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RRI IN CHINA AND SOUTH AFRICA: CULTURAL ADAPTATION REPORT

Deliverable 3.3

NUCLEUS

DELIVERABLE DESCRIPTION

NUCLEUS not only studies *responsible research and innovation* in European countries, but also in China and South Africa. This cultural adaptation report contains two case studies on *responsible research and innovation* in China and South Africa. Based on an empirical survey, observational field trips, and this cultural adaptation report – a Roadmap to implement *responsible research and innovation* will be developed.

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PROJECT

NUCLEUS is a four-year, Horizon 2020 project bringing Responsible Research and Innovation (RRI) to life in universities and research institutions. The project is coordinated by Rhine-Waal University of Applied Sciences. For more information, please visit the NUCLEUS website, follow our social media, or contact the project management team at info@nucleus-project.eu.

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EXECUTIVE SUMMARY

This study presents findings from two case studies on *responsible research and innovation* in China and South Africa respectively. The study focused on the following questions: *How are RRI and relevant other concepts implemented in international contexts? What are barriers and successes to the future implementation? What can be recommended for the future implementation of RRI in the Nuclei?*

The findings are based on a multi-method approach using qualitative research methods, which include literature and interview studies. In China 30 interviews were conducted with researchers and leading management. In South Africa 13 interviews were held with researchers and science centre managers. Analysis was performed at the conceptual, governmental, institutional and individual level, based on the following themes: equality; science education and open access; stakeholder and public engagement; and ethics and broader impacts.

Findings show are that RRI can be identified in many concepts, policies and practices, despite not being a commonly used term in either China or South Africa. In China, there is a strong emphasis on science communication and popularisation and social responsibility of researchers. In South Africa, equality, science education, outreach and stakeholder engagement in the form of including indigenous knowledge and people is important. Both countries are actively developing policies to further these; have installed agencies for science education, communication and popularisation; and are focusing on (even more) developing globally competitive universities.

The most important **recommendations** are:

- Work towards open and innovative research with minimum levels of regulations.
- Continue efforts to raise levels of scientific literacy.
- Share knowledge and research experiences with (developing) countries, for example by stimulating open access and open communication.
- Play a leading role in developing *social responsibility* and *community-oriented research*.
- Increase trust in science by stimulating research ethics, attention to impacts of research and open communication about all research findings.
- Create and facilitate means, such as platforms, to exchange knowledge and best practices on science communication and engagement.
- Use incentives to embed *responsible research and innovation* in universities and research institutes.
- Recognize and facilitate role models.
- Acknowledge the efforts of researchers regarding science popularization, science education and engagement.
- Raise awareness and train researchers in research ethics.
- Stimulate equal access to universities.

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1 INTRODUCTION

Universities, scientific institutions, and researchers can be found in all regions of the world, from crowded cities to the driest desert and the icy plains of Antarctica. Researchers in all these, very different places will partly encounter the same challenges, such as securing funds for projects and using standardized research methodologies to make sure peer review, publication in international journals, and replication are possible. The vastly different environments and cultures, however, also mean that researchers will encounter affordances and constraints that are specific to their country or their culture specifically.

As in the field trip and the European study, this study follows the definition of *responsible research and innovation* (RRI) as defined by Von Schomberg (2013, p.19):

> “Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).”

The NUCLEUS project focuses on identifying what can be key factors for the successful embedding of *responsible research and innovation* in academic practices. Identifying constraints as well as affordances for such practices is an important part of the project. International comparison is of interest as it will enrich the insights from the European study and the field trips. Insight in constraints and affordances from around the globe can help in making the NUCLEUS’ Roadmap for successful embedding of *responsible research and innovation* more complete. This report, therefore, describes *responsible research and innovation* in China and South Africa, where two of the partners in the NUCLEUS project reside.

The central questions in the case study are as follows:
How are RRI and relevant other concepts implemented in international contexts? What are barriers and successes to the future implementation? What can be recommended for the future implementation of RRI in the Nuclei?

To be able to collect data that enriches insights, methodologically, a multi-methodological approach is preferred. Not only will collection of data via a variety of sources allow for a broader cultural perspective to RRI, but also it will enable to collect data within the restricted budget and time available. To allow comparison of the two cases, data for each case will be collected in the same way and the analysis follows the same process. Data collection at the conceptual, governmental, institutional and individual level form the background of this study.

OUTLINE OF THE REPORT

The remainder of the report is as follows. In Chapter 2 the methodology is introduced. In Chapter 3, a brief description regarding studying *responsible research and innovation* in China and South Africa is given. Chapter 4 contains the findings for the case study on China. Case study findings for South Africa are presented in Chapter 5. Finally, in Chapter 6 conclusions and recommendations for the implementation roadmap are given.

2 METHODOLOGY: A MULTI-METHOD APPROACH

The NUCLEUS project wants to support academic institutions and researchers to implement *responsible research and innovation* with clear recommendations grounded on philosophical analysis and empirical study (proposal, p.10). The project will deliver, in August 2017, these recommendations in the *Implementation Roadmap* (D.3.6), which will also be based on this report. The two qualitative case-studies of this cultural adaptation report will provide insight in both the understanding of and what helps and what hinders practices of *responsible research and innovation* in China and South Africa.

The findings in this report are based on a *multi-method approach* with *mixed qualitative methods* to ensure more detailed insights. A rich variety of sources was used to collect data.

LITERATURE STUDIES BASED ON MULTIPLE SOURCES

Findings for the literature studies for both cases come from multiple sources of information such as academic literature, reports and news articles, policy documents including regulations and statistical reports as well as survey results, personal communications and presentations. An important part of the NUCLEUS project are the field trips. The purpose of the field trips was to gain insight in best practices in specific parts of *responsible research and innovation*. The field trip to China looked at public engagement in Beijing. The field trip to South Africa focused on the role of the civil society and took place in and around Pretoria. The field trip reports were included as sources as well.

INTERVIEWS

In addition, in China and South Africa, semi-structured interviews were conducted. The questions were based on the interview protocol for the European study developed by Bielefeld Universität (see deliverables D3.1 and D3.5) and were adapted after testing. Main themes for the interviews were as follows: background, challenges for research and society; engagement; impacts of research on society; governance of research; changes foreseen in practices and policies; responsibilities; and support wanted or needed. One final question asked for respondents' expectations for Europe regarding *responsible research and innovation*.

In China, Yin Lin from CRISP supervised thirty interviews. The interviews were conducted in Chinese and the report was translated into English. In South Africa, SAASTA's Shadrack Mkansi and Vanessa Naidoo facilitated 13 interviews (either via Skype or face-to-face). The recordings of the interviews[1] served as the basis for the analysis. The interview questions, the consent form, and the information for the interviewees can be found in the Appendix.

[1] For one interview, however, the recording failed and the report was based on the notes taken during the interview.

BENEFITS AND LIMITS OF A MIXED-METHODOLOGY

Mixed-methodology is considered a valid and valuable research strategy that contributes to good practice and better understanding of the research topic (Greene, Benjamin & Goodyear, 2001). Using various, in this case, qualitative methods in the study allows for enhanced validity and credibility of inferences, greater comprehensiveness of findings, more insightful understandings and increased diversity (Greene et al, 2001; Patton, 2002), and, thus, a deeper understanding of arguments and motivations related to *responsible research and innovation* in both countries. It also allows to outline the broad ways in which *responsible research and innovation* can be practiced. There are, however, also limitations to any chosen methodology. Qualitative research never is (statistically) representative. Practical challenges during the collection of the interview data, such as unreliable internet connections during Skype interviews, were dealt with at an ad hoc basis.

3 STUDYING RESPONSIBLE RESEARCH AND INNOVATION IN CHINA AND SOUTH AFRICA

There are several definitions of *responsible research and innovation.* A widely used one has been given by Von Schomberg, which is used in the NUCLEUS project:

> “Responsible research and innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)” (Von Schomberg, 2013, p.19).

What the European Commission understands as *responsible research and innovation* can be read in the following definition:

> “RRI [Responsible research and innovation] is an inclusive approach to research and innovation (R&I), to ensure that societal actors work together during the whole research and innovation process. It aims to better align both the process and outcomes of R&I, with the values, needs and expectations of European society. In general terms, RRI implies anticipating and assessing potential implications and societal expectations with regard to research and innovation. In practice, RRI consists of designing and implementing R&I policy that will:
>
> - Engage society more broadly in its research and innovation activities,
> - Increase access to scientific results,
> - Ensure gender equality, in both the research process and research content,
> - Take into account the ethical dimension, and
> - Promote formal and informal science education” (European Commission, 2017a).

The European Commission describes “thematic elements of RRI”, or *keys*, that are the focus of “RRI actions” (European Commission, 2017a). There are five thematic *keys* (public engagement, open access, gender, ethics, and science education) and one that can be seen to be overarching (“integrated actions” or governance).

The European Commission has used the terms *responsible research and innovation* and the *keys* since Horizon 2020. In June 2015, the Commissioner for Research, Science and Innovation, Carlos Moedas introduced *the three O’s – open innovation, open science and open to the world (*European Commission, 2017b). The three O’s are meant to reinforce existing ideas and policies. Commissioner Moedas has set *the three O’s* as “goals for EU research and innovation policy”, meaning that they will be important in shaping the policies on research and innovation.

The purpose of *open innovation* is "to introduce more actors in the innovation process so that knowledge can circulate more freely and be transformed into products and services that create new markets, fostering a stronger culture of entrepreneurship". "*Open science* represents a new approach to the scientific process, based on cooperative work and new ways of diffusing knowledge by using digital technologies and new collaborative tools". Finally, *open to the world* underlines "the increasing importance of international cooperation in research and innovation and sets out the gains that the EU can make by maintaining its presence at the highest level of international scientific endeavour" (European Commission, 2017b).

Introducing more actors, circulating knowledge via new and traditional means, and (international) cooperation are characteristics the *three O's* share with *responsible research and innovation*.

CONCEPTS, POLICIES AND PRACTICES IN CHINA AND SOUTH AFRICA

The concept *responsible research and innovation* is not used commonly in China or South Africa (see figure 3.1): a literature search at the library of the University of Twente for "'responsible research and innovation' and China" generated eighteen results. The search for South Africa came back with five results. This finding does not mean that practices of research and innovation in China and South Africa do not align with *responsible research and innovation*. A more cautious reading of these results is that practices of research and innovation are conceptualized in other terms than *responsible research and innovation*. This means that *responsible research and innovation* should preferably be assessed by looking at these practices of research and innovation in China and South Africa. Based on the European keys, below, the themes addressed in this study are described.

Equality

This study focuses on equality rather than gender. The European Commission's gender key has limited relevance for this study as other groups, such as ethnic groups or disabled people, are not included in the key. When looking at access to research and innovation, inclusion of these groups is important too, especially in a country like South Africa with its *apartheid* history. For this reason, findings for *equality* or equal access to universities and research positions rather than *gender* are included in the analysis.

Science education, outreach and open access

Sustaining a knowledge-economy, being an innovative country or for citizens to form informed opinions about innovations or research findings that can affect their lives, all require science education and outreach. In this study, science education, outreach and open access are therefore part of research and innovation.

Stakeholder and public engagement
Stakeholder and public engagement are ways to bring together citizens and stakeholders to exchange views on the priorities in and effects of research and innovation. Having insight in this allows to (re)focus research and innovation so that research and innovation (also) address societal priorities.

