is probably reactive too... within that though, it's selective, so we won't cover every new development that's discovered about the telescope by the agency and try rather to pick the bigger, more significant developments and then you fill in the detail that's been pushed out by the PRs.

(science journalist B: interviewed 5 December 2014)

Q.91.

When something is announced, I'll try and throw it forward to the next milestone... throwing it forward, so work packages, people are reporting on work packages... my question then is, I've already written about work packages so my next milestone would be funding agreements and the hosting agreement, which is set to come out either the end of this year or beginning of next year, so my story will be on the hosting agreement, throwing it forward, so taking the story to the next milestone and using work packages as fillers, so my top will be something that's happening in the future, something for people to look out for, because that way I own the story and everyone has to follow me.

...If it's happened it's boring. If it's happened it means it's going to be everywhere else, everyone's going to be reading the exact same story... how am I being fair to my readers if they come to read my stuff, to look at something different and I tell them exactly what everyone else has said?

(science journalist C: interviewed 27 November 2013)

Q.92.

'That is called escalating a problem because you are then effectively going over their head. So you got your news editor, you got your page one or executive editor, sometimes this is also the newspaper editor. So in going higher up you are going over their head, you are disenfranchising them and you are making a very difficult situation for yourself. It has to be one hell of a story for you to do that.'

(science journalist C: interviewed 27 November 2013)

Q.93.

There's also an element of how hard you push your story because if you think about a newspaper, for example, there are, you know... let's say I have a story that I think might be something that I think could go on the front page. There'll be a discussion with my news editor and then that discussion in the morning goes into a news conference midmorning and then as the day wears on, then there'll be a discussion with the person editing the front page who says 'well, I'm not sure. Tell me a bit more about it', so in a way then I'm selling my story to that person who has got a flood of reporters all competing for five spots on that front page. There's also an element of how well am I going to sell the story. It may be an easy sell, something that everyone agrees is a great story, or maybe it may not be. It may be one where you persuade the person who's editing that section of the paper that it is worth putting in there.

(science journalist B: interviewed 5 December 2014)

There's always a subjective element to what goes on in the front page of the newspaper and that's the editor's prerogative and I work for a paper which has an editor that likes science and so I like to do upfront stories on what we call the bottom strip. It's short and punchy but they do run and within that, you know, the person who edits the front page will have his or her own personal preferences and it is subjective, you know. There'll be times when the person running the front page really liked medical research and a lot more medical research appeared on page 1 because of that. And then there'll be times when a person editing that page is less interested and medical research stories will run on page 3. So they get used, but they... I think it starts from the top actually. If the editor likes Science stuff then it'll get in.

(science journalist B: interviewed 5 December 2014)

I think the biggest problem for some journalists reporting the SKA project is to be able to convince the editorial hierarchy of the importance and significance of the project, and I would suggest that the SKA executives approach the SA National Editors' Forum with a view to setting up regular meetings/briefings and perhaps even a formal communication channel. These remarks do not apply to all media outlets – a newspaper like *Die Burger*, for example, takes the SKA very seriously and devotes

significant space for coverage – and also not necessarily to editors. Rather, there is probably a lack of awareness, or at least sufficient awareness, among the middle-ranking editorial decision-makers, e.g. news editors, night editors, chief sub-editors, and perhaps some way should be found to include these journalists in briefings and updates.

(science journalist D: written response received 9 April 2014)

[A pro-science editor] just saying on more than one occasion, ‘I want to see more Science in the paper’ and there’s no specific instruction about what that means or what kind of science, it’s just ‘I want more’. And I think that’s why he created a post for a second writer at one.

(science journalist B: interviewed 5 December 2014)

Q.94.

On any one day a reporter on a newspaper or working for a broadcaster is fluttering through the stories and ideas and things coming at them and then they also have their own diary that they are working on, so a story, on a quiet Monday morning, a story that’s really not that significant that’s happening with the SKA... let’s say it’s the first Monday in the first week of January... that may end up being a big story for us because there’s really very little going on and we desperately need to fill some space. That same story landing at 3 o’clock on a Thursday afternoon might be nothing more than a brief, because if news is busy then we are spoilt for deciding what to package out for the next day. So a lot of it depends on what else is happening at the time, or what other commitments I have as well.