Ethics and broader impacts
Ethics is an important element of *responsible research and innovation* as it refers to the moral considerations in research and innovation processes and the impact research and innovation and its products can have on citizens' lives, society and the environment.

The policies and practices of *responsible research and innovation* are analysed at three levels – governmental, institutional and individual – which together provide more insight into how the concept is adapted (at the conceptual level) in China and South Africa.

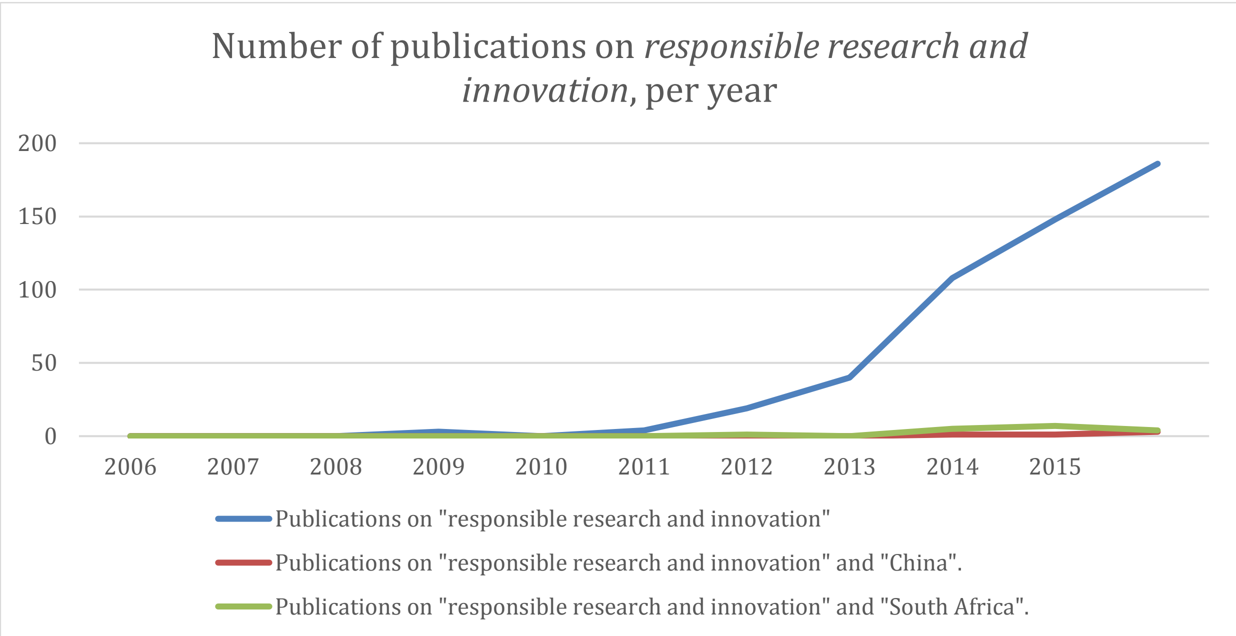


Figure 3.1. Indication of the growing body of literature on *responsible research and innovation* as found at the library of the University of Twente. Note: this figure shows the number of publications for both countries as well as the number of publications for RRI in total. Of the 18 publications found for China, one is to be published in 2017 making the total number of included publication for China in the figure 17.

4 CHINA

This chapter describes findings from China regarding the concept *responsible research and innovation*. First, contextual information is provided, then findings related *to responsible research and innovation* in China are presented at the conceptual, governmental, institutional and individual level, whereupon, conclusions are drawn.

4.1 HISTORICAL, SOCIO-ECONOMIC AND POLITICAL CONTEXT

China has a long history. It is one of the cradles of civilization. For millennia, China's political system was based on dynasties until, in 1912, the Republic of China replaced the last imperial dynasty, the Qing dynasty. In 1949, the Communist Party of China won the Chinese Civil War and established the People's Republic of China. Beijing became its capital. After Mao Zedong died in 1976, economic reforms were instituted. In the 1980s and 1990s China transformed from a planned economy to a mixed economy with an increasingly open market policy. From the 1990s onwards, the economy has been growing at almost 10% on average. Even from 2008-2013, during the worldwide economic crisis, China's growth still maintained an average annual growth of 9% (Cong, 2016, OECD, 2014).

In terms of GDP, China became the second-largest economy in 2010 and is catching up with the largest economy, the USA. Looking at the GDP per capita, China is an upper middle-income country (see UNESCO report by Cong, 2016). The change to a role as economic superpower is shown by the creation of the Asian Infrastructure Investment Bank to finance infrastructure projects; the approval by the so-called BRICS countries (Brazil, the Russian Federation, India, China and South-Africa) of the New Development Bank to be based in Shanghai; and the creation of an Asia-Pacific Free Trade Area.

In 2013, Xi Jinping and Li Keqiang took over the state presidency and the premiership respectively. According to the latest UNESCO report (Cong, 2016), China has at the moment reached a steadier, albeit slower growth, a plateau which is called the 'new normal' (*xin changtai).* The GDP-growth, for example, in 2014 was 7.4% (Cong, 2016, p.621), while it was 6.9% in 2015 and 6.8% in 2016. According to Cong (2016), rising labour costs and environmental regulations make it necessary for China to transform its economic development model from one that is labour-, investment-, energy-, and resource-intensive into one that is more dependent upon technology and innovation. In addition, Cong (2016) argues in the UNESCO report that China is, at the moment, facing several challenges related to an inclusive and green development, the aging society and the middle income trap. Therefore, the new leadership has put forward an ambitious reform agenda with a strong focus on innovation through science and technology as is pointed out in the 13th Five-Year Plan which was launched in 2016 (Cyranoski, 2016).

SPENDING IN RESEARCH AND DEVELOPMENT

Over the past decade, China has invested much in science, technology and innovation because of its aim to become an innovation-oriented nation. Gross domestic expenditure of research and development (GERD) has been 2.08% in 2013 and 2.09% in 2014, which surpassed the average expenditure of the EU-member states in 2013 (2.02%). According to the *Science, Technology and Industry Outlook 2014* (OECD, 2014), China will outpace the USA as the world's leading Research & Development spender in 2019. China's science aspirations and its research expenditure are again emphasized in the 13th Five-Year Plan (Cyranoski, 2016; Xin, 2016). Economic growth with an aging population increasingly depends on good education at all levels. According to the latest OECD report (2015), enrolment at all levels has soared but education inequalities exist due to differences between rural and urban areas and social stratification, while gender, age and regional differences contribute less to these differences. In 2013, China counted 25.5 million undergraduates and 1.85 postgraduate students, while the number of researchers is the world's highest: 1.48 million full-time equivalents in 2013. Since 2011, notable successes have been achieved in the sciences and engineering as well as in the medical sciences (OECD, 2014). See also table 4.1.

Name:	People's Republic of China (1 October 1949)
Capital:	Beijing
Inhabitants:	1.381 billion
Area:	9.6 million km^2 (9,596,961)
GDP (2016 estimates):	GDP (PPP) Total: 20.853 trillion dollar (2nd) Per capita: 15,095 dollar (83rd) GDP (nominal) Total: 11.383 trillion dollar (2nd) Per capita: 8,239 dollar (72nd)
Ethnic groups:	91.51% Han, 55 minorities
Official language:	Standard Chinese (Mandarin). Recognised regional languages: Mongolian, Tibetan, Uyghur, Zhuang, others.
Research & Development (2013):	GERD: 2.09% # undergraduates: 25.5 million # postgraduates: 1.85 million # fte researchers: 1.48 million fte

Table 4.1 Key facts China (sources: Cong, 2016; OECD, 2014, 2015; IMF, 2016; Wikipedia).

Trends in Science and Technology regulation: solving the problem of 'two layers of skin'

A series of policies promoting science, technology and innovation advances have been the key to China's successes. Since 1978, attitudes towards science, technology and innovation have been positive. In 2013, Xi Jinping indicated at the ninth group study session of the Politburo of the CCP's Central Committee that China should focus on integrating innovation with socio-economic development; enhancing the capability for innovation, nurturing talent, constructing a favourable policy environment for innovation and continuing to open up and engage in international co-operation in science and technology. In this line, according to the UNESCO report (Cong, 2016), the new leadership is focusing on weaving together the so-called 'two layers of skin' (*liang zhang pi)* of research and the economy which means research should contribute more to economic growth rather than staying a pure academic domain. In 2015, an innovation-driven development strategy was released by the Central Committee and State Council which reflects the importance to innovation restructuring China's economic development model. Important also, as stated in the UNESCO report (Cong, 2016), since there exists a mismatch between input and output. Despite massive investments, China still depends on others for innovation. Closer examination shows, according to the UNESCO report that reforms across all three levels (macro, meso and micro) of the national innovation system are wanted as "there is a lack of co-ordination between various actors at the macro level, an inappropriate performance evaluation of research projects and programmes, individual scientists and institutions at the micro level" (Cong, 2016, p. 629). Innovation alone, therefore, is not enough, and, amongst others, stimulating scientific literacy is considered important to strengthen development.

In the following sections, first, findings are given of how *responsible research and innovation* is conceptualized in China. Thereupon, the sections consider responsibility and innovation at the governmental or policy level, the institutional level as well as the individual level. In the analysis the themes outlined in the previous Chapter are included. These are equality, science education and open access, engagement, ethics and broader impacts.

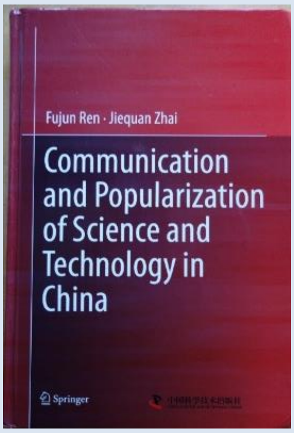
4.2 RESPONSIBLE RESEARCH AND INNOVATION AT THE CONCEPTUAL LEVEL

In China, according to Turnheim et al (2014), the phrase *responsible research and innovation* is only a recent theme. However, for years, the Chinese government has encouraged scientists to involve themselves in science popularization and communication as part of their *social responsibility* and with the purpose to establish a long-lasting collaborative relationship between scientific research and science popularization, and, in that way, to enhance scientific literacy of the public. So far, the focus of *responsible research and innovation*, lies on 'Communication and Popularization of Science and Technology in China', as is shown by the book with this title (Ren & Zhai, 2014) (see also Box 4.2). Every scientific researcher is, thus, responsible to communicate their research (Cheng & Shi, 2008; Yin, 2016). Most respondents agreed that the purpose of research is to serve society and lead societal progress. This purpose is independent from the type of research, according to the respondents. Few respondents stated that research cannot have a social responsibility. They stated that only in its use right or wrong can be done and, therefore, the responsibility lies with its users (CRISP, 2017).

Box 4.1 Main sources for the findings for China

Interviews. Based on a *semi-structured interview protocol* in total *30 qualitative interviews* were conducted in China. The interviews lasted about one hour each and were conducted in Chinese. Of the 30 respondents (19 males; 11 females; in leading positions such as professor, vice-professor, dean or director; with ages ranging from 29 to 76), 22 were scientists from universities and 8 from institutes in Beijing. Their fields of research varied and included, amongst others, statistics, robotics, seismology, water resources, education, stem cell, transportation, and agriculture.

Literature. A key publication in China and available in English, is the book *Communication and Popularization of Science and Technology in China,* written by Ren and Zhai in 2011 (Chinese edition), published by Springer (2014). The book covers advances in science and technology communication and popularization practice and research in China and abroad. It provides an extensive and updated overview of Science Popularization and Communication in China. According to professor Fujun Ren, nowadays general director of the general office of CAST and former director of CRISP, the authors work towards a new book focusing on the practices of science communication in China to be published in English in 2017. In recent years, some publications have been published in English in, for example, the journal Public Understanding of Science. Respondents indicated that publications also those about science communication and popularization mainly are in domestic journals.

Professor Fujun Ren

According to Xu, Huang & Wu (2015), *science popularization* is the main concept used in China, and it refers rather to a kind of activity or tool than to a theory. In papers included in the analysis, the focus was on notions such as scientific popularization, scientific literacy, popular science publishing, and science communication (cf. Jia & Liu, 2014; Wu & Qiu, 2012; Xu, Huang & Wu; 2015; Zhang, 2015). Public engagement was discussed in various ways depending on the definition of engagement as influencing decision-making, or broader as engagement in science communication activities in which large groups are participating in practice. Xu, Huang & Wu (2015) concluded that a shift from public understanding to public engagement is taking place, but, according to the authors, China may not have maintained pace with developments in the international field. Topics where engagement is happening spontaneously are related to environmental issues and biotechnology (Xu, Huang & Wu, 2015).

Turnheim et al (2014) argued that, despite that RRI as a concept does not appear in Chinese science and innovation policy yet, other related concepts such as *responsible research, research ethics and science and technology studies* have been discussed for some time now and concern scientists (responsible research) as well as industry, the public and the government (responsible innovation). In meeting minutes from the 7th Framework Programme PRoGReSS report, they pointed out that science and innovation policy, first of all, used to be strongly driven by economic development with research and technology serving that purpose. Second, science and technology were considered the driving forces for economic and social development. And, third, traditionally, China is governed with a top-down decision-making system with a strong state and a comparatively weak society (Turnheim et al, 2014).

However, they witnessed changes regarding, first of all, the public who becomes more aware of rights and risks and more interested in social and ethical questions around innovation and technology. Second, regarding the government, who is trying to ensure a greater distribution of the benefits of science and innovation, in particular in key areas such as population health, ecological environment and public security. In this regard, the authors argued that the government is trying to involve more parties. Third, they saw changes within the scientific community. Researchers are becoming more aware of research ethics and integrity, for example, regarding scientific misconduct while, according to Turnheim et al (2014) major Chinese Science and Technology institutions have issued norms of research ethics by defining principles, scoops and tools to tackle scientific misconduct in research ethics. The China Association for Science and Technology (CAST) announced in 2015 that it is taking measures to prevent scientific misconduct (Hvistendahl, 2015) while also the Chinese government is taking steps to prevent fraud. Finally, globalisation strongly influences the development of RRI in China. Two projects, the Global Ethics for Science and Technology project (GEST) and the Promoting Global Responsible Research and Social and Scientific Innovation project (PRoGRess) are leading initiatives which stimulate international cooperation with, for example, the Chinese Academy of Science and Technology for Development (CASTED) and Chinese Academy of Social Sciences (CASS) (Turnheim et al, 2014).

In a personal meeting with professor Li, director of the researcher support centers of Scientific Norms and Ethics and Scientific Popularization and Education, and the Institute for Policy and Management (CASS), she argued that engagement in China is mainly in the style of science popularization and communication (Li, 2016). Recently, also Li has noticed changes regarding public engagement. Increasingly, scientists become more active and reflective. Their attitudes are changing as is shown in two examples. In 2008, she organized the first consensus conference in Beijing on the topic of GM-food. All rules for consensus conferences were followed and participants, including participating citizens, showed their capability of contributing in a significant way (Li, 2016). Another event which she organised was a so-called Change-of-Roles-event where scientists went into the press offices while journalists visited labs. The two groups learned a lot from each other's experiences. These experiences are in line with findings from the interviews and the literacy survey (2016). According to the majority of the respondents, people's desire to engage with research will increase with their level of scientific literacy (CRISP, 2017). A few respondents said that it will take longer than five years. However, according to the survey findings, levels of engagement are higher in the eastern areas of China and the large cities in contrast to the rural areas and within those with a higher educational background.

4.3 RESPONSIBLE RESEARCH AND INNOVATION AT THE GOVERNMENTAL LEVEL

In the past 30 years the field of *science popularization and science communication* in China has developed rapidly. The popularization of science and technology is part of a national strategy which is reflected in various policy documents. Several policy documents have been particularly important. First, in 2002, the *Law of the People's Republic of China on the Popularization of Science and Technology* was installed. The Science Popularization Law is the only law regarding this topic in China and aims at promoting science and innovation via Science Popularization and Communication. Based on the Science Popularisation Law programmes and outlines for science popularisation and communication are designed. Since the Science Popularization Law has been installed in 2002, efforts for science popularization have been redoubled. Most likely, the Chinese government and the Chinese Academy of Science and Technology (CAST) will revise the Law in the near future to further stimulate science and innovation (Ren, 2016).

Second, in 2006, the *Outline of the National Scheme for Scientific Literacy* (2006-2010-2020) was issued. Key in the *Outline of the National Scheme* is the notion that scientific literacy is of great significance for the development of citizens and to build Chinese society (Outline, 2016). "Science researchers and organisations, partly through their involvement in science communication, should take up their social responsibility to engage in science education" (Cheng & Shi, 2008, p.161). The *Outline of the National Scheme* is designed to stimulate improvements in the quality of science, to promote innovation and to promote the capacity building of scientific literacy, through science and technology education and training, developing resources for dissemination, using mass media and to build infrastructure for science popularization. The scheme describes actions with missions and measurements. These address various groups in society, in particular, young people, farmers, urban workforce as well as leading cadres and public servants (Ren & Zhai, 2014).

A recent important policy document is the *13th Five-Year Plan* which was launched in 2016 (The 13th Five-Year Plan, 2016; Cyranoski, 2016). Even more than before, it is emphasizing roles for science and technology as well as for science popularization to help foster innovation. As president Xi Jinping pointed out, science and technology and science popularization are the *'two wings'* to achieve innovation and development. In the 13th Five

Year Plan, therefore, various policy measures are included to stimulate science popularization and scientific literacy. Respondents from the interviews pointed at these policy measures. On the one hand these are aimed to stimulate the translation from research to benefit society. On the other hand, science popularization and communication activities will be increased with the aim to raise public scientific literacy which is seen as a prerequisite for further development. The 13th Five-Year Plan also includes stimulating efforts to promote research integrity and ethics as well as training for researchers to become more aware of their scientific conduct, moral consciousness and a sense of social responsibility (13th Five-Year Plan, 2016; Li, 2016).

In September 2014, the State Council delivered a document issued by the Ministry of Science & Technology named *Guiding Opinions About Establishing the Reporting System of S&T Project* which requires the state funded large scale S&T research projects to submit reports with summaries of the projects for open access to the public. This document aims at facilitating the saving and securing of scientific research results, its successive accumulation, open access and sharing, and finally, its transformation and application.

CHALLENGES FOR CHINESE RESEARCH

More in general, the respondents noted various challenges for research in China and mentioned policy measures that are issued to tackle these challenges. The first is the lack of innovation in research. Much research is introduced or copied from abroad, and, therefore, policy measures aim to encourage scientific innovation, as, for example, 'the Proposals on Implementing National Strategy of Innovation Driven Development' (issued July, 2016, in: CRISP, 2017).

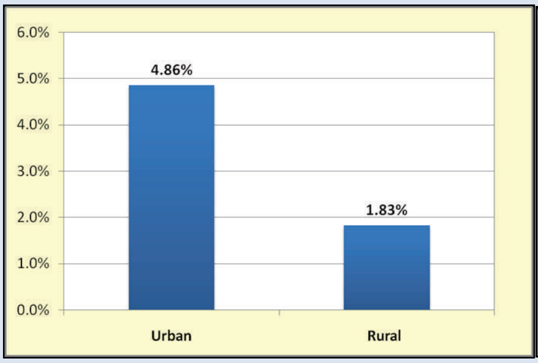
Second, the translation from scientific results to society should be improved. According to the respondents, researchers strive for rewards and titles, work under immense time pressure, and they are not familiar with the possibility to translate findings to society. The national government has issued policies to encourage such translation and increase and improve collaborations between universities, research institutes and companies. An example is the 'Act Scheme to Stimulate Transformation of Scientific and Technological Achievements' (issued May, 2016 in: CRISP, 2017). Respondents agreed that research outcomes should lead to applications in short and medium term. Both universities, institutes and companies should work on it. The majority of the respondents agreed that they would foresee changes in this respect.

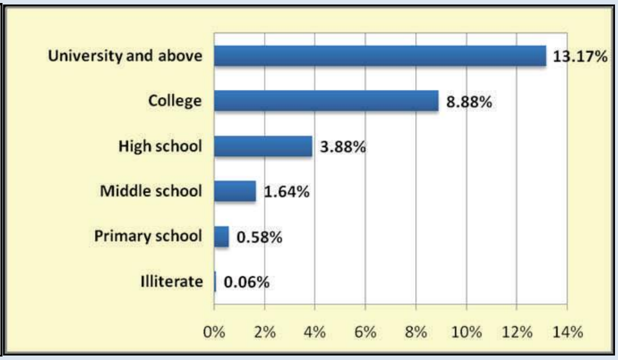
Third, the administration surrounding Chinese research is heavy. This leads to financial challenges, the assessment of researchers based on granted programmes and number of publications in key journals. It also leads to neglect of scientific rules, thus scientific misconduct. According to the OECD report, plagiarism is widespread at universities (OECD, 2015). State Policy measures, such as the policy document 'Proposals on Further Improving National Financial Administration on Science Research Projects' (issued July

2016) aim to ease the administrative tasks. In addition, the innovation of research is strongly stimulated in ‘Proposals on Deepening Institutional Mechanism Reform and Implementing National Strategy’ (issued March 2015). Respondents expected that in the next five years the financial management of research projects becomes more liberated, which would give researchers more time to do research and also to spend more time on science popularization and communication. Measures that respondents mentioned include for example, simplifying the budget and delegating budgeting tasks. Finally, according to the respondents, funding for scientific research should be increased. They argued that both investments in fundamental as well as applied research to solve real problems is needed (CRISP, 2017).

Box 4.2 Scientific Literacy Survey

To measure people’s level of scientific literacy, on a regular base, under supervision of CRISP, the Chinese Science Literacy Survey is conducted. Scientific literacy is measured with three aspects: knowing the necessary scientific knowledge; mastering basic scientific methods and advocating the ethos of science. Outcomes of the survey show a steady rise in levels of scientific literacy. In 2010 (N=68,416) the level of scientific literacy increased to 3.27% (from 1.60% in 2005, and 0.2-0.3% in the 1990s) while outcomes of the most recent Survey conducted in 2015 show an increase to 6.20% (Ren, 2016). However, differences between literacy levels of citizens in the rural areas versus citizens in the urban areas are significant. In 2010, the urban workforce showed a scientific literacy level of 4.79% versus 1.51% for farmers (see figure left). In addition, respondents’ level of education matters (see figure right)(CRISP, 2011). The aim is to reach a level of scientific literacy of 10% in 2020. To reach that many more government policy measurements, and many action plans and programmes are planned in the 13th Five-Year Plan.