...It’s also an element of newsroom dynamic, where if I’ve got one on a really busy busy day and there’s an early page deadline and I say to my news editor, look I’ve got this story and it doesn’t look that strong but there’s a space and I know you want an early copy and I can deliver it within the next forty five minutes, he’d probably say ‘yes, please. Send it through’. If I try and pitch a story at half past five, saying ‘oh, I’ve just found this out about the SKA’, and they would probably say no... early page is gone, it’s not strong enough for page three, hold it or write it for the web.

(science journalist B: interviewed 5 December 2014)

If the editorial budget(s) had been bigger and if there had been more editorial space available, I would probably have generated more coverage of the SKA, e.g. by being able to attend briefings and events that are not in Cape Town. ...It [also] depends on what information is available at the time and also on how much editorial space there is likely to be for it, e.g. a short news story for a tight news page in the daily *Cape Argus*, or a full feature page, with space for several pictures, in the *Weekend Argus*.

(science journalist D: written response received 9 April 2014)

Our editor is like a CEO, I would pitch the story and obviously I would have to find an angle so it doesn't help if the SKA lets me know the new pedestals being installed and they already standing for three weeks, so it is a bit old. It has to be current. So I would pitch a story and the news editor will put it on a news list and it all depends on how much space we have for that particular day whether that story would be used or not. The news editor will then brief the editor and chief editorial team at about 11 o'clock in the morning. Then the day progresses and other stories come and they compete, that is why I say the SKA stands on its own two legs. Then there is another briefing at about 4 o'clock, there is one at 2 o'clock and 4 o'clock. Then at 4 o'clock is it pretty much decided on what gets in the paper or not. That is why we always say I have to have my news by 4 o'clock. Then there is a content editor and a night news editor and one of the deputy editors on duty during the night, who basically decides if it comes into the paper or not. Keeping in mind what the news editor told them. I can go, if I feel very strongly about something, go and pitch my story again there. But the editor will very seldom tell them what to do.

(science journalist A: interviewed 27 January 2014)

Q.95.

We've politicised it... it was South Africa versus Australia. It was developed country versus developing country. It was all the preconceived notions about... South Africa and Australia have longstanding contentions between each other where with the brain drain, with people who have left South Africa to go and live in in Australia being very anti-South Africa justifying their move and South Africa being very resentful of the people who've left... So there's that history of antagonism existing already... I

remember on the day that it was announced and in South Africa it was all, ‘oh, a kick in the teeth for Africa, we should have got the whole thing, we had the better site’, because we politicised sites.

(science journalist C: interviewed 27 November 2013)

Q.96.

It seems to have been engendered in many people a sense of national pride and it’s certainly the message that the government puts out... They see something we should really be proud of, you know, this is a place that has been beaten down for generations by an Apartheid government and it’s been time and its right and it’s fitting that we should the world that actually, we can really do amazing stuff here and amazing science.

(science journalist B: interviewed 5 December 2014)

Q.97.

She made some rude remark about what I’d written and I was there but I wasn’t able to respond, and then [name] spoke to me afterwards, ‘oh, she’s very unhappy with the story’ and I said, ‘well, what exactly was she saying?’ ‘Oh, that it’s very inaccurate’ and so I asked ‘what’s inaccurate?’ and then he couldn’t answer that question and I never got to the bottom of it and all I was left thinking was, they did not like the idea that there was a story in the paper that had tried to pull in what the Australians had to offer. And it was a time when no one was really reporting on what was going on in Australia and that had been the story I was trying to do. I was trying to get a sense of, well, we here in South Africa, always hear this kind of very positive message from the government... we have the best possible place to put the telescope, but surely I thought the Australians would be saying exactly the same thing to their people and that was the story that I was trying to flash out and the response I got from the Australians wasn’t that substantial, but I put a little bit in of what I had to offer and that seemed to really get on their nerves, and of course that does give you cause for thought as a reporter. You know, either you go ‘oh, well I must be more careful in future’ or you think ‘well, is this water in a well that needs to be dug out?’ and yeah, I think they would like to support it and of course the Department of Science and

Technology puts a spin on everything they send out, they are totally guilty of putting out information devoid of any international context.... It's about South Africa and doing it for ourselves, and I think they have to justify their existence around the budget.