Respondents were asked about their views on different aspects of governance of research. Regarding **equal access** to universities, they mentioned that, at the moment the requirements for young researchers who want to work in universities are quite strict. Young researchers will need a doctoral or post-doctoral degree with oversees experience. Their research capabilities are expressed by their publications on the Science Citations Index. For young researchers, however, there is a special Youth Fund which attempts to encourage young researchers when they have no national level projects due to less experience (CRISP, 2017). More in general, China has a very competitive education system which focuses on mainly on test scores and less on social skills. Access to top universities from other provinces is not equal for all according to the OECD report (2015). The OECD report (2015) recommends that universities and staff should be evaluated more on the quality of academic outcome and promote research autonomy.

Open access of publications was regarded important by the respondents to enable them to conduct scientific research. For researchers at universities access to publications is relatively easy. The universities will buy access to the databases so the papers can be downloaded freely. Access to publications from abroad is more difficult to get hold to than domestic papers. For scientists and specialists at research institutes access is more difficult and often restricted to domestic publications. Both groups of respondents, researchers from universities and from institutes, thought it was very difficult to obtain data from the governmental organisations in China. Most of the (statistical) data is confidential. However, respondents stated that they expected the government to be more open on data and information as that can promote the overall level of Chinese scientific research (CRISP, 2017).

4.4 RESPONSIBLE RESEARCH AND INNOVATION AT THE INSTITUTIONAL LEVEL

According to Ren & Zhai (2014) science popularization and communication is institutionalized in the following ways. To increase scientific literacy in China, a main task is dedicated for science education which takes place both inside and outside schools. In the *Outline of National Scheme,* a systematic approach to *science education and training* is described, which takes place both inside and outside schools, for example in the section on 'Project of Science & Technology Education and Training' (Outline, 2006). Science & Technology education at all levels will help to improve literacy at large. While formal education in schools has its limitations, for example, in incorporating cutting-edge science, therefore, informal activities and other can enhance understanding.

Many organizations have their own bureaus or departments for science popularization and communication whose duties are to disseminate and communicate science. For example, the Chinese Academy of Sciences (CAS) has founded the Bureau of Science Communication. Its main tasks are designing and implementing the communication of results of innovation and stimulating the communication of scientific research to the public. The National Natural Science Foundation of China and many other universities have installed bureaus with similar tasks.

Main channels for science popularization are the following. At the national level, yearly, two big science popularization events are organised and sponsored by government. In the third weekend of September, *science festivals* are organised in various cities of which the biggest is the Beijing Science Festival. Part of the science festivals is the national *Science Day*. BAST (Beijing Association of Science and Technology), one of the NUCLEUS partners, plays a major role coordinating this event at the national level. To stimulate professional development of festivals all over the country, a training programme (e.g.

Seminar on the Organisation and Operation of Science Festivals) is offered by BAST which increases professional knowledge about organising events. In addition, recently, both qualitative and quantitative evaluation processes are executed to learn from the Science Festival experiences. Finally, a Round Table Conference is organised each year to exchange knowledge and experiences with Science Festivals all over the world (Yan, 2016). Also at the national level, each year in May the *Science & Technology Week* is organised all over the country with about 30,000 activities and festivals and 10 million visitors. According to the China Science Popularization Statistics issued by the Ministry of Science & Technology, in 2015, this number has risen to 117,506 thematic activities and 157 million visitors.

At the community level as well as on the local level, there are also plentiful of activities organised throughout the year, such as lectures, labs that open doors and various local events such as 'big-hands-small-hands', summer and winter camps, anniversaries. Also, at the local level some public engagement activities are organised.

Another way science popularization and communication is institutionalized in China is via facilities, such as science museums, parks, popular science education bases and mobile science and technology exhibitions (e.g. so-called movable science museums, science wagons, science pictorial corridors) (Ren & Zhai, 2014). In 2009, China counted 618 Science and Technology museums which have a flagship role in educating and engaging the public. The mobile facilities are popular in remote areas. According to Ren & Zhai (2014, p. 100), the importance of public participation via interactive activities is recognised by practitioners of science popularization and many facilities now include hands-on experiences. Examples are the so-called 'simulated earthquake' and the 'simulated flying' projects which the public considers highly attractive.

The main media channels in China for Science & Technology popularization are TV and newspapers (CRISP, 2011). CCTV has more shows and programmes on science and technology than before. Increasingly, web-based (internet based) science communication and popularization gets attention because of its characteristics to use multimedia, work on high speed, the large capacity and a high degree of interaction. Goals are to inform and to explain policy. According to Ren & Zhai (2014) it is important to set up mechanisms that train scientists in science communication and learn journalists how to use the knowledge of scientists.

RESPONSIBILITIES FOR UNIVERSITIES

When respondents were asked about the responsibility for institutions such as universities, they said that, first, universities should provide researchers with communication platforms where researchers can conduct science communication. Examples are online science communication courses from Tsinghua University, training programmes and open courses. Second, universities also should support researchers to communicate their findings and help them with writing popular essays. Third, respondents also would be helped with an internal platform where they exchange experiences and ideas for communication. Interdisciplinary cooperation would give them the chance to learn about effects of science communication. Fourth, when relevant policies would be implemented it would help researchers in their efforts for science communication. Finally, respondents stated that research with negative impacts should be communicated as well. It will have educational effects and help the public. A few respondents argued that universities should do more in science education for their students which would help students to balance their research and education (CRISP, 2017).

Box 4.3 Institutes responsible for science popularisation and its study

The China Research Institute for Science Popularisation (**CRISP**) was founded in 1980 (as part of CAST) and is responsible for developing the theoretical base for science popularisation and communication. Since its establishment, CRISP has made remarkable contributions to the science and technology popularization work of CAST as well as the science popularization-related policy making of the country. CRISP organises conferences and other meetings on science communication and popularization. The China Science Writing Association (CSWA, 1979) also works on the theoretical basis for science writing and is affiliated with CRISP.

The Beijing Association for Science and Technology (**BAST**, founded in 1963) is responsible for the development of science popularization activities and, amongst others, education of organisers of science communication events. Amongst others, it organises the Beijing Science Festival and hosts training programmes with seminars and International Round Table Conferences to stimulate professionalization of science festivals and other science events all over the country.

Participants of the Round Table Conference 2016: 'Soaring the wings of Science Communication'. Soaring the wings of science communication refers to the important role of science popularization in striving for development and innovation as emphasized in the 13th Five-Year Plan.

4.5 RESPONSIBLE RESEARCH AND INNOVATION AT THE INDIVIDUAL LEVEL

The survey of scientific literacy, conducted in 2010 also asked for citizens' attitudes towards science and technology as well as their willingness to participate in science and technology affairs (CRISP, 2011). Chinese citizens strongly supported science and technology (74.8%), even if it brings no immediate benefits, research that adds to knowledge should be supported (77.0% agree). Overwhelmingly, respondents (72.6%) agreed that government should provide more approaches to the public such as hearings and other occasions in order to promote the public to participate in S&T decision-making processes. And scientists should participate in science communication (70.9%).

RESPONSIBILITIES FOR RESEARCHERS

The interview findings confirmed that respondents in majority agreed that scientists should contribute to that task (CRISP, 2017). Researchers have a responsibility to popularize findings via lectures, social media and so-called hot-spot discussions (discussions at places where top research is being conducted). They should translate their research into easier language and address leaders and cadres who are intermediators to public opinion and they should try to influence decision-makers. Furthermore, respondents argued that multidisciplinary and transdisciplinary research should be stimulated as this provides chances to researchers. A few respondents held a different opinion. They argued that communicating science to the public is not a researchers' main task. Professional communicators could do that (CRISP, 2017).

In addition, important from the interview findings is the emphasis of the respondents that the administrative and managerial process around research needs improvements so that researchers can spend their sparse time to conducting research as well as communicating about it. When further asked about support needed to establish a responsible relationship between science and society, respondents gave the following answers. First, they would need to keep up the standards of good conduct regarding doing research (research ethics). This is their own responsibility. Most respondents admitted that it is expected that researchers should be self-disciplined, honest, and fair and should avoid false research (CRISP, 2017). Second, government should supervise researchers to do so. Respondents said that it is necessary to have mutual supervision among researchers themselves since conducting scientific research is rather professional. In this way, for example, informing about an offense could suppress plagiarism. However, government could issue regulations to avoid bad influences due to irresponsible researchers (CRISP, 2017). As pointed out by Li (2016) research ethics is included in the 13th Five-Year plan and institutes have taken measures. It is also important to educate researchers and make them more aware of good scientific conduct, as respondents pointed out (CRISP, 2017). Third, price winning awards would stimulate them, while, fourth, they thought that science communication and popularization efforts will help to accomplish better social responsibility (CRISP, 2017).

EXPECTATIONS FROM EUROPEAN RRI

A final question in the interviews asked for respondents' views on expectations from Europe for RRI. They agreed that research is at a higher level in Europe than in China. In addition, public engagement and social responsibility is further developed. Some of their expectations would be that, European responsibility should not be restricted to Europe but should include responsibility towards the world. Sharing scientific results (open access) with developing countries should be considered. One expression of economic, scientific and technological globalisation is the application of results from science and technology in the developing countries. Respondents expected that research results should be communicated, for example, in the field of environmental research and air pollution. In addition, a repository or library containing case findings from research would be insightful to learn from those experiences. On the one hand, it should contain successful examples of that help develop society in a positive way; on the other hand, controversial research findings should be included to learn from those as well.

Furthermore, respondents expected less governmental guidance in the future and more market driven research. Also, scientific research concerning human safety (e.g. medical, cloning technology and transgenic research) should be conducted under strict regulations only. Finally, respondents expected that communication about research findings to a general public will increase significantly in the coming years. They argued that that also is a kind of social responsibility. Researchers should be allowed the time and the conditions to be able to put efforts in science popularization and communication.

4.6 CONCLUSIONS REGARDING RESPONSIBLE RESEARCH AND INNOVATION

From the findings, the following conclusions can be drawn. At the **conceptual level** *responsible research and innovation* is relatively new in China. Researchers prefer to use the concept *social responsibility*, which in practice is translated into *science popularization and communication*, with an important aim to increase levels of *scientific literacy*. Most researchers agree to have a social responsibility towards society. A minority of the respondents argued that doing research is without responsibility. Users of the outcomes are responsible for the way research is applied and science communication is mainly a task for professional communicators. In addition, some public engagement is taking place as a few examples show but researchers mainly focus on science education via science popularization. Citizens consider the possibility to engage more important when their levels of scientific literacy rise.

At the **governmental level**, policies at the national and local level are strongly focusing on research and innovation with the aim to foster the economy. With science education this aim can be achieved. Raising levels of *scientific literacy* therefore is considered a main goal. In various policy documents (Law on Popularization, Outline Scheme, Five-Year plans and State policies), detailed plans are given regarding science education and science popularisation for various groups in society (young people, farmers, urban workforce as well as leading cadres and public servants). The strong emphasis on *scientific literacy* is partly because differences in levels of scientific literacy within the Chinese population vary strongly. However, levels of scientific literacy are on the rise. Percentages have grown from 3.27% in 2010 to 6.20% in 2015. In the 13th Five-Year Plan further increased levels of scientific literacy are strived after with the aim to reach a level of scientific literacy of 10% in 2020. Furthermore, in new plans research integrity and ethics is promoted and training of researchers in this topic is foreseen. According to researchers, governmental policies should be helping researchers in their task to first conduct research and translate this research to society, and, second, to help them conduct their science communication tasks. To be able to do so, administrative tasks should be made less heavy, researchers should be trained to learn to communicate, and stimulating measures such as awards could be established.

At the **institutional level** the following conclusions come up. Nationally, science popularization and communication programmes are institutionalised via the official activities such as the science festivals, but also through science museums and media channels. Locally, also many activities are offered. National institutes such as CRISP and BAST are helping to stimulate science education and the understanding of it. Many organisations, e.g. the Chinese Academy of Sciences, have their own departments for science popularization and communication. Institutes can help researchers to fulfil their responsibility towards society by lessen the administrative and managerial tasks of research, and, by providing platforms where researchers can exchange their experiences and offer training programmes to enhance their knowledge and skills in science education.

At the **individual level**, the main task for researchers is to conduct and publish research. They support their social responsibility towards society. However, most researchers encounter heavy administrative tasks related to executing this task. Therefore, next to policy measures that ease administrative responsibilities, training and education are wanted to execute science education and popularization activities and support them to strive for good scientific conduct. Most citizens strongly support the development of science and technology and agree that government should provide more ways to stimulate public participation into research. Scientists should participate in science communication which researchers are willing to do.

5 SOUTH AFRICA

This chapter describes findings from South Africa regarding *responsible research and innovation.* First, contextual information is given by a brief introduction to the history and culture of South Africa, then findings related to RRI in South Africa are presented. Finally, conclusions are drawn.

5.1 HISTORICAL, SOCIO-ECONOMIC AND POLITICAL CONTEXT

South Africa has a long history, which can be traced back to some of the earliest hominids there. In more recent history, several native peoples were living in South Africa, including the Bantu, Xhosa and Zulu peoples. In 1488, Portuguese sailors discovered Cape of Good Hope (Kaap de Goede Hoop). Cape of Good Hope became an important point in the trade with the East; it became the place where ships could take fresh food and water on board before sailing further. The Dutch Eastern India Company (Vereenigde Oost-Indische Companie) established a refreshment post at Cape of Good Hope in 1652. In the centuries that followed many conflicts and wars were fought over control of South African land. The country was, despite uprising from native peoples, a Dutch and British colony for a long time. In 1931 South Africa became a sovereign state and a republic in 1961.

From 1948 onwards, the ruling National Party strengthened the *apartheid* (racial segregation policy), which had already started under colonial rule. As a result the white minority in South Africa (at the time as well as nowadays less than 20% of inhabitants) (see Table 5.1 for current statistics) politically controlled the black majority, severely disadvantaging the latter group in living standard, opportunities for education, employment, health care and more. Apartheid was formally abolished by President W.F. de Klerk in 1990, but its effects can still be seen. After his release from prison, anti-apartheid fighter and African National Congress leader Nelson Mandela became the first black president of South Africa. He started to reform the country.

South Africa has a long coast line, and several different climate types ranging from desert to temperate and subtropical. This means that agricultural and tourism opportunities vary throughout the country. South Africa is rich in natural resources. Resources that are mined include diamonds, gold, and coal. There are several big cities, such as Johannesburg, Pretoria, and Cape Town, where most of the population lives. The cities are well developed, but informal communities where many people live in poor housing surround these cities. The remaining population lives in rural areas.

Most South Africans identify themselves as Christians (almost 80%), with Protestantism being the largest denomination. There are also many African initiated churches amongst these Protestant churches. Traditional religions as well as traditional healers also play a role in South African life, as often people ‘supplement’ their Christianity with traditional beliefs and practices. South Africans adhering to the traditional beliefs and practices usually live in rural communities. South Africans adhering to either Western, Christian beliefs and values or to a mixture of traditional and Western beliefs often live in urbanized areas (Mataone, 2012).

Since the end of *apartheid*, the ANC (African National Congress) has been the largest party in South African National Assembly, for which elections are held every five years. Democratic Alliance (DA), Economic Freedom Fighters (EFF), and Inkatha Freedom Party (IFP) are the three largest opposition parties. Jacob Zuma is the current president of South Africa, but he is not without controversies (Elgot, 2017; Graham-Harrison, 2016a, 2016b). The 2016 municipal elections presented the worst outcomes for the ANC since the first general elections in 1994. In some cities (including Pretoria and Johannesburg) the ANC is no longer the biggest party (BBC-News, 2016; Graham-Harrison, 2016).

South Africa faces many challenges. There is a high unemployment rate of 25.6%[2] and a relatively large rate of poverty (in 2016, 16.6% of the population had to live on less than $1,90 a day) (WorldBank, StatsSA). Tourism, agriculture, manufacture, and mining are amongst the larger sections of the South African economy. Alleviation of poverty, fighting HIV/AIDS, safety (Smith, 2015) and creating equal opportunities for all societal groups remain big challenges for South Africa, as is conserving the nature and wild-life.

Name:		Republic of South Africa
Inhabitants:		approx. 51 million people (51,770,560)
Area:		1.2 million km^2 (1,219,690)
GDP (2015 estimates):	GDP (PPP[a])	Per capita: $13,195
	GDP (nominal)	Total (February 1, 2017): $314,572 billion (32th)
		Per capita (2015): $5,724
Gross domestic spending on R&D		0.7% of GDP
Ethnic groups:		79.6 % of South Africans are black
		9.0 % are coloured
		8.9 % are white
		2.5 % are Asian
Language:		There are eleven official languages in South Africa
[a] PPP: Purchasing Power Parity		

Table 5.1. Key facts South Africa (Sources: StatsSA, 2011; South African government; OECD; WorldBank).

The remainder of this chapter will present an analysis of *responsible research and innovation* in South Africa. The findings are structured at three levels of analysis – policy or governmental, institutional, and individual leading to a conceptual analysis. The analysis focuses on the themes outlined in Chapter 3: equality; science education, outreach and open access; stakeholder and public engagement; and ethics and broader impacts.

[2] In the fourth quarter of 2016 (StatsSA, http://www.statssa.gov.za/?p=9561).

5.2 RESPONSIBLE RESEARCH AND INNOVATION AT THE GOVERNMENTAL LEVEL

Innovation is seen as a means to advance the economy and lives of people, both by the South African government and the interviewees. The Department of Science and Technology has therefore programmes for *technology innovation* and *research development and support*. The *technology innovation* programme develops policies to support and promote research and development in strategic areas (astronomy, energy, biotechnology, nanotechnology, robotics, photonics, and indigenous knowledge systems). The *research development and support* programme is designed to provide an enabling environment for research and knowledge production in both basic sciences and the strategic areas. This programme also aims to promote public engagement on science, technology and innovation (Department of Science and Technology, not dated). Universities are governed by the Department of Higher Education and Training. The National Research Foundation is in charge of funding research, although there are also specific funding options such as the South African Medical Research Council. There are no dedicated calls for research into *responsible research and innovation* or demands concerning *responsible research and innovation* in research funding.

Box 5.2 Main sources for the findings

Literature from various sources was included. Academic journals, reports about South Africa, newspaper articles and other publications were used as well as websites of various institutions and organizations. Documents were found at the university library, via Google, and via personal contacts.

Interviews. Based on a semi-structured interview protocol 13 qualitative interviews were conducted. The interviews lasted about one hour each and were held in English. All but one of the interviews were conducted via Skype. The quality of the Skype connection sometimes negatively influenced the recordings; one interview could not be finished because of a failing connection. Of the interviewees, 12 were male, one was female, ages ranged from 38 to 75 years. Interviewees held various leading positions in universities and science centres (as leading researchers, university or faculty management, managers or senior officers).

South Africa has a science system that, while being one of the best in the region, faces several challenges (UNESCO, 2016). According to the interviewees, the main issue for research in the coming years is funding. The funding of research and universities is under pressure, which has negative effects on the output of research. One interviewee, for instance, explained that not enough academic staff can be hired while more students are admitted to universities, which means that the workload goes up and research output is harmed (R10). This is a barrier to a competitive academic climate. Several respondents said that talented students, if there is budget to hire them, prefer to work for the profit sector, where they can earn up to four or five times as much money. Another prominent issue for research in the coming years is related to the alleviation of poverty, which is one of the goals of research in South Africa. Many interviewees supported this view, but there are also fears that fundamental, basic research might suffer which can potentially harm South African research in the long term. Last but not least, access to universities is mentioned as a challenge for the science system. In the last years, tuition for higher education has gone up, meaning that higher education becomes (increasingly) inaccessible for those with fewer financial means. Young black South Africans are disproportionately disadvantaged by the higher fees. The rising fees have met with protests by students (BBC News, 4 October 2016) who are using the slogan *fees must fall* (Hauser 2016) (see Box 5.3).

Regarding **equal access**, in 2012, 43.7% of researchers in South Africa were women (Kraemer-Mbula & Scerri, 2015). This percentage is close to a fifty-fifty balance, although it does not specify whether the almost equal division of men and women can be observed in all levels of academic and research positions. A speech by Naledi Pandor, Minister of Science and Technology, in 2015 suggests that this division is not equal in all research levels and fields (Department of Science and Technology, undated). Repeated efforts of the Department of Science and Technology to encourage girls to choose a career in STEM also suggest a misbalance. Equal inclusion of both males and females in research and innovation has the attention of the Minister. In addition, the inclusion of researchers and innovators from different population groups is considered a pressing issue. One interviewee stated that the necessary regulations are in place, which means that equal access is no longer a formal issue. In practice, however, he believes it still is an issue, which is tied to poverty and the inability of the poor to afford a university education.

Statistics show that the different population groups amongst researchers are shifting: the number of whites (the third largest population group) is decreasing and the numbers of African and coloured researchers (the largest and second largest population groups) are slowly rising (CESTII, 2016). The Department of Higher Education and Training also wants to promote chances for the disabled and has installed a Ministerial Committee tasked with realizing equal chances for this group (DHET, 2014). The underrepresentation of black staff and students at universities is one of the motivations for the *fees must fall* protests (Hauser. 2016; Onishi, 2015; Mahr, 2016).

A noteworthy policy of the Department of Science and Technology is the **Indigenous Knowledge Systems policy**. Some of the earliest humans are from South Africa and indigenous cultures still inhabit the land. These communities have traditional and local knowledge and practices in areas "ranging from cultural and religious ceremonies to agricultural practices and health interventions" (WIPO, 2006, p.10). By law, indigenous knowledge is defined as "knowledge which has been developed within an indigenous community and has been assimilated into the cultural make-up or essential character of that community, and includes a) knowledge of a scientific or technical nature; b) knowledge of natural resources; and c) indigenous cultural expressions" (DST, 2016, p.5).