(science journalist B: interviewed 5 December 2014)

Q.98.

SKA South Africa does the best that it can, but its set up in Carnarvon, which is a shithole, where the government has entirely left those people to rot, it's a forgotten place and if it weren't for that telescope, it'd be like all the other forgotten places so there's that... where no matter what the SKA does, it will never ever completely save Carnarvon. It's not its job to save Carnarvon because it's scientific bureaucracy but it also can't just sit by and do nothing.

(science journalist C: interviewed 27 November 2013)

That does come up a lot with this project because it is so big and so grand and gets so much attention. It's that classic 'guns versus butter' debate. You see it play out in the communities where big science projects happen. It plays out in Sutherland where the Southern African Large Telescope is built, and it's playing out in the community in and around Carnarvon. The media will of course report on it, and it's also a way to report on a story that's a long story and a slow moving one in many respects.

(science journalist B: interviewed 5 December 2014)

I would like to think that the questions I ask on the bigger stories, the features, are more critical, but I reflect what I see. I've just been to Carnarvon and written this piece about community expectations and I reflected what I saw... it might not be what someone else sees and you might see a different tone to it, but I saw a big project that's trying really hard to be sensitive to the unrealistic and enormous expectations on a very poor community and drawing some boundaries and saying 'we hear you've got lots of problems, but some of those issues are for the government to deal with and most of those issues you're raising are government's issues and responsibilities, not ours. We came to build a telescope. But they're doing nothing for the local community either.

(science journalist B: interviewed 5 December 2014)

Q.99.

There's the farm issues, where the farmers complain about signal, which also brings in Telkom, and Telkom can't put in Telkom lines there because the equipment keeps getting stolen, and it's not economically viable to put in there, but at the same time farmers need communication. And then you've got the SKA, and SKA is trying to make a plan, DST is stepping in trying to fix it, and then I also think that the farmers had original problems that they're now tacking on to the SKA to get what they want. So all of these are complex issues that are being brought to the fore by a scientific project.

(science journalist C: interviewed 27 November 2013)

Q.100.

The [1996] White Paper on Science and Technology. I love it, that we have to focus on the basic sciences or else we, quote, 'forever chain ourselves to the treadmill of feeding and clothing ourselves'. How do we get better without Science?

(science journalist C: interviewed 27 November 2013)

The politicians say it will create jobs. I've written extensively about that and while the SKA is a telescope it is not a job creating factory... Yes there have been people over the years that have trained there, you have over five hundred PhD and postgraduate students been trained through the years. There have been many people that have been trained there, so there are unrealistic expectations of the SKA as a job creator. In the first place it is a telescope.

(science journalist A: interviewed 27 January 2014)

In a country like South Africa with so many pressing welfare needs, you have to have that kind of political commitment or it just won't happen. Once you've got that commitment, you need to have some kind of big message going out, otherwise why is the government spending so much money on this big telescope project when children go hungry and don't have school books and people live in appalling houses, appalling

conditions? So, I think that in a way, that political message had to come with the commitment to the project.

(science journalist B: interviewed 5 December 2014)

Q.101.

Where are the conversations about the actual science of fracking? Why are we not having that... so everyone is saying no, it's so bad, you shouldn't be fracking. Why is no one looking at the regulations of fracking, or the monitoring, or whether we have enough people to monitor it, the science of how we would monitor it? This loud cacophony of nonsense and we as a South African community are doing it because we're not finding scientists or science reporters reporting on it and stuff like the environmental reporters, which is generally hijacked by the environmental lobby, or you're having business done by business reporters. We're not having a middle ground conversation about it... So on the one side we have the corporate lobby, on the one side we have the NGOs. Where is reality?

(science journalist C: interviewed 27 November 2013)

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