This policy has been developed with input from practitioners and holders of indigenous knowledge and aims to "stimulate and strengthen the contribution of indigenous knowledge to social and economic development in South Africa" (WIPO, 2006, p.9). A framework to stimulate indigenous knowledge holders and practical measures for them to contribute to the South African economy has been put in place. This includes developing connections between indigenous knowledge holders and practitioners and researchers and industry. There are several examples of indigenous people working with researchers. For example, the San have worked with HG&H Pharmaceuticals on the *kougoed* plant (developing an anti-anxiety and mood-enhancing drug, Zembrin). The process of collaborations between indigenous people and researchers or industry is very complicated as it poses questions unknown in 'traditional' research and innovation processes, such as who is the rightful owner of knowledge or skills that have been passed down from previous generations (Van Niekerk et al., 2014a, 2014b). Although the indigenous knowledge legislation poses many questions and has been critiqued in South Africa, it can be seen as a form of engagement. Actively engaging indigenous people (or knowledge) and rewarding them is not a part of the European concept of *responsible research and innovation*, but fits well within the ideas behind it.

Research and innovation are being opened up to the South African public. Science education and outreach are seen as important and government funds are allocated to the South African Agency for Science and Technology Advancement (SAASTA) to create awareness about science and technologies. There are programs and activities trying to increase science literacy and keep citizens informed about science (see also Section 5.3). Awareness of and enthusiasm for science, technology and innovation is stimulated so high school learners hopefully choose a university education in such a field. Interviewee R2 is a manager of a science centre and sees some of the high school learners, who came to the centre years ago, now coming back as researchers, but he stressed that the effects of science education and outreach activities are hard to measure.

ENGAGING THE PUBLIC IN RESEARCH WORKS BEST IN SMALL-SCALED PROJECTS

Engagement builds on increasing knowledge and uses various methods to have the general public or specific stakeholder groups share their ideas on research and innovation. In South Africa, engagement is a policy objective of the Department of Science and Technology's Research development and support programme (Department of Science and Technology). Additionally, part of the tasks and activities of SAASTA can be seen as a form of engagement. No policies for engagement in which citizens are given a say in the (direction of) research processes or regulation of science and technology were identified during the research. According to one respondent, this could be because engagement on the small scale works best. In research projects aiming to improve lives in small communities, engaging those communities is a prerequisite for the success of those programs (R4). Another interviewee (R3) pointed out that engagement with research is not a priority for many South Africans, as they are living in very poor conditions. They have more urgent needs. Improving the education system will have a higher pay-off, for science (literacy) too, in the long run, in his view. For the future, interviewees held mixed views. Most agreed that science education, science literacy and communication of research are important and will help to increase trust of the public in research. Some interviewees thought that engagement or public debates on research are valuable, while one (R4) argued that engagement efforts often escalate into heated public debates and that this can harm potential positive outcomes of engagement efforts.

Box 5.3 *Fees must fall*

For many young South Africans a university education is out of reach. First of all, only 18% of all high school learners can matriculate (i.e., officially enrol in a university) as universities cannot accommodate more students. Of the 18%, approximately half drop out in their first year in university (Nkosi, 2015). Second, the tuition fees have risen strongly over the years, which means that tuition is much harder or impossible to afford for the (relatively) poor. In practice, young black South Africans have been disproportionally hit by the rise compared to other groups. They either cannot afford to go to university or are left with massive debts. For a few years, protests against the risen fees are united under the *fees must fall* slogan. The students are calling for free university education. "We want more black students to be able to come to university and to have a better chance of participating in the economy," said student leader Busisiwe Seabe to CNN (Vilakazi & Swails, 2016). Currently, the fees are being studied by a government committee (South African Government News Agency, 2016).

The unrests about the university tuitions reflect problems with equality that still influence lives of many South Africans (Hauser, 2016; Mahr, 2016; Onishi, 2015). *Fees must fall* can be seen as a part of larger social movement – sometimes called the *fallist movement* - trying to create better circumstances and opportunities for young, black South Africans. "The protesters' rallying cry is the need to 'decolonize' the university. They are demanding more black faculty members, continued affirmative action policies to increase the number of black students, and a curriculum that is less Eurocentric and more African-oriented. The slow pace of change at the nation's 26 public universities – where only 14 percent of full professors are black – has more far-reaching consequences for South Africa than does transformation in other institutions, critics [of the slow pace of change] say" (Onishi, 2015). There are several reasons for *fees must fall*: "'It's a combination of national, political unresolved issues and the students' own personal search for issues of identity and meaning,' said Xolela Mangcu, an associate professor of sociology at the [U]niversity [of Cape Town] and one of the national leaders in the debate over transformation in higher education" (Onishi, 2015).

In addition, during a university debate, a South African student expressed the need for *science must fall*, and argued to focus solely on African knowledge in universities. Her call was not widely endorsed, but did spark some debate

5.3 RESPONSIBLE RESEARCH AND INNOVATION AT THE INSTITUTIONAL LEVEL

At the institutional level, equal access to universities and research positions for all men and women, from all racial backgrounds is one of the big challenges for the coming years. One respondent (R9) pointed out that, like him, more black academics have risen to leading positions in academia and now are in the position to change the composition of the staff and include more black academic staff. Most respondents expected universities to slowly become more inclusive.

People	Money and means	Output
• There are 818 researchers per million inhabitants in 2012 • In 2012, 43.7% of researchers were female and 44.0% in 2013 • In 2014, 56% of researchers were white, 29% African, and 15% Indian and coloured • In 2013, of those aged 18 – 29 the following were enrolled in universities, per background: 18.7% white, 9.2% Indian, 3.2% Africans, 3.1% coloured • Only 18% of the high school students can matriculate, and approximately half of them drop out in the first year	• 0.73% of GDP spent on research and development in 2012 • There are 26 universities, of which 6 are Universities of Technology	• 9,309 articles published in 2014 • The number of articles published annually more than doubled in less than ten years , from 4,235 in 2005 • In 2015, 8,672 patents were applied (by residents, non-residents and from abroad – global rankings: 36, 17, and 34th) • In 2015, 5,236 patents were granted (filed by residents, non-residents and from abroad – global rankings: 30, 14, and 29th) • In 2015, 58,624 patents were in force (global rank: 16th)

Table 5.2. Facts and figures on research and innovation in South Africa (Sources: Kraemer-Mbula & Scerri, 2015; Department of Higher Education and Training, undated; CESTII, 2016; Wakefield, 2014; Nkosi, 2014; WIPO, 2016).

The importance for science education and outreach can be seen at the institutional level as well. The South African Agency for Science and Technology Advancement (SAASTA) is tasked with education, communication, and building awareness about science and technology (SAASTA, 2015).

> "The aim of SAASTA's Education Unit is to build the supply of tomorrow's scientists and innovators. […] [SAASTA's Science Communication Unit is tasked with] providing credible and accurate information that is accessible to all South African communities. […] The main aim of SAASTA's Science Awareness Platform is to literally put the world of science in society's hands through exhibitions and through hands-on experience of science" (SAASTA, undated).

To realise its tasks, the agency undertakes various activities ranging from developing and distributing materials to be used in classrooms, organizing various science competitions, and organizing exhibitions, science festivals, and training for researchers wishing to learn more about science communication. SAASTA uses internet based methods of increasing science literacy and stimulating engagement, for instance, via websites with videos, factsheets and cartoons as well as social media. The agency also encourages students and young scientists to promote their research via non-traditional means. In 2013, students could enter a newspaper article, a radio script or a viral video in a competition (SAASTA, 2013, 29). The use of means that fit the intended audiences well is laudable. However, it is not studied how much online strategies can contribute to reaching the rural communities (Fieldtrip report South Africa, 2016). The Department of Science and Technology funds various science centres. The science centres develop educational programs to teach high school learners about science. They also organize interactive expositions that facilitate learning in ways that are attractive to young people (Department of Science and Technology).

The rural areas of South Africa are less developed than the big cities. Matoane (2012) claims, in explaining the role of traditional worldviews in modern South Africa, that people who adhere to traditional beliefs and practices in rural communities have "little or no education" (p. 109). These communities are also, because of their rural location, hard to reach for those trying to increase science literacy or to engage South Africans in discussions on research and innovation (Fieldtrip Report South Africa, 2016). The science centres have access to mobile labs which they send to areas too far removed from the centres, so high school learners can learn by doing and are better prepared in case they pursue an academic education (SAASTA, 2016).

The funding pressure also has an impact on the institutional level, forcing universities and other institutions to realize many tasks with little means. Universities stimulate entrepreneurial attitudes amongst researchers and look for non-traditional funds. For instance, the mobile lab of the science centre of the University of KwaZulu-Natal is sponsored by the Japanese embassy.

South Africa is a leading African country in open access initiatives (UNESCO, 2017). Open access is taken up by several universities and other institutions, such as the Academy of Science of South Africa's SciELO SA open access platform for publishing articles (Cerniewicz & Goodier, 2014). Other open access initiatives include South African based open access journals. Cerniewicz and Goodier wrote that engagement of universities and research institutions as well as Departments, that fund SciELO and might fund other open access initiatives, is necessary: "The lack of a national open access policy in South Africa hinders the development, growth and availability of local [i.e. South African] research"

(2014, 8). One interviewee (R10) called open access publishing “the definite way to go.” Funding is an important theme in open access, as the charges related to processing and publishing an open access article (in an international journal) can be problematic for institutions and individuals without big budgets. However, Czerniewicz & Goodier (2014) pointed out that many South Africa based open access journals do not ask a fee for publishing. There are also problems related to difficulties for some organizations to make materials suitable for open access and to copyrights (UNESCO undated). Open access is not yet part of the ‘business as usual’ and there is no reward system for open access publishing. Several interviewees expressed their concern whether the publications have the same quality as traditional journals.

IMPACTS AND ETHICS: INSTITUTES TRY TO ADVANCE COMMUNITIES

The National Research Foundation is the main funding agency in South Africa. Its mandate is to promote, support and facilitate research and knowledge production in order “to contribute to the improvement of the quality of life of all the people in the Republic” (National Research Foundation, undated). The National Research Foundation therefore funds research that aims to address topics that benefit South Africa, such as the Grand Challenges identified by the Department of Science and Technology (Engelhard et al*,* 2014). This means that impacts are an important consideration in South African research. According to one respondent, for community oriented research projects that aim to improve communities or citizens’ lives, the impacts of - and engagement in – research are crucial for the success of the project (R4).

Regarding ethics, the National Research Foundation, that funds South African research, “expects the relevant [i.e. funded] university to ensure that ethical considerations – including environmental protection – are taken care of through the university ethics structures.” (Engelhard et al, 2014, 18). Research proposals therefore have to adhere to ethical standards, interviewees said. Safeguarding indigenous knowledge and treating indigenous knowledge holders is, as explained above, an important theme in South Africa (DST, 2016; Van Niekerk et al*,* 2014a; Van Niekerk et al, 2014b).

The interviews showed that, next to social impacts of research for community oriented projects, environmental impacts of research and innovation projects are most considered. According to one interviewee (R9) environmentalists influence media, which he thought is an explanation for the awareness of potential environmental impacts. Tourism to South Africa’s wildlife is important for the country’s economy. It is unclear, however, to what extent universities and other research institutes encourage or facilitate assessments to explore such impacts. It is also unclear to what extent the potential impact influence the research projects. According to several interviewees, stakeholder involvement could be a way to identify broader impacts of research and innovation. Other respondents stressed that the impacts of fundamental research might only become clear in twenty or a hundred years' time. They simply cannot be predicted in their view and, therefore, are given little consideration in research projects.

5.4 RESPONSIBLE RESEARCH AND INNOVATION AT THE INDIVIDUAL LEVEL

One important observation at the individual level from both the interviews and the field trip is that researchers and those working in science education and outreach are performing many tasks with little means, both in regard to funding and time. The science education and outreach activities they do, furthermore, are not always considered a part of their job (Fieldtrip Report South Africa, 2016). One way this could change, according to the interviewees, is via role models that show the importance of doing these activities. Another way is via soft regulations, like financial incentives, or via policies.

For many interviewees, equality, equal access to universities and research positions, and inclusion were topics of concern. The interviewees are all involved in research or science education and the *fees must fall* and *science must fall* debates are in the core related to the South African science system, its future and the transformation of the country to a post-*apartheid* democracy. One interviewee (a university faculty dean) said he and his university are thinking about what kind of university they want it to become. His field of research internationally is diverse, but the faculty at his university is predominantly white. To re-address this requires carefully thought through strategies they are developing. He also noticed that, now, there are some people from disadvantaged backgrounds that are in the position to make these changes (R9). It is clear, from the interviews, that this transformation is a difficult process.

Furthermore, equality is important at the personal level in some of the interviewees' perceptions of the relationship between research and society. Many interviewees mentioned that society distrusts research and researchers and pointed at a gap between research and society. They used terms like openness, transparency, respect and balance to characterize the relationship research and society should have and thought research should be aware to societal needs. Interviewees all appeared to agree that a general level of science literacy is required to realise such an equal relationship. Citizen science – research projects in which citizens have an active role – are mentioned by some interviewees and can be a way to more equal relationships as well as engaging citizens and stakeholders in other ways.

Organising and participating in science education and outreach activities are also seen as important by the interviewees. One respondent (R2) for instance works for a science centre that regularly organizes 'meet a scientist' events, where researchers present their work and answer questions. Another (R6) is a researcher but also participates in science education and outreach events.

The need for science education and outreach are underlined by survey findings into public attitudes towards science. Amongst the 3,183 participants, the following attitudes were found:

> "Over 70% of participants responded positively to questions asking whether science and technology (1) makes their lives easier, healthier, and more comfortable, (2) makes work more interesting, and (3) creates more opportunities for the next generation. However, the majority of the public were concerned that science makes our way of life change too fast, and that we depend too much on science and not enough on faith. Just over half thought the benefits of science were greater than the harmful effects." (Reddy et al*,* 2013, p.4)

Not understanding the language in which activities are offered might be a barrier for participants to participate in activities, due to the eleven national languages and rural areas that are hard to reach. Some interviewees were also critical of large scale programs for science education: Interviewee R3 pointed out that many poor South Africans hardly know or care about science; efforts to reach them should be focused on improving their lives. Science education can have a role in this, but should not be an end in itself.

Several respondents experienced with publishing open access. Positive features of open access publishing that the interviewees mentioned were the circumvention of the costly subscriptions to traditional journals; the availability of materials to everyone, and the ease to keep that publications up to date. Concerns related to the quality of the articles. One interviewee mentioned that open access publishing is easier for some universities than others (R13). Several respondents, however, doubted that open access publications will have significant effects on the levels of science literacy or engagement, pointing out that not everybody wants to read a scientific paper.

Many interviewees were positive to engagement of stakeholders and citizens in research processes, insofar as such engagement can be valuable for the research project. For research projects in theoretical physics, the field of one interviewee, stakeholder and citizen engagement add little value for either parties. Still, he believed it is important to communicate to citizens about his research. Engagement of citizens and stakeholders in community oriented research projects, increase the chance of success of these projects.

Stakeholders and the general public need to have a basic understanding of science, in the view of the interviewees. Not all South Africans are scientific literate, which is one of the reasons for outreach and science education projects. Also, poor South Africans can be more concerned with their day to day needs.

Important groups in South Africa are the indigenous peoples. Representatives of indigenous people like the San and Kwe have united forces and have drafted a code of ethics to guide researchers and media in interactions with these communities. Respect for the knowledge and culture of the indigenous people in as well as acknowledgement and fair treatment of their contributions to research appear to be key points in this contract. Iatridis & Schroeder (2016) presented a case-study in which a researcher studied the medicinal properties of a South African plant. The researcher included the indigenous people from whom he had gained knowledge about this plant into the patents based on it. This way, they could benefit from possible commercial success of the plant. They point out that "*[r]esponsible* research and innovation involve[s] proactively seeking information about legal conduct as well as *doing the right thing* (p.15)"

Amongst the interviewees, there were mixed views towards assessing the impacts that research and innovation can have on the lives of citizens, society, or on the environment. Some saw this as normal, especially taking with regard to the impact on the lives of citizens or on the environment into account. Others thought that this is in part done to secure funding for research. A third view debated the value and possibility of this, since the outcome and impact of research cannot be predicted.

Being considerate and respectful towards citizens and participants in research is an attitude that many interviewees shared. This attitude could be characterized as one of care. The interviewees used many terms to explain the hallmarks the relationship between research and society ought to have, like openness, awareness of needs, or trust. This attitude of care is not universal amongst those involved in the science system. One interviewee provided anecdotal evidence that corruption and fraud play a role in South African universities. Many researchers and science education professionals care a lot about their work, the citizens and the science system.

5.5 CONCLUSIONS REGARDING RESPONSIBLE RESEARCH AND INNOVATION

The findings described above lead to the following conclusions. At the **conceptual level**, in South Africa, *responsible research and innovation* is not a well-known label. However, this does not mean that the ideas behind or the elements of RRI are unknown to South African research and innovation and researchers. On the contrary, there are many efforts that can be seen as *responsible research and innovation*. Some elements were more prominent than other. Equality, science education, and outreach are most developed and present at the governmental, institutional and individual levels as well. Open access is less prominent and is seen at the institutional and individual level mostly. Stakeholder and public engagement as well as attention to the potential broader impacts of research and technology – and being responsive to stakeholders, the public or potential impacts - are less prominent. Ethics are seen as important, but the main focus of researchers is on doing their job and not on ethical reflection. The South African interpretation of *responsible research and innovation* is mainly focusing on equality and science education and outreach. Other elements are present, but to a lesser degree and, in the case of assessing the broader impacts of research, not perceived to be equally relevant for fundamental research as it is for community oriented research projects. Not all elements are to the same extent present at each level.

At the **governmental level**, the findings show clear positives: South African researchers produce many articles, its universities and researchers are well respected , and research policy is both focused on improving lives (e.g., alleviating poverty) and fundamental research projects (of which the largest is the astronomy project). This demonstrates that research is both responsive to the needs of society and concerned with long-term innovation and competitiveness of the knowledge-economy. Science education, furthermore, has a prominent place at the governmental level, which means that there are programs and funding. Dealing with indigenous knowledge is another prominent feature of policy making. Acknowledging and valuing other knowledge systems is not a feature of *responsible research and innovation,* but appears to fit very well with the *spirit* of the concept.

Some challenges and obstacles can be identified. The first concerns the budget for research. Any discussion about *responsible research and innovation* starts with research, and regards funding for researchers, for equipment, for libraries. Open access, which is generally viewed positive, is a way to deal with some of these problems, but the pressure on funds hinder research outcomes. Another challenge is equality and equal access to universities and research positions. The *fees must fall* movement will influence decisions for the future.

Public and stakeholder engagement in South Africa is seen as science communication rather than a deliberative model in which stakeholders or the public have a say in the direction of research. Researchers assess the impacts of research and innovation on citizens, society or the environment.

At the **institutional level**, first, there are large efforts dedicated to science education and outreach via SAASTA, the science centres, and nation-wide programs. Together, these are responsible for a range of activities, education programs and exhibitions aimed at improving the understanding of and enthusiasm for the sciences. Second, institutions make the best of the budget challenges they encounter, stimulating entrepreneurial attitudes amongst researchers and looking for non-traditional funds. An important barrier concerns the distance to rural communities. Also, according to respondents, poor communities have other priorities than (participating in) science education or outreach. Both make the work harder for institutions trying to work with these groups.

At the **individual level**, frequently, individuals have to work with small budgets. They are, however, skilled in making the most of it. A second obstacle at the individual level is the lack of acknowledgement. Researchers participate in engagement activities such as public lectures because they find that important, but it is not always seen as a part of their job. Formal recognition of these activities could make it easier for researchers to partake as could role models help to stimulate them to do so. It needs to be stressed, though, that some researchers are more at ease in their labs than when holding a public talk. It is therefore important to support the individual researcher.

6 CONCLUSIONS AND RECOMMENDATIONS

In this chapter the main conclusions for the case studies on China and South Africa are drawn and recommendations are given.

6.1 CONCLUSIONS

This study focused on the following questions: *How are RRI and relevant other concepts implemented in international contexts? What are barriers and successes to the future implementation? What can be recommended for the future implementation of RRI in the Nuclei?*

Data was gathered in a multi-method approach. In addition to literature, personal communications, and presentations, interviews contributed to the data. In China 30 interviews were conducted with researchers and leading management. In South Africa 13 interviews were held with researchers and science centre managers. Analysis was performed at the conceptual, governmental, institutional and individual level. For each level, the main conclusions are summarized, followed by a reflection on the themes.

CONCEPTUAL LEVEL

The concept of *responsible research and innovation* is a relatively new concept in China and South Africa. In both countries, elements of *responsible research and innovation* are conceptualised via various notions. The findings identified elements:

- In China emphasis is on researchers' *social responsibility* and science popularization and science communication.
- In South Africa, focus is on science education and *community or societal oriented research*. Inclusion or equal access are core policy concepts, and as such inform education and university policies and practices.
- Scientific education is in both countries considered key to enhance scientific literacy which is important for research and innovation.

GOVERNMENTAL LEVEL

At the governmental level in both countries, innovation and the knowledge economy are guiding principles for policies. In China, all state policies are innovation driven. In South Africa, innovation is an important policy aim as well.

- China's policy measures focus strongly on innovation to benefit the country. Most important is increasing the level of scientific literacy to help reach the goals of innovation. Science popularization is a means to achieve this and is targeted at specific groups (young people, farmers, leading cadres and public servants). Ethics is getting more attention in recent policies. Researchers expect from governmental policies support to conduct research such as how to translate research findings to society and how to perform their science communication tasks. They consider training a way to improve this.

- South Africa faces challenges due to poverty, inequality and unemployment. The country is in transition. Innovation is seen as one of the means to overcome its challenges. Noteworthy is the attention to indigenous knowledge, which is protected by law. Acknowledging and valuing other knowledge can be considered a relevant expansion of the RRI concept. Following the *fees must fall* protests, access to universities including tuition is currently subject of study of a committee who will report in 2017. Research funding needs continuous attention from government to find a balance between community oriented and academically competitive research.

INSTITUTIONAL LEVEL

At the institutional level in both countries institutes at the national level (CRISP, BAST, SAASTA) are responsible for science education and communication and its study. Science centres and science museums play an important role in stimulating scientific literacy and engagement with research. In both countries, there is a large distance to the rural communities that pose challenges for educational activities. Research ethics and research conduct are increasingly considered in Chinese universities.

- In South Africa, a system for research ethics is in place. Institutes are inventive with their limited budgets. Most respondents expect universities to slowly become more inclusive. South African research institutes are leading in open access initiatives in the region. Regarding the assessment of the impacts of research, the findings show that not all respondents considered this relevant for all types of research. Researchers consider the impacts on communities and the environment most often.
- In China, researchers would appreciate institutes help to stimulate them in their social responsibility by providing platforms for knowledge exchange, offering training programmes, raising awareness. Controversial research findings should be communicated as well, for educational effects and to empower publics.

INDIVIDUAL LEVEL

In both China and South Africa, the respondents have mostly positive attitudes to the elements that add to practices of *responsible research and innovation*. Role models are in both countries seen as way to promote and improve the practices of *responsible research and innovation*. Researchers are inclined to inform the public over their research; increasing levels of science literacy is needed to foster innovation. *Social responsibility* or *community oriented research* is important for researchers.

- In China, researchers are becoming more aware of good scientific conduct, but want support from institutions and the government.
- In South Africa, the findings show that respondents are concerned with equality. Equal access to universities for all societal groups is considered important as well as an equal relationship, based on trust and respect, between research and society.

The study was guided by analysing concepts, policies and practices regarding equality, science education, outreach and open access, stakeholder and public engagement, and, ethics and broader impacts.

The findings show that, in South Africa, **equality** is a subject that is reflected in the 'fees must fall' debate, in the staffing of institutions, and in dealing with indigenous knowledge holders. Regarding **science education, outreach and open access,** in both China and South Africa, science education, communication and popularisation are the most emphasised elements of RRI. Both countries have institutions that work on science education and increasing scientific literacy with various means. Distance to the rural communities is literally far. In both countries, levels of scientific literacy differ significantly between those living in rural areas and the cities. In South Africa, open access is regarded important for future research possibilities.

In both countries, there are some **stakeholder and public engagement** activities observed. However, emphasis is mainly on science education and scientific literacy. There is awareness of the need for **ethics**. The countries differ in how research ethics are (being) institutionalised. With regards to **broader impacts** the emphasis for South African researchers is mainly on the potential impacts research has on communities and the environment.

In addition, several findings from the study could be of interest for Europe and European researchers. First, responsibility should also include responsibility towards the world. Sharing research results and best practices with developing countries is regarded as valuable and helpful. Second, including all relevant actors and knowledge holders, as is done in the indigenous knowledge policy in South Africa, improves the science-society relationship. To conclude, responsible research and innovation can take shape in different ways as can be seen in the concepts, policies and practices in China and South Africa. RRI includes openness towards societal influence and should be more than a checklist of elements.

6.2 RECOMMENDATIONS

The following recommendations for consideration and for the NUCLEUS Implementation Roadmap can be given.

FOR GOVERNMENTS

- Work towards open and innovative research with minimum levels of regulations.
- Continue efforts to raise levels of scientific literacy.
- Increase trust in science by installing (soft) policy measures that promote research ethics and open communication about research findings.

- Share knowledge and research experiences with (developing) countries, for example by stimulating open access and open communication.
- Develop a knowledge-base of best practices of *responsible research and innovation*.

FOR RESEARCH INSTITUTES

- Play a leading role in developing *social responsibility* and *community-oriented research*.
- Increase trust in science by stimulating research ethics, attention to impacts of research and open communication about all research findings.
- Create and facilitate means, such as platforms, to exchange knowledge and best practices on science communication and engagement.
- Use incentives to embed *responsible research and innovation* in universities and research institutes.
- Recognize and facilitate role models.
- Stimulate equal access to universities.

FOR RESEARCHERS

- Acknowledge the efforts of researchers regarding science popularization, science education and engagement.
- Train researchers to engage with the public and in science communication.
- Educate the public to enlarge the numbers of researchers; to raise awareness of research findings; and to increase trust in science.
- Raise awareness and train researchers in research ethics.

Responsible research and innovation is aiming to improve the science-society relationship. By looking at concepts, policies and practices in China and South Africa, the two cases in this study provided an enriched insight in aspects playing a part in the science-society relationship. The mixed-methodology led to the collection of more diverse data to build the cases. However, qualitative findings, although allowing for greater comprehensiveness, never can be conclusive. The Implementation Roadmap will include findings from the Field trips and the European interview study as well.

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APPENDIX: INTERVIEW QUESTIONS, INFORMATION FOR PARTICIPANTS, CONSENT FORM

INTERVIEW QUESTIONS CULTURAL ADAPTATION REPORT

Introduction
This interview is part of the European Horizon project ‘NUCLEUS’. In this interview, we would like to hear your views on and your experience with research, society and the relations between them.

We are conducting interviews in China and South Africa. The results will be used, together with the results of interviews conducted in Europe by our colleagues, to create a roadmap to improve the relation between research and society.

To be able to transcribe the interview, we would like to record the conversation.

The interviews will be transcribed and anonymized. The interviews are only used for research purposes. If you do not have any further questions, please sign the consent form.

Are you ready to start the interview?

About the respondent

Gender:		male/female
Age:	…	years
Country:		China / South Africa
Institution:		
Position:		
Field of research:		

Interview protocol
1 Can you briefly describe your professional background?

2 What are the main challenges for research in China / South Africa in the next five years?

3 How do you see the relation between research and society?

We would like to hear your views on a few aspects of the relations between research and society. The first aspect is engaging stakeholders and citizens.

4 How are stakeholders and citizens *at the moment* engaged in (your) research?

5 How *should* stakeholders and citizens ideally be engaged in research?

6 Do you foresee any changes in the way stakeholders and citizens are engaged in research in the next five years?

Another aspect is looking early on to the impact research has on society, the lives of citizens, and the environment. The reason to look at such impacts early on is to increase positive effects and to prevent, or limit, the negative ones.

7 To what extent do you consider the societal and other impacts of (your) research?

8 How can the broader impacts of research (the effects on society, citizens and the environment) best be assessed *during* the research process?

9 What needs to change to reach a situation in which these broader impacts are routinely considered during the research process?

We would also like to hear your thoughts on the governance of research.

10 What do you think about the following aspects of governance in universities? [For each interview, select two]
- Inclusion policies, i.e., equal access to higher education and research positions
- The division of funding across research disciplines
- Open access publishing
- Demands on the *content* and/or *conduct* of the research made by policymakers or funding agencies

11 Do you foresee any changes in these policies and/or practices in the next five years?

12 To what extent do you see efforts to stimulate these aspects of research (engagement, looking at the societal impacts, and good governance) in South Africa?

Some say 'responsible' is a key characteristic of when discussing the intersection of research and society/when discussing the relation between research and society.

13 How would you describe a responsible relation between research and society?

14 What kind of support (regulations, financial, etc.) would be necessary to stimulate this?

15 Since responsible research and innovation is mostly debated in Europe, we would like to end with a question about Europe. In your opinion, what is necessary for Europe to realize responsible research and innovation?

16 Is there anything that we have not discussed that you would like to add?

Thank you for your time and answers! If you'd like to receive the transcript of the conversation for factual correction, let us know. In that case, we will send you the transcript as soon as possible.

INFORMATION FOR PARTICIPANTS

Information about the NUCLEUS project and the comparison study

NUCLEUS is a European Commission funded Horizon 2020 project that aims to help universities and scientific institutions in overcoming barriers in the relationship between research and society. For this project, interviews are conducted in China, South Africa and Europe.

The project

NUCLEUS is a four-year project that aims to develop a **New Understanding of Communication, Learning and Engagement in Universities and Scientific institutions (NUCLEUS)**. NUCLEUS is funded by the European Commission's Horizon 2020 program. With a consortium of 24 international partners and a focus on practical implementation, NUCLEUS' goal is to overcome institutional barriers in the relationship between research and society.

Your participation

We ask you to participate in this interview. Our goal is to identify factors that shape the relationship between research and society in universities and research institutions in China and South Africa.

The process

Interviews will be conducted online, via telephone or in person. The interviews will be approximately 45 to 60 minutes. We will ask a range of open questions about different facets of research processes and the relationship between research and society.

Ethical considerations and data protection

Information and consent

A description of the research can be found above. If you have any questions about the interview or the NUCLEUS project, you can ask them to the interviewer or the researchers (contact details below).

Participation in this research study is entirely voluntary. You have the right to refuse to participate and to withdraw your participation, samples or data at any time — without any adverse consequences. In this case, personal data are deleted without delay.

If needed, you can also contact the secretary of the Ethics Committee at the University of Twente with complaints or comments about the research. Mrs. J. Rademaker is not involved in the NUCLEUS research and can be contacted at: j.rademaker@utwente.nl.

Risk and benefits for participants
There are no direct benefits for the participants in this study; participation is voluntary. You will not be paid for your contribution to the study.

There are no physical risks or discomfort involved in your participation. If, at any time, you do not wish to discuss a subject, you can decline to answer that question, questions relating to that subject, or end the interview.

Recording and transcription
During the interview, notes will be taken by the interviewer and an audio recording will be made. You will be asked for permission to record the conversation. The recordings will only be used to transcribe the conversation so the insights and views of the participants are understood and captured as accurately as possible. Besides the researchers, no one will have access to the audio recording or the raw notes and transcript of the interview. The transcript of the interview will not contain any information that could identify the participant or institution.

Confidentiality and data protection
No personal or confidential, identifiable information will be used in the research. All data from this research will be anonymised and no remarks will be attributed to an individual or institution, in any reports or papers produced by the project.

Data are saved for the purpose of this study for the duration of ten years. Data will be stored securely. Data will be stored only on the computers of universities that are part of the consortium and have to adhere to our data collection processes. All researchers involved in this endeavour are obliged to respect applicable data protection legislation and policies. As the lead in this aspect of NUCLEUS project, the University of Twente will hold the overall responsibility for approval of our research ethics and Data Protection. No data are exported from the EU to any third country.

Contact information
In case of any questions about this project, please contact:

Dr. Anne M. Dijkstra
a.m.dijkstra @utwente.nl
+ 31534895717

Mirjam Schuijff MA MSc
m.j.schuijff @utwente.nl

CONSENT FORM

Consent form for participation in international comparison NUCLEUS project
This consent form applies to research for the NUCLEUS project. For this project, interviews are conducted in China and South Africa to collect information about practices of research and innovation in universities and scientific institutions.

The international comparison research for the NUCLEUS project is conducted by dr. Anne M. Dijkstra and Mirjam Schuijff MA MSc from the University of Twente. The interviews in this project are designed to gather information about research and innovation in universities and scientific institutions in China and South Africa. There will be approximately 50 people interviewed for this research.

1. Participation in this project is voluntary and unpaid.
2. Participants have the right to decline to answer any question, or to end the interview, without consequences.
3. Participation involves being interviewed by researchers from the University of Twente, BAST or SAASTA. The interview will last approximately 45 minutes. Notes will be taken during the interview. An audio tape of the interview will be made. The sole purpose of the audio recording is to be able to capture the responses of the interviewee accurately in the transcript. The audio recording will only be used for the transcript.
4. The anonymity of the participants in this research project will be protected. Subsequent uses of records and data will be subject to standard data use policies which protect the anonymity of individuals and institutions.
5. Questions about the research can be addressed to the researchers:
   dr Anne M. Dijkstra: a.m.dijkstra @utwente.nl
   Mirjam Schuijff MA MSc: m.j.schuijff @utwente.nl
   Queries, complaints or comments about the research can addressed to the secretary of the Ethics Committee, mrs. Janke Rademaker. Mrs. Rademaker is not a member of the project team.
   drs Janke Rademaker: j.rademaker @utwente.nl
6. I have read and understand the explanation provided to me.
7. I have received a copy of this consent form.

Signature:

Name:
Date:

I want to receive the publications resulting from my participation:
☐ no ☐ yes, e-mail me at: