**REPORT FROM NATIONAL CASE STUDY**

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<tr>
<td>Author(s):</td>
<td>Zhao Yandong, Zhang Wenxia, Liao Miao, Huang Lei, Teng Fei, Song Runjie, Wu Yue, Yao Yu</td>
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**Abstract**

This report presents the findings from the Chinese case study, including the reviews and outlooks for CASTED (research conducting organisation) and NSFC (research funding organisation).
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1. Executive summary
Summary of the main results and action points

To cope with new social challenges in the new era of social and economic development, China’s
development philosophy evolves into five key concepts, namely innovation, coordination, green
development, opening up and sharing, which have an affinity with Responsible Research and
Innovation (RRI) principles. As a newly introduced theoretical and policy concept, RRI has attracted a
large scale of the attention across research institutes, industries and the public sectors in China. The
concept has been written into the latest national plan for STI. Social actors for responsible research
and innovation, such as the public, scientific community, enterprises, and government, are emerging
and growing up in China.

Based on case studies of a research institute and a funding organization, this report focuses on RRI
practise in organizational level in China. The study showed that, the principles of RRI have already
been embedded in research and innovation in China, even though they might not be labelled as “RRI.”
For example, as a national-level think tank that plays a key role in national STI policy making,
Chinese Academy of Science and Technology for Development (CASTED) has been trying to
introduce the ideas of RRI into the national STI policy system through policy research and advisory.
Their studies on scientific ethics, gender equality in science, public image of scientists, open access
and inclusive innovation, have a prominent impact on China’s STI policy orientation towards more
responsible innovation.

National Science Foundation of China (NSFC) is the most important funding organization for basic
research in China. The main target of NSFC is to implement the state policy orientation on basic
research and to promote excellent research and innovation through an open, fair, and transparent
funding procedure. Though RRI is not yet within the scope of main work content and functions of
NSFC, we can see some of the RRI keys, such as ethics, gender equality, and open science are already
involved in NSFC’s organizational practice.

The practices of RRI in China are facing many challenges still. Institutional and policy framework for
more responsible innovation needs to be built. Platform and channels for public engagement in STI
need to be constructed. International cooperation on RRI needs to be strengthened.
2. Introduction: about the report

Purpose of the report, resources used and challenges faced

This report aims to describe the general situation of RRI practice in China at both national and organizational levels. Case studies on one research organization and one funding organization were conducted. The study not only focuses on the impact and practice inside the institutions of the case study, but also analyses the interactive relationship between the institution and other stakeholders under the framework of RRI.

Most of the research resources were offered by the administrative department of CASTED and NSFC. The materials of the related qualitative research, including archives and structural investigation, were collected and executed by the research group.

The report consists of ten parts. Part 1 is the executive summary. Part 2 is the introduction.

Part 3 mainly introduces the methodology and overall process of the national case study, including three sections: (1) methodology; (2) national mapping; (3) approaches of the organizational study of CASTED and NSFC.

Part 4 describes the overview of the national science policy system of China. The general country information, legal framework, political and cultural values and discussions related to STI have been included in this part.

Part 5 introduces aspects of responsibility in national science policy in China. This part briefly explains China’s conceptualisations of responsibility in national science policy. The related official documents are analysed to reveal the notion of “RRI” in China’s science policy discourse.

Part 6 focuses on the review and outlook of the research conducting organisation: CASTED. This part introduces the organizational mapping and RRI practices of CASTED. Part 7 conducts similar analysis on the research funding organizations: NSFC, which is one of the most important funding in China.

Part 8 is the summary of the finding of China’s national discourse analysis and case studies.

Part 9 contains the discussion of the finding of China’s national discourse analysis and case studies.

Part 10 concludes policy recommendations for both China’s policymakers, European policymakers and organizations of the case study.
3. Methodology

3.1 Analytic approach

The analytical approach to the national case studies in RRI-Practice project has been inspired by the organisational institutionalism. Scott (1987) describes the following three perspectives to study organisations: as a rational, natural and open system. We have adopted this approach, but have as well used other concepts that we believe are more intuitively understandable. The following table presents the basic approach to organisational studies adopted by the RRI-Practice consortium partners.

Table 1: Analytical approach to the organisational studies

<table>
<thead>
<tr>
<th>Aspects of organisations</th>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange dynamics</th>
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<tbody>
<tr>
<td></td>
<td>Mandates, legislative frameworks, formal hierarchies</td>
<td>Culture, informal routines, informal reward systems, focus on management</td>
<td>Policy learning, pressures from key stakeholders (owners, the public, etc.)</td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
<td>Active ownership (e.g. the state), legislation that includes social responsibility as a core element of the mandate, formal evaluation criteria adapted to RRI goals</td>
<td>RRI dimensions become mainstream, managers start seeing RRI dimensions as an obvious part of their responsibilities, no social acceptance for neglect of the RRI dimensions</td>
<td>Pressure from the media, success stories from organisations considered to set “gold standards” in the field</td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>No formalised pressures conforming to RRI dimensions</td>
<td>Informal incentive systems reward economic output/excellence/etc., effectively marginalising the RRI dimensions</td>
<td>Important stakeholders reward, for instance, excellence and economic performance to a greater extent than RRI related matters</td>
</tr>
<tr>
<td>Methods</td>
<td>Analysis of formal documents</td>
<td>Interviews with employees at different levels in the organisations and focus groups</td>
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3.2 National mapping

3.2.1 Document analysis

In order to understand the main societal and political discourses of science, technology and innovation (STI) policies and the ways in which these are framed and have been implemented in China, we have collected about 100 documents from 19 government departments and literature about historical background, social, cultural and political environment of STI policy making in China to review. Due to the huge number of government documents, we have selected several of the most relevant laws, plans, opinions, and speeches as the key documents to analysis, based on the decision-making mechanism of China’s science and technology policy (see Section 4.2) we learned from the literature review. The following key documents have been reviewed and analysed from the perspective of RRI:¹

Laws:
- Constitution of the People’s Republic of China²
- Law of the People’s Republic of China on Scientific and Technological Progress (2007 Revision)³
- Law of the People’s Republic of China on Promulgation of Science and Technology⁴

¹ Document summaries are presented in Annex 1.
² “Constitution” in short below.
³ “Progress Law” in short below.
⁴ “Promulgation Law” in short below.
• Law of the People’s Republic of China on Promoting the Transformation of Scientific and Technological Achievements (2015 Amendment)

Plans and strategy:
• National Innovation-Driven Development Strategy Outline
• The 13th Five-Year Plan for Science, Technology and Innovation

Opinions and speech:
• The State Council’s opinions on promoting certain policies and measures for Mass Entrepreneurship and Mass Innovation
• The State Council’s opinion on strengthening the implementation of the Innovation-Driven Development Strategy to further promote the in-depth development of Mass Entrepreneurship and Mass Innovation
• President Xi Jinping’s speech at the 19th Academician Meeting of the Chinese Academy of Sciences and the 14th Academician Meeting of the Chinese Academy of Engineering

3.2.2 Interviews
For further understanding of the history and characteristics of Chinese STI policy especially related to RRI, 11 semi-structured interviews have been taken on people from universities and policy making research institutions. The interviewees represent main advisory organisations (think tanks) regarding STI policy, including senior and junior researchers from:

(1) Chinese Academy of Science and Technology for Development (CASTED) affiliated to the Ministry of Science and Technology (MOST);
(2) Institute of Policy and Management (IPM) of Chinese Academy of Science (CAS);
(3) Institute for the History of Natural Sciences (IHNS) of CAS;
(4) China Association for Science and Innovation Strategy Research Institute (NAIS) affiliated to Chinese Association for Science and Technology (CAST);
(5) Chinese Academy of Medical Sciences (CAMS) & Peking Union Medical College (PUMC);
(6) Beijing Institute of Technology (BIT).

The interviews focus on these issues:
(1) The main theme and discourse in STI policy in China;
(2) The responsibility of STI in China;
(3) The awareness and opinions on RRI from the perspective of China;
(4) Ethical issues, concerns and norms related to STI in China.

3.2.3 National workshop
A national workshop was held on February 22nd, 2017. A diverse group of stakeholders from policy making agencies, funding agencies, research institutions, higher education institutions and industries participated to discuss: the understanding of responsibility and responsible research and innovation

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5 “Transformation Law” in short below.
(RRI) in the particular context of China; the necessity, practice and policies of improving RRI in each organisation; the driving forces and barriers in practicing RRI and how responsibilities should be distributed among government, institutions and individual researchers.\(^6\)

The participants are representatives of different actors in the Chinese S&T system:

(1) The Ministry of Science and Technology (MOST) that plays the main role in national S&T policy making;

(2) The High Tech Research and Development Centre (Administrative Centre for Basic Research) is in charge of managing the National Basic Research Programme of China, National High-tech R&D Programme, and Key Technologies R&D Programme;

(3) The National Centre for Nanoscience and Technology (NCNST) of China, a subsidiary non-profit organisation of CAS that mainly conducts basic and applied research in Nanoscience;

(4) The Chinese Academy of Medical Sciences & Peking Union Medical College that is the top medical school in China, representing both universities and hospitals;

(5) The China Academy of Railway Sciences (CARS) that has more than 50 years’ history and is the only comprehensive research institute with multi-disciplines and multi-specialties in China Railway industry, representing the applied research of technology and innovation;

(6) The Lepu Medical Technology (Beijing) Co., Ltd. that specializes in high-tech medical device development, production and sales, as the representative of industry/enterprises.

3.3 The organisational studies

We selected two institutions for case studies. CASTED represents a research conducting organisation, but it is quite special. It is a policy research and consulting institution, which is different from institutions such as universities and research institutions conducting natural sciences and social science research. Because CASTED is affiliated to MOST, it is able to get in touch with the dynamics of STI policies in a timely manner, and to provide advice and suggestions for decision-making, with special policy influence. As a representative of the funding agencies, NSFC funds basic scientific research mainly for universities.

3.3.1 Document studies

The official websites of CASTED and NSFC provide a lot of documents and materials on the organisation, history, purpose and news. In particular, on the NSFC website, a large number of documents such as regulations, laws, plans, project guides, and annual reports are available. In addition, NSFC publishes a journal, *Science Foundation in China*, which publishes many articles on the research and discussion of NSFC’s historical development and funding policies. We collected and read through these documents to identify RRI-related content. Much of the materials for the case studies of the two institutions come from the analysis of these public documents. Other complementary documents are provided by interviewees.

3.3.2 Interviews for reviews

In order to review NSFC’s policies and measures related to RRI, we interviewed employees at different levels in NSFC. A total of 7 people were interviewed. Our interviewees are mainly from the Bureau of Policy, including senior officials, middle-level cadres, and ordinary employees. The Bureau of Policy is mandated to provide consultancy concerning significant S&T policies and to draft policy statement of NSFC. There are also interviewees from the Centre for Communication which is in charge of science

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communication and open access in NSFC. Besides, a workshop was held with NSFC officers on October 2016 discussing RRI related issues such as open access and research integrity. A thorough review on gender equality policy in NSFC has been discussed with the organisation.

7 semi-structured interviews have been done in CASTED. Interviewees include 2 vice presidents, 1 director of the manage department, 2 directors of 2 different research institutions, and 2 junior researchers from different research institutions. They compose a fair sample regarding the organisation of CASTED (see Section 6.1). Besides, a lot of informal discussions on RRI and the keys have been conducted with employees at different levels in CASTED.

3.3.3 Focus group and outlook
A focus group was held in CASTED, with participants of 1 vice presidents, 2 directors of research institutions, 2 senior researchers and 3 junior researchers. An outlook on 5 keys of RRI based on review has been presented to all the participants and discussed during the focus group. Some questions and opinions have been raised. However, no concrete consensus has been reached.

Due to the complicated situation in the period of institutional adjustment of NSFC, the focus group cannot be held. An outlook on 5 keys based on the review of workshop, interviews and documents has been presented to some senior officers but with no concrete feedback.
4. The context for RRI: the national science policy system

4.1 General country information

Of all the countries in the world, China has the largest population. At the end of 2017, the total population of the Chinese mainland were 1.39008 billion, of which 711.37 million were men, accounting for 51.2%, and 678.71 million were women, accounting for 48.8%. At the end of the year, there were 776.4 million employed people nationwide, including 424.46 million urban employees. In the whole year, there were 805,000 students enrolled in postgraduate education, 2,639 million graduate students, and 578,000 graduates. Ordinary undergraduate enrolment was 7.615 million, with a total of 27.536 million students and 7.358 million graduates.

China is the second largest economy in the world today. In 2017, the annual gross domestic product was 82,712.2 billion yuan (approximately 10,955 billion euros). The annual per capita disposable income of the national residents was 25,974 yuan (approximately 3440 euros).

Stimulating research and innovation is a key priority of the Chinese government. This is exemplified by the investments and programmes. In 2017, the annual research and experimental development (R&D) expenditure was 1750 billion yuan (approximately 231.8 billion euros), with an increase of 11.6% over the previous year, and was 2.12% of GDP, of which the basic research funding was 92 billion yuan (approximately 12.2 billion euros). In the year, the National Key R&D Programme has arranged a total of 11 key special projects for 1115 science and technology projects, and the National Science and Technology Major Project has arranged 454 projects. The National Natural Science Foundation has funded a total of 43,935 projects. By the end of the year, 503 national key laboratories, 131 national engineering research centres, 217 national engineering laboratories, and 1276 national enterprise technology centres had been built. The National Science and Technology Achievements Transformation and Guidance Fund has established a total of five sub-funds with total capital of 24.72 billion yuan (approximately 3.27 billion euros). In the whole year, there were 3.698 million domestic and foreign patent applications, and 1.836 million patents were granted; the number of PCT patent applications accepted was 51,000. By the end of the year, there were 7.148 million valid patents, including 1.356 million domestic effective invention patents and 9.8 invention patents per 10,000 population. A total of 368,000 technical contracts were signed throughout the year, and the turnover of technology contracts was 1342.4 billion yuan (approximately 177.8 billion euros), with an increase of 17.7% over the previous year.

4.2 Legal and other binding normative frameworks

Policy making for S&T in China is part of the bureaucratic system, which formulates and implements policies in general. S&T policies, like others, take shape through the interactions between scientific and political institutions, in which actors from the legislative, government, advisory bodies, conducting or funding organisations all play roles. The parliament and the highest level of state power, the National People’s Congress (NPC) by use of the Standing Committee and the Committee on Science, Technology, Education and Health “have the authority to draft, enact, and amend S&T-related laws, which usually are drafted by a specific government ministry. Technically speaking, NPC also monitors the implementation of such laws and approves the state budget for science and technology affairs. Members of the Chinese People’s Political Consultative Conference (CPPCC), an advisory body, many

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being non-Chinese Communist Party (CCP) member scientists and engineers, also voice their expert opinions and comments” (Liu et al., 2011: 919).

In the centre of S&T government enterprise in China is the Ministry of Science and Technology (MOST), which conducts China’s national S&T programmes, including basic and applied research, commercialization of S&T, backing of innovation within companies as well as support of science parks and incubators (Liu et al., 2011: 919). Correspondingly the mission of the Ministry is as follows: “MOST takes the lead in drawing up S&T development plans and policies, drafting related laws, regulations and department rules, and guaranteeing the implementation […] MOST aims to serve socio-economic growth by coordinating basic research, frontier technology research, research on social service, key technology and common technology.” Here we again find close ties between S&T development and economic growth.

A further important actor is the Chinese Academy of Sciences (CAS), which plays a large advisory role in S&T policy making through the provision of decision-making services of its academicians. CAS is active in “research, high-tech development, technology transfer, and training” (Liu et al., 2011: 920). In its own mission, CAS understands itself as “the linchpin of China’s drive to explore and harness high technology and the natural sciences for the benefit of China and the world […] Since its founding, CAS has fulfilled multiple roles: as a national team and a locomotive driving national technological innovation, a pioneer in supporting nationwide S&T development, a think tank delivering S&T advice and a community for training young S&T talent.” CAS sees itself as a driver for original innovation and S&T development in China, taking on an advisory role for policies in these areas.

Another central player is the National Natural Science Foundation of China (NSFC), which “mainly supports basic research and mission-oriented research projects through competitive and peer review processes” (Liu et al., 2011: 920). The NSFC is the institution which administers the National Natural Science Fund for the central government: “supporting basic research, fostering talented researchers, developing international cooperation and promoting socioeconomic development.” The administrative system in NSFC aims to improve decision-making in funding policy and to implement as well as monitor and consult. Also, here we find connections made between the economic development for society and the importance of S&T for this.

The Chinese Association for Science and Technology (CAST) can be regarded as an umbrella organisation made up of various academic and professional societies (Zhu, 2009: 72). It understands itself as the largest national non-governmental organisation of scientific and technological workers in China, which also serves as the bridge that links the Communist Party of China and the Chinese government to the country’s science and technology community.” The societies of CAST, over 200, spread throughout China and allow for a wide network in the area of S&T. Overall, CAST is an important player in driving Chinese S&T development and has participated in shaping policies and regulations through its networks of scientists, engineers and other people working in S&T (Zhu, 2009: 72). Close ties to policy and decision-making are provided by the constituent membership of CAST in the CPPCC. In its mission statement CAST describes itself as an organisation aims at developing S&T in China, opening S&T up to a wider public as well as providing advice for the overall S&T strategies. “CAST devotes itself to boosting the development of science and technology in China, enhancing science literacy of the whole nation, organising and encouraging scientists and engineers of the country […] to conduct academic exchange, science popularization and scientific and technological consulting and other activities according to the country’s science and technology development strategy, accelerating the emergence of scientific and technological talents, voicing the opinions of science and technology professionals and firmly safeguarding their legitimate rights.” Again, we see here the alignment between strives in S&T and the development of China as well as communication and promotion of S&T in different areas. These organisations derive their legitimacy and standing from their activities for enhancing the development of S&T in China as a way to support the development of the
country as a whole. In this way, we find close links between the self-understanding of these organisations and the well-being and development of China.

Figure 1 shows the key actors in the R&D system regarding S&T in China. At the top we find the State Council as the main authority, followed by the State Science and Education Group which is an inter-ministry institution which serves as a coordinator, for example for the Premier of the State Council to coordinate S&T policies (Zhu, 2009: 69).

4.3 Political and cultural values and discussions related to STI

The tripartite culture of Confucianism-Buddhism-Taoism, with Confucianism dominant, constitutes traditional Chinese values. These values take an individual as the basis of value judgment and focus on the moral cultivation of an individual, extending from the self to others, from an individual to a family, and from a group to a state and even the whole world. What is elaborated in the Confucian classic *the Great Learning*, from individual cultivation to familial regulation, governance by the state and universal tranquillity and happiness, is only an ideal description of the lifetime accomplishments of an individual in Confucianism.

Confucianism regards virtue (*ren*) as the general principle guiding people’s ethics, and embraces wisdom, courage, filial piety, brotherhood, loyalty, integrity, humility, tolerance, ingenuity, kindness and respect as the ethical codes for constraining behaviour. It underlines the different social status of the emperor, the official, the father, the son, the husband and the wife, and the importance of abiding by the moral principles and standards that exhort the son to love the father, officials to stay loyal to the emperor, the wife to follow the orders of the husband, the young to respect the elder, and friends to treat each other with honesty. Taoism, on the other hand, advocates the principle of inaction and urges people to endure humiliation, lower social status and a position of weakness, stay out of conflict, cherish life, maintain purity and to refrain from making moral judgments (Jiao, 1993).

In the process of global modernization, a number of concepts and ideas came to China gradually. A series of reforms and revolutions after 1840 allowed Western religions, science and technology, political concepts of democracy and freedom, and Marxism to exert immense influences on intellectual elites and the public in China (Zhu, 2002: 304). Over one to two hundred years, an affinity for Western science and technology, the ideology of freedom, equality and affluence, and the concepts of rights and legal

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awareness has taken root in Chinese society and constitutes an important criterion for value judgments by the public.

New values have grown in contemporary China under the new social conditions of building socialist market economy towards independence and rejuvenation. On one hand, the pursuit is towards the socialist ideal of national development, common prosperity, social harmony and improved quality of life; on the other, it focuses on the philosophy of the market economy, featuring individual achievements and fair competition. These two aspects stand in conflict yet have common grounds, such as the pursuit of economic development. Consequently, developing the economy has become the most essential discourse in contemporary China.

Meanwhile, along with economic development, unintended consequences such as environmental risks and social inequality have undergone adjustment and integration by other elements of values to form the concept of sustainable development. Sustainable development as a moral concept emphasizes development not just in the economy but also in society, science, culture and environment. It expresses equity among generations and within one generation; and it calls for respecting nature, learning from nature, protecting nature and living in harmony with nature (Zhu, 2002: 144).

In recent years, in order to realize the importance of solidarity in values, the central government and the Communist Party of China have made a series of efforts to refine and codify the values. The core socialist value system that embodied the spirit of the nation and the time gradually germinated and formed over the period from the 16th national congress of the party in 2002 to the 18th in 2012 (Guo, 2014).

In September of 2012, the party formally put forward the core socialist values as follows:

Core socialist values are the soul of the Chinese nation and serve as the guide for building socialism with Chinese characteristics […] We should promote prosperity, democracy, civility, and harmony, uphold freedom, equality, justice and the rule of law and advocate patriotism, dedication, integrity, and friendship, so as to cultivate and observe core socialist values (Hu, 2012).
5. Aspects of responsibility in national science policy

5.1 The conceptualisations of responsibility in national science policy

Since Chinese is a language completely different from English, it is impossible to find the English word “responsibility” in any Chinese documents. The term Chinese used to translate “responsibility” is “ze ren” meaning “function” and “task.” Therefore, in order to discuss about the conceptualization of “Responsibility” in China’s science and technology policy, it is necessary to rely on the author’s interpretation of the term “responsibility” and then to identify the related discourse and narrative from China’s science and technology policy.

“Science and technology are the first productive force” is a famous assertion put forward by Deng Xiaoping, the core figure of the PRC’s second-generation leadership collective. It originated from the basic principle of Marxism: “science and technology are productivity.” This is the most basic discourse to guide China’s science and technology policy. In the logic of this discourse, science and technology naturally have the functions and responsibilities of “transferring into industrial innovation achievements” and “promoting economic and social development.” Aside of the basic discourse of Marxism, the main discourse in the field of China’s science and technology policy also includes: historical trends, international position, and people’s needs. These aspects are reflected in the discourse of “Chinese Dream.” “Chinese Dream” is the important guiding ideology and important governance idea put forward by President Xi Jinping since the 18th National Congress of the Communist Party of China on November 29, 2012. The definition of “China Dream” is “to realize the great rejuvenation of the Chinese nation.” The concrete manifestation is that the country is prosperous and strong, the nation is rejuvenated, and the people are happy. The means of implementation are political, economic, cultural, social, and ecological civilization. In China, the main responsibility of science, technology and innovation is to help build a socialist modernization power and realize the great rejuvenation of the Chinese nation.

Xi Jinping’s speech at the 19th Academician Meeting of the Chinese Academy of Sciences and the 14th Academician Meeting of the Chinese Academy of Engineering in 2018 outlined the main themes of China’s science and technology: (1) Innovation-driven development (transformation into productivity and economic efficiency); (2) Independent innovation; (3) deepening the reform of the science and technology system; (4) participating in global scientific and technological cooperation and governance; (5) talent-led.

Main actors include: (1) Government (CCP, Ministry of Science and Technology); (2) Scientific community (represented by the Chinese Academy of Sciences); (3) Universities; (4) Enterprises; (5) Society (media, social organisations, ordinary people)

The main relevant policy/legal instruments in use are two kinds: (1) Planning, such as the Mid- to Long-Term Plan for Science and Technology, Innovation-Driven Development Strategy, 13th Five-Year Plan for Science and Technology Innovation, which functioned as guided policy adjustment tools; and (2) laws, such as Progress Law, Promulgation Law, and the Transformation Law, which functioned as basis and norms.

In the policy documents of STI, the words “talent-led” and “two-wheel driven” are often mentioned. Talent is an important driving force for promoting technological innovation and the transformation of scientific and technological achievements. “Two-wheel drive” means that “scientific and technological innovation” and “institutional innovation” are two wheels that drive the development of science and technology. The two wheels must work together and cannot be neglected. Some existing institutions do not adapt to the new situation of scientific and technological development, and will become the barriers to the development of science and technology. Reforming these old institutions and creating new
mechanism that adapt to the development of new technologies will become the driving force behind the development of science and technology.

The focuses of S&T policy in China are both on upstream and downstream practices. However, the linkages between and transferring from upstream to downstream are the biggest issue.

Another dimension of “responsibility” of innovation in national science policy relates to the governance of risks emerges in the development of modern science and technology, and to ensure the safety of people and society. In order to realize the “double-edge sword” effect of science and technology, the government and scientific community in China became more and more concerned about the potential ethical, legal and social risks brought by science and technology, and came up with laws, regulations to deal with the challenges. For example, the Development Plan on the New Generation of Artificial Intelligence, issued by State Council, clearly stated that we should “cope with the possible challenges brought by artificial intelligence,” “study the legal, ethical and social problems related to artificial intelligence,” and “build up safety regulation and evaluation system of artificial intelligence.”

5.2 The notion of “RRI” in national science policy discussions

The notion of Responsible Research & Innovation is formally written in the 13th Five-Year National Science and Technology Innovation Plan (2016–2020). Article 24 “Creating A Social and Cultural Atmosphere for Encouraging Innovation” of Chapter 7 “Strengthening Science Popularization and Construction of Innovation Culture” mentioned: “promoting responsible research and innovation, strengthening research ethics, enhancing research ethics education, raising science and technology personnel’s awareness of scientific research ethics, and guiding enterprises to pay attention to and undertake social responsibility for protecting ecology and ensuring safety in technological innovation activities.”

5.3 Ethics in the national science system

When talking about ethics in science and technology areas in China, for most of normal people, the first impression is research integrity. However, in this project, as one of the RRI pillars, ethics means more than research integrity. Furthermore, in Chinese language, “ethics” and “research integrity” are translated into two different terms and have different meanings. So, in this section, “ethics” and “research integrity” are reviewed as two sub-categories.

In the most important national law on science and technology, the Progress Law, there is only one reference to “ethics,” that is, in Article 29 titled “Scientific Research, Technology Development, and the Application of Science and Technology” of Chapter 2 “the state bans the scientific and technological research and development activities that endanger national security, harm public interests, harm human health, or violate morality and ethics.”

In National Medium and Long-term Science and Technology Development Plan (2006–2020), there is only one reference to “ethics,” that is, “research on development and reproduction,” one of the four “major scientific research plans,” which mentions “focusing on […] the safety and ethics of assisted reproduction and stem cell technologies.”

In the 13th Five-Year National Science and Technology Innovation Plan (2016–2020), there is slightly more content of “ethics.” Article 24 “Creating A Social and Cultural Atmosphere for Encouraging Innovation” of Chapter 7 “Strengthening Science Popularization and Construction of Innovation Culture” mentioned: “strengthening social supervision on research integrity and research morality, and expanding public right to know and supervision on scientific research; Promoting responsible research and innovation, strengthening research ethics, enhancing research ethics education, raising science and technology personnel’s awareness of scientific research ethics, and guiding enterprises to pay attention to and undertake social responsibility for protecting ecology and ensuring safety in technological innovation activities.”
It can be seen from the above three representative documents that the term “ethics” in China’s science and technology system mainly refers to “moral norms” rather than “value controversial issues.” In the Progress Law, “morality and ethics” refer to the existing norms. Similarly, in the 13th Five-Year Plan, “ethics” refer to some existing norms, and what needs to be done is to “strengthen, enhance and raise.” However, there is no document at corresponding level and in the same field that clearly stipulates what exactly is the “existing ethical norms” and how to define the applicable subject and scope. This makes the seemingly harsh words in the document such as “prohibition” and “enhancement” not actually have great execution power. In the Medium and Long-term Plan, the meaning of “ethics” here is also very vague; but as a subject of “research,” it is possible to be understood as a “value controversial issue.” After all, the use of assisted reproduction and stem cell technology in medical treatment is closer to the public understanding of the Chinese term used to translate “ethics,” namely “lun li,” the relationship between offspring and family.

As “moral norms,” “ethics” in China’s science and technology system is mainly concentrated in the biomedical field. The national health authorities have issued a series of regulatory documents related to medicine and life sciences, including: High-grade Pathogenic Microbiology Laboratory Construction Review Method, Human Organ Transplant Regulation, Laboratory Animal Management Regulations, Genetic Engineering Safety Management Measures, Laboratory Animal Quality Management Measures, Interim Measures for the Management of Human Genetic Resources, National Rodent Laboratory Animal Seed Centre Introduction, Seed Supply Implementation Rules, National Laboratory Animal Seed Centre Management Measures, Basic Standards and Technical Norms for Human Sperm Bank, Human Assistant Reproductive Technological Norms, Ethical Principles for Human Assistance Reproductive Technology and Human Sperm Bank, Ethical Guidelines for Human Embryonic Stem Cell Research, Guiding Opinions on the Treatment of Experimental Animals, Ethical Review Method for Biomedical Research Involving Human Subject (Trial), and so on.\(^ {10} \)

As a “value controversial issue,” in recent years, there have been a number of events that have raised great concerns in the public, science community, and science and technology management departments. The most typical ones are: (1) controversy over genetically modified crops, (2) the use of human embryos to carry out gene editing research, and (3) artificial intelligence research and development.

The controversy over genetically modified crops took a long time, and spread from Europe and the United States to China. During extensive discussions, related laws and regulations were issued. For example, the State Council issued the “Regulations on the Safety Management of Agricultural Genetically Modified Organisms” in 2001. In August 2009, China’s Ministry of Agriculture formally approved the issuing of safety certificates to two transgenic rice varieties and a transgenic corn variety. When Greenpeace International learned of this and made it widely known through the media, a huge public backlash ensued; In March 2010, the Centre for Science Communication, Peking University, published on its official website an open letter jointly signed by some scholars in humanities and social sciences, claiming that the safety certificates granted to the transgenic rice and maize varieties were not based on adequate demonstration. If decisive measures are not taken immediately to put a halt to commercial planting of genetically modified corps, China’s food security and food sovereignty will face major impacts. In April 2013, Presidium of the Academic Divisions of the Chinese Academy of Sciences issued the “Advocacy Initiative for Responsible GM Technology R&D” and proposed that scientists working on R&D of genetically modified technologies should pay attention to the social effects of technological applications, abide by ethical norms, ensure safety, maintain sensitivity to technical ethics, consciously consider the ethical, social, and legal issues that may arise from the development and application of technology, as well as the principles, scope of responsibility, and action guidelines for decision-making consultation, science communication, and ethics education. However, with news events such as “Golden Rice” frequently appearing, the topic has been continuously fermented through

\(^ {10} \) See http://www.nsfc.gov.cn/nsfc/cen/pfzl/index.htm
media hype. Due to the intertwining of multi-national corporation monopolies, national food security, and China’s specific political factions, it gradually became an inextricable knot. Many scientists with interests have shied away from it.

In 2015, a research team of Sun Yat-sen University published a paper on genetic modification of human embryos, which immediately triggered intense debates in the academic community at home and abroad on the research ethics. Natural scientists and social scientists in China have expressed their opinions. Some researchers expressed support for the study, believing that it is conducive to the advancement of science and technology and the development of human health; while other scholars are more cautious about this, calling for researchers to pay more attention to the ethical and social responsibility of new technologies. In 2016, CAS participated in organising the International Summit on Human Genome Editing, in which the organisation clarified China’s attitude and position in the field of genome editing of human embryos, actively taking part in the development of an international code of ethics (Zhao and Liao, 2017).

In recent years, due to the rapid development and application of artificial intelligence, related ethical issues have gradually surfaced. In the New Generation Artificial Intelligence Development Plan issued by the State Council in 2017, “ethics” appeared 15 times in total. Apart from mentioning “formulating,” “establishing” and “strengthening” “ethical standards,” it also specifically mentioned the impact of uncertain development of artificial intelligence on social ethics, supporting interdisciplinary exploratory research on the law and ethics of artificial intelligence as a basic theoretical issue.

Compared with ethical issues, scientific community is more concerned about research integrity. On May 30, 2018, Central Office of the Communist Party of China and Office of the State Council issued “Several Opinions on Further Strengthening the Construction of Research Integrity.” Published by such a high-level government department, it fully explained the country’s attention to this issue. The opinions were drafted by the Ministry of Science and Technology, with opinions extensively collected from relevant departments, localities, colleges and universities, scientific research institutions, enterprises, and front-line researchers, and were reviewed and approved by the Central Committee’s first comprehensive deepening reform committee. According to the opinions, the Ministry of Science and Technology and the Chinese Academy of Social Sciences are responsible for overall coordination and macro-level guidance for research integrity work in the field of natural sciences and philosophy and social sciences. They also deployed the roles and functions in the construction of research integrity of different entities such as scientific and technological planning agencies, scientific research funding agencies, universities and research institutions, technology agencies, service organisations, associations, and other social organisations.

The opinions emphasized the importance of “research integrity as the cornerstone of scientific and technological innovation,” and laid out an overall plan for the construction and management of research integrity systems. It can be foreseen that in the next few years, China will establish a system for the monitoring, management, investigation and handling of research integrity.

5.4 Societal engagement strategies in research

Scientific research should benefit society and the public can acquire scientific knowledge and participate in scientific research, which are written in the Constitution. Article 14 of the Chinese Constitution states: “the state continuously raises labour productivity, improves economic results and develops the productive forces by […] disseminating advanced science and technology.” Article 20 states: “the state promotes the development of the natural and social sciences, disseminates scientific and technical knowledge, and commends and rewards achievements in scientific research as well as technological discoveries and inventions.” Article 47 states: “citizens of the People’s Republic of China have the freedom to engage in scientific research, literary and artistic creation and other cultural pursuits; the
state encourages and assists creative endeavours conducive to the interests of the people made by citizens engaged in education, science, technology, literature, art and other cultural work.”

Accordingly, China has issued three important laws directly related to the social functions of science and technology.

(1) Progress Law

Article 4 stipulates: “economic development and social development shall depend on science and technology, and scientific and technological progress shall serve economic construction and social development.” Article 5 states: “the state encourages public institutions, enterprises and social organisations, social groups and citizens to participate in and support scientific and technological progress activities.” Article 13 stipulates: “the state shall improve the rules and procedures for scientific and technological decision-making, establish a normative consultation and decision-making mechanism, and promote scientific and democratic decision-making. When formulating scientific and technological development plans and major policies, identifying major projects of science and technology, and major projects closely related to science and technology, scientific decision-making should fully listen to the opinions of scientific and technical personnel.” Chapter 3, “Enterprise Technology Progress” states that “enterprises are the main body of technological innovation.” Enterprises are encouraged to participate in the implementation of government-funded science and technology projects, set up R&D institutions, cooperate with universities and other scientific research institutions carrying out cooperative research, jointly cultivate talents, conduct science popularization activities for the public, and to fund research and development activities. For universities and scientific research institutions, Article 44 of this law states: “science and technology research and development institutions set up with fiscal funds to carry out scientific and technological research and development activities shall serve the national goals and social public interests; if conditions permit, they shall open up venues or facilities for popularizing science and technology and carry out science and technology popularization activities.”

(2) Promulgation Law

It states: “the state and the public shall popularize knowledge of science and technology, advocate scientific conduct, disseminate scientific ideologies and advance scientific spirit.” “All citizens have the right to participate in activities associated with the popularization of science and technology.” “The popularization of science and technology is a welfare undertaking, and as such is an important component of socialist material progress as well as cultural and ethical progress. It is a long-term mission of the state to develop the popularization of science and technology.” The law stipulates the goals and principles, organisation management, social responsibility, conditions and legal responsibilities of science popularization, which gives importance to science popularization in the form of national laws. It stipulates the responsibilities of various subjects such as government departments, science and technology associations, educational and scientific research institutions, and scientific and technical workers in the field of science popularization, and clarifies that “science popularization is the common task of the whole society.”

(3) Transformation Law

This is a law learning from the Bayh-Dole Act of the United States. Although it is about regulating the follow-up experiments, development, application, and promotion of the already-existing scientific and technological achievements, formulating laws in the downstream of innovation to clearly distribute and guarantee researchers’ income of scientific achievements will encourage enterprises and society to invest more in and participate in scientific research in the upstream, and it may also guide publicly-funded scientific research activities toward more economic and social benefits.

In addition to being embodied in laws, societal engagement of science is also reflected in more effective and guided national strategies and policies. The representative ones are as follows.
(1) Rejuvenating the country by science and education has become China’s national strategy since the mid-1990s. On the one hand, it clearly defines the crucial role of science and technology in national, economic, and social development. On the other hand, it also defines the direction and goals for science and technology activities: rejuvenating the country. Because of juxtaposing science and education, the strategy has greatly promoted the reform of China’s science and technology system and education system. In the historical phrase of the transition from planned economy to market economy, higher education institutions and public research institutions have undergone major transformations, resulting in the establishment of research universities and the transformation of a large number of institutions into enterprises, which have laid a foundation for the establishment of a national innovation system for education-sci-tech-economic integration, and trained a new generation of talents that are oriented to the needs of the knowledge economy.

(2) Innovation-Driven Development Strategy is consistent with Rejuvenating the Country by Science and Education Strategy, emphasising more on the importance of science, technology and innovation. In May 2016, the CPC Central Committee and the State Council issued the National Innovation-Driven Development Strategy Outline. This is the highest-level policy document. The outline clarifies the goal of “deep integration and mutual promotion of science, technology and economy” and has made strategic arrangements for building a national innovation system that can get through the upstream and downstream chains. Basic research and scientific exploration have been given to the position of “original innovation” and “source supply,” “to support industrial change and safeguard national security.” The outline lists five types of innovative subjects, including companies, universities, research institutions, new types of R & D institutions, and technology transfer service organisations, and clearly defines their respective functional positioning and cooperation in different aspects of the innovation chain. It can be seen that the Innovation-Driven Development Strategy has regarded scientific research as an organic component of broad innovation. Clearly, the broad innovation activity requires the involvement of different social actors, and each social entity will also interact through different links in the innovation chain. Their social needs and values would infiltrate into scientific research activities.

(3) The policy Mass Entrepreneurship and Mass Innovation more directly reflects the societal engagement of science and technology activities.

In 2015, the State Council issued the opinions on promoting certain policies and measures for Mass Entrepreneurship and Mass Innovation, using a variety of financial policies and institutional reform measures to stimulate and ensure that all types of social entities actively participate in entrepreneurship, especially using new technologies to start businesses. Article 20 mentions “establishing a long-term mechanism for opening up science and technology infrastructure, large-scale scientific research instruments, and patent information resources to the entire society; improving the mechanism of opening to society, the national key scientific laboratory and other national-level scientific research platforms (bases), strongly supporting Mass Entrepreneurship and Mass Innovation; encouraging enterprises to establish a number of professional and market-oriented technology transfer platforms; encouraging companies to develop socialized services for entrepreneurs based on advanced technologies and development models such as 3D printing and network manufacturing.” Article 22 mentions “supporting scientific research personnel to entrepreneurship […] mobilizing the entrepreneurial initiative of scientific researchers; supporting and encouraging science and technology associations to provide consulting services for science and technology personnel and start-up enterprises.”

In 2017, the State Council once again issued the opinion on strengthening the implementation of the Innovation-Driven Development Strategy to further promote the in-depth development of Mass Entrepreneurship and Mass Innovation, and proposed to “focus on diversification of innovation and entrepreneurship subjects, and large enterprises, research institutions, and universities should play leading roles and effectively promote the integration of various types of market entities. […]” The opinion also takes the “sharing” concept in the Five Major Development Concepts as a guide for the value of Mass Entrepreneurship and Mass Innovation, pointing out that “practicing the concept of shared
development, achieving everyone participating, everyone putting effort, and everyone enjoying, making innovation and entrepreneurial achievements more fair and beneficial to all people, and promoting social fairness and justice.” A major feature of this opinion is that it specifies concrete implementation departments for various policy initiatives. Among them, Article 6 is “promoting the open and sharing of instruments and equipment, and exploring the separation mechanism between the ownership and management rights of instruments and equipment; for the purchase of instruments and equipment for financial funds, exploring the introduction of professional services for social services and other means (Ministry of Science and Technology takes the lead).”

Science communication, more commonly named as science popularization in Chinese context, is becoming more and more important in China’s science and technology policies. Xi Jinping emphatically pointed out that science innovation and science popularization are two wings to achieve innovation and development, calling for science popularization to be considered just as important as scientific and technological innovation (Xi 2016). Over recent years, science popularization has become a basket filled with issues in various aspects, including the responsibilities of scientists, public engagement and science education. Despite the fact that current models of science popularization are dominated by deficit models associated with the popularization of scientific knowledge, attempts are being made concurrently to build new models of communication and public engagement.

Movements towards more public communication and participation in China can be seen in the role of non-governmental organisations (NGOs), for example in the context of environmental issues (Zhang and Barr, 2013). In the Chinese context, NGOs present actors that can disseminate ideas, provide empirical evidence as well as support the “creative search for alternative solutions. [They] have served to empower the general public and restrain government authority” (Zhang and Barr, 2013: 133). It seems that the Chinese government will have to adapt to growing civil society and empowered citizens, with various actors stepping into decision-making processes. Especially pressing environmental issues such as air pollution provide a ground on which growing awareness of the public is especially apparent in China. Here the effects of demands for economic growth and S&T development as well as their societal implications become obvious.

Perhaps the most important example of an engagement event to mention in the context of participatory technology assessment in China is a consensus conference in Beijing on GM food conducted in 2008 by researchers from CAS. Here, interested citizens as well as scientists working in the field gathered for discussions on the technical aspects as well as the societal implications of this complex S&T issue. The importance was that the CAS researchers were trusted by both sides and therefore their research could be facilitated. Yet, it remained difficult because the participants were not familiar with the method of consensus conference and therefore not accustomed to taking part in discussions with one another. This event remained the only one of its kind.

Obstacles in the practice of Chinese public participation in science and technology decision-making (Fan et al., 2011):

(1) Lack of institutional guarantee. The public participation in science and technology decision-making activities that China has undertaken is mostly passive, primitive, and non-institutional. It lacks legal guarantee and is ignored by many policymakers. Without effective guarantees, it is difficult to develop in many cases.

(2) Lack of operational procedures and implementation methods. The lack of specific operational procedures and implementation methods makes the public participation of scientific and technological decision-making more remain in the concept.

(3) Lack of participation channels and participation methods. At present, Chinese public participation in science and technology decision-making lacks a fixed channel, so that in many cases, public participation only becomes a diffuse expression of opinion.
(4) Insufficient dialogue between science and the public. Western developed countries have gone from one-way public understanding of science to two-way public participation in science, science, and social dialogue. In contrast, Chinese public participation in scientific and technological decision-making is not well-founded. There is no real dialogue between scientists and the people.

5.5 Gender equality and diversity strategies in the science system

China has always upheld the constitutional principle of equality between men and women, which is also a basic state policy for promoting progress in the country and in society. Over the years, China has progressively improved its laws and regulations, developed public policies, worked out development plans and pressed forward steadily with gender equality and women’s development. In 1990, the State Council established the National Working Committee on Children and Women (NWCCW), which has been commissioned the responsibilities to organise, coordinate, guide, supervise and urge departments concerned in promoting gender equality and women’s development. Composed of leading ministerial-level members from relevant government organs, the Committee is chaired by a member of the State Council leadership. Over the previous 20 years, the Committee has expanded its member units from 19 to 35, now including government organs such as the National Development and Reform Commission, Ministry of Education, Ministry of Civil Affairs, Ministry of Finance, Ministry of Human Resources and Social Security, Ministry of Agriculture, and the National Health and Family Planning Commission, in addition to six mass organisations (The Information Office of the State Council, 2015).

Article 53 of Scientific and Technological Progress Law stipulates: “young scientific and technical personnel, scientific and technical personnel of ethnic minorities, and female scientific and technical personnel are competing for professional and technical positions, participating in scientific and technological evaluations, undertaking scientific and technological research and development projects, and receiving continuing education; equal rights are enjoyed in other areas.”

Since the founding of the People’s Republic of China, the educational level of women has been continuously improved. According to the statistical data in 2014, the ratio of female undergraduates and postgraduates in ordinary colleges in China accounts for 52% of the total number of undergraduates and master students. The proportion also reached 37%. Among them, the proportion of women in doctoral students was only 31% in 2004, an increase of 7 percentage points in 10 years (Department of Development Planning in Ministry of Education of the PRC, 2015). According to the “Science and Technology Research Report on Human Resources Development in China 2014” published by the China Association for Science and Technology, in 2014, China’s total female human resources for science and technology amounted to 29.71 million, accounting for 40.5% of the nation’s human resources for science and technology (CAST and NAIS, 2016), and women have constituted a crucial component of China’s human resources for science and technology. Although women have already occupied a considerable proportion of the overall human resources for science and technology, their share of high-level scientific and technological talents has been low. For example, as of the end of 2008, although about half of all teachers were women, only 25.1% of professors were women. As of 2015, the Chinese Academy of Engineering had a total of 850 academicians, and women accounted for only 5% (excluding senior academicians); the Chinese Academy of Sciences academicians had 777 academicians, and women accounted for only 6%. The highest national science and technology award (2000–2014), none of the 25 winners was women (Ma and Fan, 2016).

In recent years, the Ministry of Science and Technology and other departments have promoted women’s scientific and technical personnel’s growth and development in related work and policy measures to increase women’s willingness and ability to participate in scientific and technological undertakings, expand women’s employment and development in the field of science and technology, and to resolve female scientific and technical personnel in scientific research workers. Faced with difficulties and problems, relevant departments have introduced a number of policies and specific measures to create an institutional environment that supports the development of women talents throughout society.
In 2011, the Ministry of Science and Technology and All-China Women’s Federation issued the Opinions on Strengthening the Construction of Female Science and Technology Talent Teams and proposed relevant policies and measures to increase female science and technology talent reserve, expand female employment opportunities in science and technology, and to promote the development of high-level female talents. In the 13th Five-Year Plan on National Science and Technology Talent Development issued by the Ministry of Science and Technology in 2017, it is also clearly stated that in the major talent engineering and talent special projects, women’s science and technology talents should be given appropriate tilt support.

The relevant departments have also taken some policy measures to implement a tilted support policy for female researchers in response to the characteristics of women.

1. Actively promote the implementation of a full-fledged retirement system for female senior professional and technical personnel and men at the same age. In March 2015, the Central Organisation Department and the Ministry of Human Resources and Social Security issued a notice to provide that female professional and technical personnel with senior professional titles may retire at the age of 60 years. The implementation of this policy has aroused strong reactions among female science and technology workers in scientific research institutions such as the Chinese Academy of Sciences, and also has a catalytic effect on enterprises. It is learned that some large state-owned enterprises are preparing to issue corresponding regulations.

2. Take practical measures to vigorously support female scientists and technicians to undertake national science and technology projects. The first is to give priority to female scientists and technicians. For example, the National Natural Science Foundation has clearly stated that in the evaluation of various types of projects, women researchers should be given priority in support under the same conditions. In recent years, the percentage of women in charge of the National Natural Science Foundation’s Facing Projects, Regional Science Fund Projects, Key Projects, and Outstanding Young Scientists Fund Projects has steadily increased, and the proportion of female heads of Young Scientists Fund Projects has remained stable at the high level of 40%. This year, the ratio of heads of women in general projects has reached 24.53%, that in youth science fund projects was 40.76%, that in regional science fund projects was 34.44%, and that in excellent youth science fund projects was 19.80%. The second is to relax the age limit for female applicants. For example, the National Plan for Ten Thousand Talents raises the age limit of young women from 35 to 37 years old (the social sciences is 40 years old); the National Natural Science Foundation of China limits the age of female applicants for Young Scientists Fund projects to 35 years old then relaxed to 40 years old since 2011; the Outstanding Youth Science Fund starts from 2012, in which men are required to be under 38 years old and women are under 40 years old. These measures have greatly stimulated the enthusiasm of female scientific researchers in applying for the project. The number of female applicants for the Young Scientists Fund project has doubled compared with that in 2010 before the implementation of the policy, and the number of funders has more than doubled. This year, 32% of female applicants for female scientific researchers aged 36–40 applied for the Youth Science Fund, of which 1572 were funded.

3. The China Association for Science and Technology actively plays an association role to support and promote the growth of women science and technology workers. The General Office of the China Association for Science and Technology released the “Notice on the Role of the National Association in Promoting the Growth of High-level Scientific and Technological Talents for Women” (Council for Study and Development (2015) No. 10), which fully mobilized the enthusiasm of the national societies and gave full play to women’s high-level scientific and technological talents. The role of strong promotion of female scientific and technological talents specifically includes the following aspects. (1) Focusing on increasing the proportion of women in the leadership structure. Of the 1323 delegates to the Ninth Congress of the China Association for Science and Technology, 335 were female representatives, accounting for 25.3% of the total. For 383 members of the Ninth National Committee of the Chinese Association for Science and
Technology, 74 of them were female members, accounting for 20% of the total number of members. Of the 54 members of the Standing Committee of the China Association for Science and Technology, 9 are female members, accounting for 17% of the total number of members. (2) Establishing a specialized agency. The Ninth Standing Committee of the China Association for Science and Technology established a special committee of women science and technology workers. It is dedicated to promoting the advancement of social civilization, giving full play to the role of high-level scientific and technological talents for women and promoting gender equality. Special awards are created to promote the development of women science and technology workers. (3) Building a platform to promote the growth of women science and technology workers. In 2004, the China Association for Science and Technology jointly established the Chinese Young Women Scientists Award with the All-China Women’s Federation, the National Commission for UNESCO and L’Oréal (China) Co., Ltd., and in 2009 relaxed the age of candidates for the Young Women Scientist Award from 40 to 45 years old. In 2015, a plan for future women scientists will be added. Up to now, the China Young Women Scientists Award has been honoured for 13 sessions. A total of 114 outstanding female science and technology workers have been commended. In the future, women scientists plan to launch 10 outstanding young female scientists and scientists to receive funding.

In China, diversity in science and technology is reflected not only in gender equality but also in the diversity of geographic regions and ethnic groups. Article 6 of the Progress Law stipulates: “the state shall strengthen cross-regional, cross-industry and cross-sector science and technology cooperation, and support science and technology progress in ethnic regions, remote areas and poverty-stricken areas.”

The two institutions we studied have policies and initiatives to promote regional diversity. NSFC has set up a regional fund to support the development of science and technology in poor regions. CASTED has done concrete work on poverty alleviation and inclusive innovation. Details could be seen in Section 6.2.4 and 7.2.4.

5.6 Open access and open science strategies in the national science system

In terms of open access, at present, China’s relevant policies and measures mainly include science and technology reporting system, open research infrastructure, and science and technology literature sharing.

(1) Science and technology reporting system

The main driving force behind the reporting system and the opening of scientific research infrastructure is the government sector, led by the Ministry of Science and Technology.

In July 2012, the CPC Central Committee and the State Council held a national conference on science and technology innovation, proposed to establish a unified science and technology reporting system. A S&T report elaborated the process and results of scientific research, written in fixed form with purpose to realize the accumulation, transmission and exchange of knowledge of science and technology. It includes different types like project reports, progress reports, final reports and organisational management reports. According to the description in S&T reports, researchers can repeat the experiment or make understanding of the results. National S&T reporting system plays an important role in the comprehensive preservation and sharing of science and technology information resources. It will also provide basic scientific information for scientific researchers and decision support for science and technology management. For the general public understanding and the utilising of national scientific research, the reporting system will function as a service platform, to promote national science and technology innovation.

Starting in April 2013, Ministry of Science and Technology launched a pilot science and technology report project of the national science and technology plan. Public funded science and technology reports are made available to researchers and the public through the state S&T reporting service system. The
system provides services for the public, professionals and managers. To the public, abstracts of reports are provided for free. Also, the public can go through the basic information, and understand the basic situation of the reports system under the investment of national finance without registration. For professionals, it provides online full-text browsing service, but a real-name registration is required. They can search and browse the full text of scientific reports online through identity authentication, however, no downloading and saving of the full text is allowed. After the registration, the author of the S&T report will enjoy 15 times of the number of report pages for further articles pushed. The scientific research management personnel can enjoy the statistical analysis service. After registration approved by department, they are also free to enjoy the service of search, query, browse, entirety and the corresponding statistical analysis within a certain scope. With the continuous development of S&T reports from various regions and departments, more S&T reports from other departments will be added in the future. The report system will be developed into higher standardization. In addition to the final report, more special reports, progress reports will be submitted in the process of scientific research project. Report resources will continue to expand.

In 2014, the Opinions of the Ministry of Science and Technology on Accelerating the Establishment of the National Science and Technology Reporting System was forwarded to the whole country by the general office of the State Council. The opinions set forth four general requirements. First, mandatory submission, public funded science and technology projects are required to submit S&T reports. Second, key assessment, the submission and sharing of S&T reports will be an important condition for the follow-up rolling of the project leader and the project undertaking unit. Third, centralized collection, Ministry of Science and Technology and its entrusted agencies should process and manage S&T reports collected nationwide. Fourth, open access, stakeholders will provide open and sharing services to project authorities, project undertakers, researchers and the public through the National Science and Technology Reporting Service System.

(2) Open research infrastructure

In Science and Technology Progress Law Article 65 states: “science and technology resources management unit shall publish to society the information of system used in the management of science and technology resources sharing and usage, and shall manage the usage according to the institutional arrangement.” In December 2014, the State Council issued Opinions on Open Access of Major National Scientific Research Infrastructure and Large Scientific Instruments, requiring for related management system and methods to clarify the responsibilities, straighten out the open operation management mechanism, improve the efficiency of scientific research infrastructure and release full service potential. According to the above polices, Ministry of Science and Technology, Ministry of Finance, and the National Development and Reform Commission, based on full investigation and consultation, jointly formulated Management Methods for Open Access of the National Major Scientific Research Infrastructure and Large Scientific Instruments.

(3) Science and technology literature sharing

The main driving force for science and technology literature sharing is universities, which constitute the Confederation of China Academic Institutional Repository (CHAIR), and scientific research institutions, which are represented by the Chinese Academy of Sciences.

China Academic Library & Information System (CALIS), is a higher education public service system. The aim is to establish the system cored with the Chinese higher education digital library construction, realizing the sharing of Information resources, maximizing social benefit and economic benefit, and better serving China’s higher education. Since its establishment in 1998, CALIS management centre has introduced and built a series of domestic and foreign literature databases, including a large number of secondary literature libraries and full-text databases. A relatively complete CALIS document
information service network has been formed. So far, more than 500 members have participated in the construction and service of CALIS project.

In 2003, Lu Yongxiang, President of the Chinese Academy of Sciences, signed the Berlin Declaration on Open Access on behalf of Chinese scientists, which marked Chinese Academy of Sciences as a pioneer in the international open access movement. In 2004, Lu also signed the Berlin Declaration with Chen Yiyu, director of the National Natural Science Foundation Committee, on behalf of the Chinese Academy of Sciences and NSFC respectively. Li Jinghai, vice president of the Chinese Academy of Sciences, pointed out that maintaining open access to public funded academic achievements and papers is the special political responsibility of scientists and scientific community, and is also the social responsibility of the Chinese Academy of Sciences. Gao Ruiping, deputy secretary of NSFC, pointed out that fair and open exchange of information is one of the key factors to realize the independent innovation of science and technology development. NSFC as the basic research funding agencies, is willing to actively participate in and promote open access of academic information. In October 2010, the 8th international conference on open access jointly organised by the Chinese Academy of Sciences and the German Max Planck Institute was held at the national science library of the Chinese Academy of Sciences. It was the first time for the conference held outside Europe since 2003 (Zhang, 2010).

In 2009, the Chinese Academy of Sciences constructed the Chinese Academy of Sciences Knowledge Base Service GRID (hereinafter referred to as CAS IR GRID) with goal of developing institutional knowledge and knowledge management ability, to realize the organisation knowledge assets collection, conservation, reasonable spread and use, and to improve the capability of capture, conversion, transmission, utilization, and audit of knowledge. Besides, gradually building capabilities including content analysis and analysis of relationship between knowledge and ability to audit, and carrying out comprehensive knowledge management are also an important goal.

The China Open Access Journals (COAJ) are organised by the Chinese Academy of Sciences, China Science and Technology Publishing Media Co., Ltd., and Beijing Zhongke Journal Publishing Co., Ltd. COAJ, formerly known as CAS-OAJ, is an open access, academic and non-profit scientific literature portal of the Chinese Academy of Sciences. It was launched in October 2010. On the basis of CAS-OAJ, COAJ as a library storage project of the reform and development of press and publication project, will become a “one-stop” work style construction of China’s science and technology periodical OA integration platform and portal for showing and navigating open access of journals of science and technology in China. It also strengthens the function of communication of academic journals of science and technology, improve the academic influence of sci-tech periodicals, and lead the science and technology information of open access in China.

Paper pre-release platform of science and technology at Chinese Academy of Sciences (http://www.chinaxiv.org) facing the scientific researchers all around the nation, is aimed at the construction of a reliable, normalized open storage library of Chinese research papers in the field of natural science, receiving preprints of scientific papers in English and Chinese and the open archiving published scientific papers. It is a standardized academic exchange ecosystem supporting the rapid exchange and release of high-level scientific research papers in China, and the right of Chinese scientists to publish scientific research as the first one.

Since 2012, the document information centre at Chinese Academy of Sciences (National Science Library) has held an annual China open science promotion week (China OA week). Experts from all over the world, technology from areas of scientific community, publishing and library, get together to discuss a variety of implementation of the open access policy, practical plan and practice, especially in the case of China.
5.7 Science education integrated into research\textsuperscript{11}

Science education usually refers to organised and planned education and training activity teaching science and technology knowledge, and methods of scientific inquiry helping educates to improve their ability to apply knowledge, and to grasp spirit and thoughts behind knowledge and methods. Civic Scientific Literacy Action Plan Outline (2016–2020) clearly stated that the goal of science education is to cultivate citizens with certain scientific knowledge so that they can adapt to the social development and have the ability of innovation and practice. Formal science education in school and informal education together formed the modern science education system with formal education as the main channel and informal education to further promote and extend.\textsuperscript{12}

Conducting science education is the responsibility of the state stipulated in the Constitution. To this end, China has the Promulgation Law, and the government implemented the National Science Literacy Action. The specific executor of this action is mainly CAST. CAST is the largest organisation of science and technology personnel in China. In 2008, CAST established the National Science Literacy Action Implementation Office, which is responsible for organising the National Science Literacy Action. China Research Institute for Science Popularization (CRISP) affiliated to CAST has long been committed to the investigation and research of science popularization policies and practices. Youth Science and Technology Centre in CAST has organised a number of specific activities for science education for young people.

Due to the scientific popularization and education as a special work, although many researchers participated, it was not really integrated into their research. The content of most of science popularization and education is often to convey the research results to the masses, or to provide some professional knowledge according to the needs of the masses.

Another major enabler of science popularization and education is CAS. Under the CAS, the Science and Communication Bureau has its functions: to carry out public communication work on important innovation achievements and scientific research progress at home and abroad; to promote scientific spirit and develop scientific culture; to be responsible for the organisation and management, macro guidance and scientific communication of the school unit comprehensive coordination; to be responsible for planning and implementing the communication activities of the key work of the whole hospital; to be responsible for the comprehensive processing of government affairs information; to be responsible for public opinion research and management; and to be responsible for science and publishing management.

Since CAS is China’s largest institution engaged in scientific research, the science popularization and educational activities carried out by CAS will be more closely integrated with research work. The educational activities organised by the Science Communication Bureau can be supported by scientists in the CAS. CAS is working hard to encourage scientists in the organisation to participate more in science education activities for adolescents and the general public. For example, long-term organisation of the “Public Open Day” event is to make people learn more about knowledge and research activities in the organisation, and participate in science activities to earn credits.

\textsuperscript{11} See http://ec.europa.eu/research/swafs/pdf/pub_science_education/KI-NA-26-893-EN-N.pdf for an explanation of what is meant with this key.

\textsuperscript{12} See http://www.cast.org.cn/n200750/n203920/n204078/index.html
6. Organisational reviews and outlooks: research conducting organisation

6.1 Mapping of the organisation

Chinese Academy of Science and Technology for Development (CASTED) was established in 1982. The former name of the organisation was National Research Centre for Science and Technology for Development (NRCSTD). The establishment of it was due to the older generation of political leaders attached great importance to the research on China’s science and technology (S&T) strategies for development. Therefore, the organisational function of it is to make efforts to transform the government functions further and to improve the capability of macro-management and decision-making. NRCSTD was one of the most important institutions in China on S&T development strategy and policy studies. It mainly studies national S&T development strategies, policies, mechanism, management, foresight and assessment. It plays a crucial role in S&T in facilitating social and economic development. NRCSTD also organised or participated in many studies on national key programmes and on regional development strategies or plans to assist the systematic reform and the development of China’s S&T.

In 2007, NRCSTD was transformed into CASTED by the proposal of the Ministry of Science and Technology (MOST). The purpose of this transformation is to improve the research on S&T macro development strategies and to meet the new requirements of improving the independent innovation and constructing an innovative country. Due to this change, CASTED has gained a new opportunity to provide strategic thinking and decision-making consultation. It devoted to forward-looking, holistic and comprehensive strategic research targeting at “constructing an innovative country” and “improving independent innovation” in the new era. CASTED has established a project-proposing mechanism, which emphasises both national targets and free exploration. CASTED as a state-owned institute is under the supervision of MOST and provides policy recommendations mainly to MOST and other relevant national or local ministries. The major functions of CASTED are to (1) participate in the top design of national S&T development strategies by providing studies and consultations on national S&T development strategies; (2) undertake key strategic research tasks under the government-oriented and demand-oriented principles; (3) cultivate research talents on S&T strategy by guide the S&T strategy research of regional governments and other ministries; (4) and to develop a cooperative research network both internationally and domestically, and well-known periodicals and forums via mechanism innovation.

CASTED has around 100 staff members. By 2008, 32 researchers in CASTED have got doctoral degrees and 33 of them have got master degrees, accounting for 77.4% of the total personnel. There are also 44 senior researchers (with 31 associate researchers) and 32 mid-level researchers. CASTED staff are allocated in 8 research institutions and two management departments (see the organisational chart Figure 1).
Department of Administrative Management is in charge of all the administrative work of CASTED, including human resources, financial management, documentation processing, archives management, secretary work and so on. Department of Research Management, as the coordinator and manager of CASTED research activities, conducts management on research projects, postgraduates and associations. It is also in charge of the academic exchanges, including international cooperation and the cooperative base development. Entrusted by MOST, it carries out an additional task on managing the National Soft Science Research Programme.

CASTED is consisted of eight research institutions. The research focus of the Institute of Comprehensive Development is the national S&T development at macro-level, which focuses on crucial and hot strategic issues in economic and social development. The study fields of the Institute of Science and Technology Systems and Management, are policies of science, technology and innovation, S&T management and system reform, national innovation system, enterprise innovation management, and S&T-related legal issues. The Institute of Foresight and Evaluation studies the social-economic needs and S&T development trend. It carries out the technology foresight activities and makes the priority setting of critical technologies for policy-making. The Institute of Science and Technology Statistics and Analysis is responsible for S&T related statistic work to serve the decision-making of the national authorities. The Institute of Science and Technology Investment researches fiscal and revenue support systems of S&T innovation and financial mechanism for innovation and entrepreneurship-related services. It also studies forward-looking theoretical and policy studies on entrepreneurship finance and entrepreneurship investment activities. The responsibility of The Institute of Science and Technology for Industrial Development is to provide professional consultation on industrial technology innovation and industrial organisation. It concerns, at the macro level, industrial development strategy and planning, industrial innovation policy, industrial reform and motivation, innovation and structural transformation, and so on. To improve and promote the construction of regional innovation system and urban and rural development, the Institute of Rural and Regional Development focuses on its research question on S&T innovation and development strategies for agriculture and rural areas and critical S&T issues in
urbanisation process. The Institute of Science, Technology and Society is the division which uses sociology as the core subject direction and focuses on the social issues of S&T development. By using the qualitative and quantitative empirical research methods, it studies S&T-related social development issues at the macro level, the innovation of institutions and organisations at the middle level and the issue of national human resource strategies, S&T human resource policies at the micro level.

Also, CASTED sponsors three national organisations: China Federation of Scientific and Technological Institutions, China Society for Science and Technology Indicators, and China Association for Promotion of Science and Technology and Finance. CISTRAT (the International Research and Training Centre for Science and Technology Strategy) under the Auspices of UNESCO is co-established by CASTED and MOST in 2012.

The strategic priority of CASTED for the future development is to devote itself to becoming one of the national high-level think tanks and an influential think tank for S&T policy and decision-making.

6.2 Aspects of responsibility in organisational policy and practice

6.2.1 The conceptualisations of responsibility in the organisation

In CASTED, the term “responsibility” in CASTED is often related to S&T innovation. Researchers would associate this term with research topics which are related to their S&T policy, for instance, S&T risks, S&T ethics, and inclusive innovation. This means when speaking of responsibilities, it often refers to the following questions: how to prevent the social risks and negative effects of S&T, and how to use ethical norms to guide the development of S&T, so that it would not be opposed to the public. When it comes to “inclusive innovation,” the concept of “responsibility” always involves social equity and coordinated regional development, eradicating poverty, and helping vulnerable groups.

From the internal and operational aspects of the organisation, the concept of responsibility in research and innovation is mainly understood in the following two aspects.

(1) Support the decision-making of national S&T development. CASTED attaches importance to focus on S&T development strategies and policies. As a think tank at the national level, it is responsible for paying attention to the frontier issues of S&T development and providing accurate and timely consultations to MOST and other ministries for their future policy decisions. From this perspective, the responsibilities in research are related to the issue of predicting the potential risks of certain policy changes, evaluating the impacts of S&T development and implementing related policies.

(2) The responsibility of CASTED is not only to support the national level decision-making, but also to concern the societal impacts on S&T development and other related issues. For instance, the organisation would carry out investigations with concern to the regional development. CASTED did the investigation and monitoring of the living conditions of urban and rural residents in the western region of China, and the rapid assessment of demand after a severe natural disaster.

Thus, for CASTED, the concept of responsibility is to help the government establishing and improving policy system for science and technology innovation and development. In addition, it is also responsible for providing better understanding of the social impacts of S&T development.

In the S&T policy and strategic research, it is inevitable to take competing concepts into considerations along with the concern on the responsibility of research and innovation, due to the factors which may influence the impact of certain policy are diverse, and the involved stakeholders are multiple. In the current stage of S&T development, the competing concepts with responsibility are mainly the speed of S&T development and economic growth. It is often believed that addressing the topic of “responsibility,” “ethics” and “risk,” will restrict the freedom of innovation and slow down the speed of economic development. Thus, the discussion on responsible innovations or other RRI-related issues will
always invoke the argument of the development stage of the society, which argues that compared with developed countries, such as the U.S. and Europe, China is still at a relatively lower stage. There are still gaps between China and developed countries, in the development level of economy, living standard and culture. Thus, the most important goal is to develop economy, catch up with the developed countries, and then to reach a higher level of society. After these achievements, we then can consider more about the issue of “ethics” and “responsibility.” Although this view may receive criticisms, it shows that the idea of fast development could be the competing concept of “responsibility.”

The concept of responsibility for CASTED is also related to issues such as social responsibility and sustainable development and inclusive development. These relationships can be seen in the establishment of the organisation, and the work that CASTED have carried out. When the National Science and Technology Promotion and Development Research Centre (NRCSTD) was established, the predecessor of CASTED, it has been guided by the strategy of sustainable development and researched national science and technology development strategies, policies, mechanisms, management, forward-looking, and evaluation. CASTED follows this tradition, to adapt to the new requirements of the Chinese government’s scientific and technological work in the new period, and to strengthen research on macro-technical development strategies and policies. CASTED adheres to the national development strategy, the strategy of sustainable development with the international vision, and commits itself to the development of S&T in China. There are various studies in CASTED, which are closely related to the sustainable development strategy. Especially, CASTED has interests in development of the new energy industry. Also, the strategic research from CASTED has also demonstrated a strong sense of social responsibility, for example, assessment of rapid demand after the Wenchuan earthquake in Sichuan Province, monitoring of socio-economic development in the western region, research on rural and regional development, and evaluation and research of innovative companies.

The use of the notion of RRI comes directly from the European Union. It is introduced from the EU-funded project of international cooperation. There are discussions by using the English term RRI, and there is a corresponding Chinese translation. In recent years, the relevant discussions also include five aspects of RRI. In addition to the terms that we mentioned above, inclusive innovation, sustainable development, corporate social responsibility and other policy discourses are also discussed.

6.2.2 Ethics in the organisation

A. Description of the practice and its development and an assessment of how well it currently works

The concerns on ethical issues, namely research integrity and ethical research norms, started in CASTED since there was an increasing discussion about research misconduct and ethical issues in the S&T community. Ethics in CASTED can be divided into two parts. The first part is the internal practices among the staff in CASTED. Within the leadership of CASTED, the academic committee is in charge of guiding all the research outcomes from CASTED following ethical codes of academic research. Also, young researchers, especially postdoctoral researchers, will receive instructions from their supervisors and the academic leaders of each institute. There is no independent committee on ethics within CASTED yet. However, CASTED has devoted more effort to the second part, namely studies on S&T related ethical issues for the external use, such as demonstrating the current status of ethics in S&T research and providing policy recommendations on this issue.

As a policy research institute and a think tank, regarding the ethical issues in scientific and technological innovation, CASTED focuses on the empirical investigations on the ethical issues of science and technology. It evaluates the status quo of current practices. During the process of policy making, CASTED could inform the decision makers about the relevant policy-making consultations. In this way, it could have impacts on the ethical issues in scientific and technological innovation. Due to the research interest on S&T innovation policy, CASTED mostly studies ethical issues within the context of the potential risk of S&T innovations. In past few years, there are several research projects focusing on the research ethics within the context of S&T development. About the issue of research
integrity, researchers from CASTED surveyed the situation of research misconduct on a national scale. Major practices in recent years include as follows.

1. Submit research reports and policy recommendations on S&T ethics, and research integrity and biotechnological ethics (internal reference) to the Ministry of Science and Technology. In the past few years, Institute of Science, Technology and Society in CASTED conducted several investigations of public opinions on ethical contested issues. For instance, in 2013, due to the rising public awareness of the S&T related ethical issue, researchers from CASTED were trying to analyse if there are significant changes in public opinions towards S&T ethical issues. The study shows, 46% of the public believe scientists should be responsible for the social consequences of their research. This result is nearly 10% higher than that in 2007. This sociological study also shows that there is a significant increase in concerns on the ethics of animal experiments. Further, based on the result of the investigation, it provides policy recommendations to MOST on the establishment and management of S&T ethics advisory bodies. In 2015, this institute conducted another research on public attitudes towards GM technology in China (He et al., 2015). This research shows that more people hold a negative view on GM food. Most of the people are unwilling to try GM food and the acceptance of GM food among the public has a significant decrease. In addition to these investigations on the public opinions, researchers from CASTED also study the biotechnology ethics, and relevant policy in China compare with the experiences of the international community (Li and Zhang, 2013). In 2012, researchers from CASTED surveyed Chinese science and technology personnel’s views on academic misconduct. This survey collects opinions from 30,000 Chinese researchers. From their perspective on research misconduct, the study shows the current status and the main reasons for research integrity in China (Zhao and Deng, 2012). The study shows that nearly one-half of the respondents believe the misconduct in research is common in China. Most of the people think that the current evaluation system cause this situation. Many of the respondents did not have systematic learning on research ethics. Based on this results, researchers provide several recommendations for decision makers (Zhao and Deng, 2012).

2. Conduct the national investigation on the ethical consciousness of scientific researchers for China Association for Science and Technology. To understand Chinese researchers’ views on research ethics accurately, objectively and systematically, researchers from CASTED surveyed 324 research institutions and 12,332 individual participants. This research widely studied to what extend S&T researchers know about research ethics and their attitude and behaviours towards those ethical rules. Further, it also tried to make sense of the reasons for these facts. The “research study” here includes not only research integrity but also animal ethics, medical ethics and environmental ethics. As a result of this study, researchers from CASTED suggest that strengthening the establishment of ethical examine institutions at different levels and the training and education system for research ethics are urgently necessary (Zhao et al, 2016b). Also, researchers from CASTED are interested in studying the governance system of research ethics in other countries. They introduced and analyses the examples in Japan from three viewpoints: the concept of governance in Japan, the structure and institutional norms in Japan, and comparison between Japan and China (Feng and Zhang, 2016).

B. Main barriers (structural, cultural or related to interchange dynamics)

The main barriers come from cultural elements and interaction between institutions.

For the cultural barriers, there are potential underlying cultural elements that make the topic of ethical issues less urgent than others. First of all, compared with western countries, development of ethical debates in China, for instance, the discourse on animal ethics is relatively legged behind. This is partly because, for some people, ethics is believed to be the “brake” of scientific and technological innovation, instead of the “steering wheel” of it. Therefore, ethics is believed to have potential conflicts with the main goal of promoting the development of scientific and technological innovation. In addition to this cultural barrier, the theory of the development stage of society also plays an important role. Countries at different developmental stages should consider different kinds of problems. This may imply that in a
developing country, ethical issues are not the primary concern according to its stage of social development. Although it may not be the correct interpretation of this theory, it still to a certain extent represents one particular opinion of how ethics are understood in developing countries. Regarding the issue of research integrity, research from CASTED shows that a considerable number of scientists and technicians have a tolerant attitude towards academic misconduct. The reasons for forming such a mentality are diverse. Age, surrounding environment, and understanding of causes of academic misconduct all have potential influences on the formation of people’s attitudes. Therefore, to a certain extent, the ignorance of ethical reflections from society may be the potential barrier of the past. However, due to the awareness of ethics has increased in recent years, both from the government and the public, the discussion on the moral aspect of S&T innovation and development will draw more attention.

For the interactive communicational barriers, since CASTED mainly serves as a think tank for the policy-making of government by providing advice to decision-makers, the primary concerns of the government directly affect the primary goal of CASTED. Since “ethics” is yet not a primary concern for national leaders, the research efforts on ethical issues are limited in CASTED.

C. Main drivers (structural, cultural or related to interchange dynamics)

There are drivers from structural and interchange dynamics reasons.

First, the official obligation for CASTED is to facilitate the policy design for S&T development. The policy which concerns the ethical aspect is inevitably crucial for prudent decision-making. For the moral impacts of research integrity, biotechnology and artificial intelligence, carrying out the research is encouraged by the concern from the government and the public. This encouragement of research interest fits the responsibility of CASTED. Thus, it can be understood as the structural driver of ethics in this organisation.

Second, the international cooperation and communications with other policy-related research institutions play an important role. For instance, the research project which is collaborated with EU and SPRU includes the issue of the responsibility of the scientific and technological innovation, ethics, risk and evaluations. In this way, these topics have been brought into the research vision of CASTED.

Thirdly, the driving force comes from the communication with domestic academic and business entities. For instance, the CAS, Tsinghua University, Beijing Genomics Institute, Tencent Company, and other institutions which concern the ethical and social impacts of the emerging technology. Their research interests in ethical issues would affect the research interest of CASTED as well.

D. Best practices (or bad practices)

The best practices on ethics in CASTED are mainly participation in the drafting of the new generation of artificial intelligence planning and investigation of ethical, legal and social impacts on the planning. Researchers from CASTED join in the development planning of artificial intelligence from the perspective of S&T management. Their research concerning the security, privacy and ethical challenges in the application of artificial intelligence. The study points out that currently, the technical development of artificial intelligence invokes a wide range of ethical problems. For instance, when artificial intelligence could replace human being for decision-making behaviours, such as a self-driving car, it is necessary to set up plausible ethical norms from the human world for them to make decisions. Also, due to the potential capability of perception, cognition, self-learning and decision-making, the character of each artificial intelligence may be significantly influenced by their user. This may imply that the potential users need to bear moral and even legal responsibilities as the guardians of their robot (Li, 2017).

E. Current indicators (if any)
Currently, in CASTED, the indicators for the practice of ethics include: (1) the number of research projects which investigate the ethical reflections on S&T innovations; (2) the number of internal references submitted to the decision makers to promote the legislation or the policy of ethical issues; (3) the number of lecture or training concerns the research integrity.

F. All points of improvement

Improvement can be conducted in the following ways. (1) CASTED will continue with the investigation and assessment of ethical discourse in the context of S&T development in China. These type of investigations will be conducted more constructively. The discussion of research ethics will be undertaken within the discourse of economic and social development, and it also aims to put forward the collaborations with scientific researchers and enterprises. In this way, the policy recommendations will be more concrete and timely. Also, the investigations on ethical issues will be undertaken in a more industry-specific way. For instance, CASTED plans to organise research on medical and bioethics issues among doctors and relevant researchers and ethical issue on artificial intelligence among AI industry researchers. (2) CASTED could also make an effort in improving the situation of research integrity in China. Based on the existing study on academic misconduct, CASTED could conduct follow-up investigations after the improvement in policy and training system in recent years. In this way, the policy recommendation could be more accurate to target at the problematic issues.

G. Agreed points of improvement, with action plans and indicators for success

The Institute of S&T and Society in CASTED is already planning the next investigation on bioethics and medical ethical issues among doctors and relevant researchers. This is aimed to provide an adequate evaluation of their attitude and behaviour on ethical problems during their research. The similar kind of industry-specific investigation will be on the agenda of CASTED.

H. Resulting matrix

<table>
<thead>
<tr>
<th>Aspects of organisations</th>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State mandate and legislation, supported by internal rules and guidelines.</td>
<td>Lack of strong ethical culture in the academic/research environment.</td>
<td>Higher accountability for public research funding.</td>
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<td></td>
<td></td>
<td></td>
<td>More discussions in the public domain and social interaction.</td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
<td>As a think tank for national level decision-making, the mandated responsibility of CASTED is to provide policy recommendation to facilitate the development of S&amp;T innovation. Ethics is one of the aspects that policy-making should take into considerations.</td>
<td>There are increasing concerns on ethics from the public sphere as well as in S&amp;T research. Following the research ethics, especially the research integrity is the essential requirement for each of the staff member in CASTED.</td>
<td>MOST and other governmental entities or research institutes would entrust CASTED to do survey on ethical issues as policy-making consultations.</td>
</tr>
<tr>
<td></td>
<td>The official obligation for CASTED is to facilitate the policy design for S&amp;T development. The policy concerning the ethical aspect is inevitably</td>
<td></td>
<td>The international cooperation and communications with other policy-related research institutions play an important role in encouraging the study in ethical issues in CASTED.</td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>crucial for prudent decision-making.</td>
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<td>--------------------------</td>
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<tr>
<td>(1) Compared with western countries, the development of ethical debate in China is relatively lagged behind.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(2) The theory of the development stage of society, which maintains that ethical issues are not the primary concern in the current stage of social development, also hinders the extent of concerns on ethics.</td>
<td></td>
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<td></td>
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<tr>
<td>CASTED mainly serves as a think tank for the policy-making of government by providing advice to decision-makers. The primary concerns of the government directly affect the primary goal of CASTED. Since “ethics” is yet not a primary concern for national leaders, the research efforts on ethical issues are limited in CASTED.</td>
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<tr>
<th>Most important potential organisational actions</th>
<th>CASTED will conduct an industry-specific investigation on ethical issues, for instance, medical ethics and ethical issues raised by AI respectively.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Several actions can be included</td>
<td>The research project which is collaborated with EU and SPRU includes the issue of the responsibility of the scientific and technological innovation, ethics, risk, and evaluations.</td>
</tr>
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<tr>
<th>Indicators of success</th>
<th>(1) The number of policy reports related to ethical reflections on S&amp;T innovations. (2) The number of lecture or training that concerns the research integrity.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The number of internal references submitted to the decision makers to promote the legislation or the policy of ethical issues.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Potential indicator for the improved performance of the dimension in the research activities/programmes</th>
<th>Improvement can be achieved in the following ways: doing research more constructively, including the ethical issues within the mainstream discourse in economic and social development and putting forward the collaborations with scientific researchers and enterprises.</th>
</tr>
</thead>
</table>

### 6.2.3 Societal engagement strategies in organisation

**A. Description of the practice and its development and an assessment of how well it currently works**

As the think tank for the decision-making of the Ministry of Science and Technology, CASTED participates in the consultation for the national S&T development planning and the process of decision-making for long term, such as the drafting of the development of science and technology.
“five year plan,” the medium and long-term S&T planning and so forth. During this process, CASTED understands and responds to social needs through expert consultation, field investigation and social investigation. In addition to consulting technology experts, CASTED also works with local government departments, enterprises, and social organisations. **Thus, along with the work in CASTED, the practices related to societal engagement can be classified into two aspects. One way is analysing the public opinions towards S&T policy through investigation.** The result could provide critical information for relevant policy making. Researchers from CASTED conducted investigations on public opinion of the S&T related issue, such as the citizen’s opinions on food safety, scientists and GM food. These investigations could provide solid factual bases for policy recommendations. The results of policy proposals are submitted to the government decision-making departments. **The other way to promote public engagement is to create a communication channel among the public, scientists and the government, which provides high-quality information and data of S&T information.** In this aspect, CASTED created a popular publication for S&T communications with the public. *China Science and Technology*, which is a reputable journal run by CASTED, plays a critical role in the dissemination of S&T development in China. It provides timely highlights of domestic and international S&T news, insightful comments on the social, and legal and ethical aspects of S&T innovations. This journal dedicates to creating an innovative, accurate platform for not only academic exchanges among peers but also communications among scientists, policy-makers, and the public. Moreover, CASTED disseminates knowledge about S&T strategies and policies by the website and other social media. The official website of CASTED is a gateway for citizens, business people and policymakers to access S&T development reports and other policy research results both in Chinese and in English. This website also updates news on all academic activities from CASTED. This information includes knowledge about building an innovative country and improving its capacity for independent innovation, forward-looking, comprehensive and comprehensive studies on strategic issues. Also, researchers from CASTED often participate in interviews on television and newspapers, and write commentary articles for newspaper and other new media.

However, although there are some long-term cooperation networks and channels for public engagement, there is a lack of a formal mechanism within CASTED. Until now, the practices related to public engagement are only workable through specific projects. The advantage of this form is the flexibility, which can quickly capture the latest trends. However, its disadvantage is the lack of stability and institutional guarantee. Another problem is the lack of access to the public engagement. Although on the website of the Ministry of Science and Technology, there is a section for public engagement, the popularity and the practicability of it are relatively low. During our interview, interviewees mentioned the method of using new internet media, for instance, internet or WeChat (a Chinese multi-purpose messaging and social media app), to collect opinions of ordinary people, but this method still lacks adequate regulations and institutional support

**B. Main barriers (structural, cultural or related to interchange dynamics)**
The main barrier to public engagement is the lack of institutional support. Because CASTED is a policy research institute, promoting public engagement is not the top priority of this organisation. Thus it does not form a systematic institution to encourage and guarantee the social participation in the process of scientific and technological decision-making.

There are also cultural barriers. Traditionally, when it comes to the issues in science and technology, the opinions from experts are highly appreciated while those from non-experts are relatively ignored. This phenomenon is also counted as an interactive communication barrier, because the collaboration between experts and institutions (Academy of Sciences, a think tank, universities, research institutions and other ministries) has significant influence in decision-making, and it will hinder the communications among other social departments (corporate, local, public, and so on.)

**C. Main drivers (structural, cultural or related to interchange dynamics)**
There are institutional reasons to motivate the work regarding societal engagement. For instance, CASTED could use the think tank report and investigation reports as the channel to support the communication between the government and the public. There are also institutional drivers outside the organisation. The government has increased their demand on the information of public opinions to facilitate the policy decision-making. For instance, MOST relies on CASTED to investigate the attitude of the public on specific issues.

There is also an internal cultural driver within CASTED. In the evaluation system of CASTED, the number of interviews to the public through all media, commentary or newspaper article or any other publications that are sharing knowledge about S&T policy and strategies or any relevant topics, gives credit for staff researchers. In this way, researchers in CASTED are motivated for knowledge sharing with the public.

There are also dynamics coming from interactive communication with other institutions. Due to the external cooperation, CASTED also has channels to submit consultative reports through other institutions.

D. Best practices (or bad practices)

The best practices in promoting societal engagement in CASTED are the investigations of public opinions on the S&T related issue. In the past few years, the researchers from the Institute of S&T and Society of CASTED did several empirical studies to investigate the opinions and needs of the public on various topics. In 2009, researchers analysed the level of satisfaction with food safety and related impact factors based on the residents from Beijing. This study suggests that the transparency of the government and people’s trust to scientists and government significantly impact the level of satisfaction towards food safety issue. Also, food safety incidents can significantly reduce public satisfaction. It suggests that government departments from all level could improve the public confidence on this issue through information transparency and the work efficiency especially when it comes to the communication with the public (Ma and Zhao, 2009). In 2011, researchers from CASTED tried to look into the image of S&T researchers from the public. The study shows that scientists have high reputations among the public and social credibility. Thus, it suggests that if there is an active condition to encourage scientists, they can take advantage of their credibility and participate in the governance when there is a public crisis. This study also shows that the public pays more attention to the ethical issue in the development of S&T. Thus, an adequate level of regulation and legislation on S&T ethics is urgently in need. This study also maintains that the Internet and other new media play a more significant role in shaping the image of scientists. This result implies that S&T management departments should make better use of new media as a channel to enhance the communication with the public (He and Wang, 2009). In 2018, ten years after the Wenchuan earthquake, the survey of earthquake disaster areas, which is carried out by the Institute of S&T and Society, studied the needs for post-disaster reconstruction of local people. Especially, this study focused on providing consultative proposals for the policy-making of promoting S&T to support the reconstruction of the disaster areas.

E. Current indicators (if any)

The number of relevant research projects and the number of reports which were replied and approved by leaders of the ministry. The number of publications which target knowledge sharing with the public and the number of articles and news that contribute to media.

F. All points of improvement

For the improvement of the societal engagement in CASTED, there could have been the institutional construction on this issue, for instance, establishing institutional arrangement of societal engagement which is in charge of the communication among multiple sections (experts and the public, local, enterprise and other possible stakeholders). This structural improvement could also go with more systematic changes in research projects. It not only requires investigations to collect opinions from the
public but also conducts project which aims to promote the engagement and communications of the public into S&T policy design.

During studies on the S&T policies, when it comes to consulting experts, improvement is to avoid excessive reliance on the judgment from experts, which may result in the standardization of policy recommendation. Another point of improvement is trying to create a channel which could include the public, as well as the communications between experts, policy-makers, citizens and other stakeholders, within the process of consultation.

G. Agreed points of improvement, with action plans and indicators for success

Institute of S&T and Society in CASTED has some public opinion surveys on the working agenda, such as people’s attitude and behaviour towards sharing economy and data privacy.

H. Resulting matrix

<table>
<thead>
<tr>
<th>Aspects of organisations</th>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>State mandate and legislation, supported by internal rules and guidelines.</td>
<td>Lack of strong ethical culture in the academic/research environment.</td>
<td>Higher accountability for public research funding.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>More discussions in the public domain and social interaction.</td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
<td>As a policy research institute and a think tank, CASTED produced policy reports based on public surveys, which provided channels for public engagement in policy making. CASTED researchers are encouraged to post their research reports on CASTED website, to publicize S&amp;T development news through publications.</td>
<td>CATED has the tradition of collecting public opinions through grounded research and field studies.</td>
<td>Public opinions on the specific issues are the solid factual basis for policy recommendation that CASTED could inform the decision makers with the relevant policy-making consultations.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The government has increased their demand on the information of public opinions to facilitate the policy decision-making.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CASTED also have channels to submit consultative reports through other institutions.</td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>Lack of institutional support for public engagement</td>
<td>Traditionally, when it comes to the issues in science and technology, the opinions from experts are highly appreciated while the public opinions are less considered.</td>
<td>The collaboration and communication with public/social organisations are not enough.</td>
</tr>
</tbody>
</table>
6.2.4 Gender equality and diversity strategies in the organisation

**A. Description of the practice and its development and an assessment of how well it currently works**

As an institution for policy consultancy, the major practices in CASTED which are related to the issue of gender equality and diversity include two parts. The first part is the internal policies and regulations for female staff to protect their equal opportunity during their recruitment, their research, maternity leave, parental leave and so on. From this perspective, as an organisation which is under the guidance of MOST, CASTED strictly follows relevant regulations to protect the equal rights of female workers. The second part regarding CASTED’s contribution to gender equality and diversity issue provides relevant policy studies and advice along with the goal of S&T policy consultation. In past few years, gender dimension is largely embedded in many of the research subjects. Also, CASTED researched the growth of female researchers and the gender policies of the research funding agencies. The results were submitted to the relevant department (Ministry of Science and Technology, foundation, the Association for Science and Technology). CASTED researchers have conducted in-depth research on the development of women in scientific research and policies to promote their development, and the development of women’s scientific and technical personnel.

The seek for diversity in CASTED mainly makes efforts externally to promote diverse and inclusive development. Researchers from CASTED undertakes the “Inclusive Innovation Research” Project, which is sponsored by MOST. The idea of inclusive innovation is to provide equal opportunity and development for the poor through innovative thought and method. The study shows that although inclusive innovation is a good alternative of the high cost and consumer society, it faces some problems to fit in the existing value of innovation and the creation of a complete policy chain. Thus, the researchers suggest that to promote inclusive innovation further in China, it is essential to implement policies which could motivate the market exploration, resources support and commercialization (Hao, 2016; Hao and Li, 2015). They also conducted an empirical analysis of inclusive policies in various countries of the world and provided reasonable recommendations for inclusive innovation in China.

**B. Main barriers (structural, cultural or related to interchange dynamics)**

There is one potential barrier that can be seen as the institutional reason. An organisation like CASTED often follows the guideline policy or regulations regarding gender equality and diversity issues from the upper level of governance. Namely, the gender policy is mainly implemented in the form of a top-down order. This regulation form may potentially limit the speed or the form of changing the way of achieving
or protecting gender equality within the organisation. For instance, to what extent and in what way to improve the representation of women in various R&I positions and levels of decision-making can be various. The top-down gender policy may limit the motivation of local organisations to take initiatives.

C. Main drivers (structural, cultural or related to interchange dynamics)

Culturally motivated: CASTED internal researchers are concerned with and promote relevant research work. For example, CASTED researcher devoted themselves to the study of gender policies and published many papers that support, promote, and evaluate the development of women researchers.

Other drivers come from the interactions and communications with other institutions. There are policy orientations on supporting female scientists from the concerns of the political leaders. Also, there are requirements for the consultative report on the relevant topic from other institutions, for instance, NSFC and the Association for Science and Technology.

D. Best practices (or bad practices)

The best practices regarding gender equality and diversity in CASTED are the integration of these dimensions in their research. CASTED evaluated and researched the effectiveness of the NSFC’s policy on female researchers. With the support of the NSFC, CASTED researchers took the lead in the research on women’s development. The studies show the facts and the potential problems of women scientists in their academic career. The policies which promote the female researchers in S&T innovations can be divided into three stages: the equal right/opportunity policies, preferable policies and the mainstreaming policies. China, at this moment, is transforming from the first one to the second stage. Thus, the choices for the policy should be based on the stages of the national background (Ma et al, 2017; Ma, 2011). In general, these studies analysed the development of scientific and technological talents, including the differences between female and male researchers in actual research, the reasons for these differences, and the factors affecting female researchers and so forth. Also, CASTED using the concept of “her economy” combines the topic of gender equality and innovations to provide policy advice to MOST to show that what way concerning the power of women would give S&T innovation a boost.

E. Current indicators (if any)

Current indicators include the number of investigations, internal reference and reports, which are related to the issue of gender equality and diversity from the researchers in CASTED. The number of female staff and female leaders. The number of regulations to facilitate pregnancy and parenting.

F. All points of improvement

For future improvement, there would be more policy research on promoting gender equality consciousness. Also, there should be more collaborations concerning the topic of gender equality and diversities with domestic and international research institutions in promoting the policy of gender equality and diversity in S&T development.

G. Agreed points of improvement, with action plans and indicators for success

H. Resulting matrix

<table>
<thead>
<tr>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspects of organisations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
<td>CASTED researcher devoted themselves to</td>
<td>STI policymakers in China are becoming more</td>
</tr>
</tbody>
</table>
the study of gender policies and published many papers that support, promote, and evaluate development of women researchers. concerned about supporting female scientists. There are increasing requirements for policy research on the relevant topic from government sectors, institutions, and so on

<table>
<thead>
<tr>
<th>Potential barriers to RRI</th>
<th>An organisation like CASTED often follows the guideline policy or regulations from the upper level of governance. This may potentially limit the autonomy or the flexibility of achieving gender equality within the organisation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most important potential organisational actions</td>
<td>More evaluations on the impact of policies promoting the development of female scientists.</td>
</tr>
<tr>
<td>Several actions can be included</td>
<td>More evaluations on the impact of policies promoting the development of female scientists.</td>
</tr>
<tr>
<td>Indicators of success</td>
<td>The number of regulations to facilitate pregnancy and parenting.</td>
</tr>
<tr>
<td></td>
<td>The number of female staff and female leaders.</td>
</tr>
<tr>
<td></td>
<td>The number of evaluation projects.</td>
</tr>
<tr>
<td>Potential indicator for the improved performance of the dimension in the research activities/programmes</td>
<td>The number of evaluation projects.</td>
</tr>
</tbody>
</table>

### 6.2.5 Open access and open science strategies in the organisation

**A. Description of the practice and its development and an assessment of how well it currently works**

The idea of open access is getting more popular in China in recent year. The organisations which start to participate in the discussion and promotion of open access are mainly universities. The leaders and researchers from universities are aware that open access has become the trend of future research. Many universities have raised their hope that open access can be implemented at the national level. However, except for universities, the topic of open access is not often mentioned on their agenda. CASTED, as a research institute under the lead of governmental entity MOST, is to serve national government agencies with policy recommendations. Due to this organisational nature, open access has not yet attracted much focus at this moment. This means that the researchers from CASTED, like scholars from the universities, would publish peer-reviewed journal articles and investigation reports which could be openly accessed. However, part of the output from CASTED are only available as policy recommendations or internal reports for the government.
Although open access and open science are not yet hot topics within CASTED, researchers from the Institute of S&T and Society are planning an investigation on this issue. They attempt to measure the attitude, behaviour and needs toward open access and open science from academic researchers in universities and major research institute in China. The analysis of their attitude and need would provide crucial information for relevant policy-making of the government, facility building of universities and research institutions.

B. Main barriers (structural, cultural or related to interchange dynamics)

The primary resistance is the structural barrier. Due to the nature of the CASTED organisation, some of the statistical survey data have certain confidentiality, which are only partially accessible to the public in general. Part of the output from CASTED only serves as an internal report within the organisation or for the government. Thus, the official responsibility of CASTED, as a think tank which belongs to the governmental body, may limit the implementation of open access and open science in this organisation.

C. Main drivers (structural, cultural or related to interchange dynamics)

The potential driving force is embodied in the research interest of CASTED. This organisation is interested in the topics which will have an impact on S&T development. Open access is a trend which will have a crucial impact on the future of S&T innovation. This is an important driver for open access as an external topic outside the organisation. Internally, there is much space for improvement, because the researchers within CASTED would be interested in access data more openly for their research. This could be considered as cultural motivations.

D. Best practices (or bad practices)

So far, CASTED does not have many practices on open access except to publish peer-reviewed journal articles and other output which is openly accessible. One exception is that an investigation on open access and open science is in the planning stage. It will investigate the attitude, behaviour and needs toward open access from academic researchers from universities and major research institute in China.

E. Current indicators (if any)

F. All points of improvement

The possible ways for improvement could strengthen exchanges and cooperation with universities and scientific research institutions in open access.

G. Agreed points of improvement, with action plans and indicators for success

H. Resulting matrix

<table>
<thead>
<tr>
<th></th>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspects of organisations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
<td></td>
<td>CASTED researchers work on projects related to open science.</td>
<td>Requirements from domestic and international co-operators to share research resources.</td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>Since CASTED is a governmental</td>
<td></td>
<td>Regarding open access to data, and others, there is less</td>
</tr>
</tbody>
</table>
research organisation, most of the research data have certain confidentiality.

work on the interaction between universities and academic institutions.

Encouraging CASTED researchers to post their reports on CASTED website, and to publicize S&T development news through publications.

Creating press office which is in charge of public relations.

Most important potential organisational actions
Several actions can be included

Encouraging CASTED researchers to post their reports on CASTED website, and to publicize S&T development news through publications.

Creating press office which is in charge of public relations.

Indicators of success
Number of the publications

Potential indicator for the improved performance of the dimension in the research activities/programmes

Strengthening exchanges and cooperation with universities and scientific research institutions in open access.

6.2.6 Science education integrated into research

A. Description of the practice and its development and an assessment of how well it currently works

Since the major functions of CASTED include conducting research on crucial strategic S&T issue and cultivating researchers on S&T strategy, science education practices have always been a part of its working objectives. The science education programme in CASTED can be understood regarding creating a platform to exchange S&T innovation-related knowledge and providing an education programme to S&T researchers and young politicians.

The science education projects set up S&T journals and International Research and Training Centre for Science and Technology Strategy (CISTRAT). To put forward the educational project in publicising the knowledge and policy of scientific and technological innovations, CASTED has tried to create a platform with academic journals and all kinds of academic exchange activities. CASTED has two journals: *Forum on Science and Technology in China* and *China Science and Technology*. The journal *Forum on Science and Technology in China* mainly focuses on the academic research on S&T development strategies, policies and management. It widely discusses the integration of S&T with the economy, policy-making in support talent researchers, international S&T relations, and other theoretical and practical issues. This journal has been the source periodical of Chinese Social Sciences Citation Index (CSSCI) and the Academic Journal Comprehensive Evaluation Database of China. *China Science and Technology* plays a significant role in recording the development of S&T development in China, with its in-depth and vivid reports. The journal aims at audiences including government officials at various levels, S&T personnel, enterprise managers and college students interested in S&T. In addition to these two journals, CASTED also organises and participates in all kinds of academic exchange
activities, including inviting experts and scholars to attend lectures and researchers from CASTED to deliver speeches. For instance, in 2017, CASTED President Hu Zhijian, serving as a chief expert, was frequently interviewed by leading media including CCTV and delivered keynote speeches at important domestic and international academic events. CASTED researchers were interviewed by traditional media and online media and they also delivered reports to international conferences including Pujiang Innovation Forum, China-Germany Forum on Innovation, Technology and Innovation, and China-UK Innovation and Development Forum and the U.S.-China High-Level Consultation on People-to-People Exchange, which widely promoted Chinese experience on S&T development and innovations and stimulated the learning from other countries at relevant issues.

International Research and Training Centre for Science and Technology Strategy (CISTRAT) was co-established at CASTED in 2012 by UNESCO and MOST, which aims at improving the S&T policy and innovation strategy research and training in developing countries. It is one of the first organisations which focused on the S&T policy and innovation strategy and training. It is also the only organisation which is established by UNESCO for S&T strategy and policy centre within China. This centre is located in CASTED. CISTRAT organises research and education programme under the guideline of Millennium Development Goals and new goals of sustainable development of UNESCO. As a co-established organisation, the governing board of CISTRAT is composed of 12 members, including UNESCO assistant director-general for Natural Science, deputy secretary-general of the Chinese National Commission for UNESCO, and experts from relevant Chinese and foreign organisations. The president of CASTED is the director of CISTRAT. The executive committee which is in charge of daily management consists of the vice minister of MOST as chairman and seven members, and six of them come from CASTED. Thus, as part of science education practice of CASTED, CISTRAT is partly initiated from external organisations, namely MOST and UNESCO.

B. Main barriers (structural, cultural or related to interchange dynamics)

Although CASTED made much effort in promoting the science education on S&T innovations, there are still barriers may restrain the further improvement of its science education practices. One important barrier is that the orientation of science education practice is limited to S&T innovation-related research and policy-making issues. This is due to the function of CASTED, which means that research on science and technology innovation strategies and policies is mainly for the decision-making of the authorities. To some extent, it may limit the content and depth of science education. This barrier can be considered as coming from the structural nature of the organisation.

C. Main drivers (structural, cultural or related to interchange dynamics)

Several drivers will potentially improve the science education projects of CASTED. The mission of CASTED is to study S&T development and innovation issues to provide professional consultations for policy-making. For this purpose, CASTED will continue to provide forefront information on scientific research and academic research on S&T innovation strategies for the public, researchers and government officials at various levels. CASTED also regards providing education programmes to cultivate S&T policy researchers as part of its organisational responsibility. It will improve the education programme internally for postdoctoral workstation and other researchers and externally strengthen the influence of CISTRAT for international cooperation in the research of science and technology innovation strategies and policies. These drivers for potential improvement come from the official functions of CASTED. Also, especially for CISTRAT, the future development will also be promoted by the guidance of MOST and UNESCO. Thus, all these reasons can be understood as structural drivers.

Cultural drivers include internal culture and external culture. The internal culture of CASTED is highly inclusive and focuses on the frontier of S&T development. The inclusiveness and the vision of S&T development play significant roles in the dissemination of institutional science education. There is a
pleasent atmosphere of learning, research, and preach in the institute. Externally, science education is compatible with the national goal of developing S&T. National science and technology innovation strategy, technological system reform, science and technology prediction and evaluation are the particular topics that CASTED would make efforts to improve the communication with the public and with other countries. Science education projects from CISTRAT, namely the international cooperation on S&T development strategies with other countries, fit the idea of mutual development based on the Belt and Road Initiative. Through open collaborations, all countries involved various participants to share their understanding of the role of sustainable development, their experience in S&T innovation and development strategies, and their views on S&T innovation trends and progress.

There are also drivers related to interchange dynamics. The communications with other institutes and foreign entities could promote the science education practice. CASTED has wide cooperation with various research institutions and universities domestically and internationally. These collaborations make CASTED possible to improve the science education projects further, through inviting scientists and social researchers to attend lectures, cooperating with postdoctoral education programmes, and strengthening the influence of CISTRAT internationally.

D. Best practices (or bad practices)
The best practice regarding science education in CASTED is organising education programmes based on the International Research and Training Centre for Science and Technology Strategy (CISTART). CISTRAT established cooperation among developing countries and shared the developmental experience of China with others, to enhance the level of S&T strategy research and the level of management capacity in the developing world and to promote joint development. The centre earnestly implements the agreement between UNESCO and the Chinese government and puts forward a series of fruitful work. It strengthens the communication of China with the rest of the world. CISTRAT aims to become an internationally renowned centre for S&T strategy and policy research, a training base to improve the S&T strategy and policy capability of third-world countries, a bridge of cooperation between developing countries and developed countries, and an important partner of other UNESCO Category II centres.

With the purpose to share professional information with S&T innovation researchers and policy-makers in developing countries, by the end of 2017, CISTRAT has held six sessions of international training courses on science and technology policy and strategy for the third world countries and less developed areas. Hundreds of participants from Africa, Southeast Asia, West Asia, Latin America and other regions took part in the training. The annual training workshops last for three weeks to allow trainees to have extensive exposure to S&T innovation strategy research and practices in China. Every year, the annual training workshop focuses on specific themes, for instance, Strategic Research and Formulation Method for S&T Development Plans (2012), STI Policy Research and Method: STI GAP for the Asia-African Region (2013), STI Policy Research and Method: Reinforcing National Capacity on STI Assessment (2014), STI Policy and Method in the Belt and Road Region (2015 and 2016). Within these themes, the issues of STI policy-making, system reform, statistics, investment and STI for rural development and industrial development would be covered in the lectures. The lecturers consist of experienced research staff from CASTED, as well as experts from other organisations affiliated to MOST to diversify the topics and viewpoints. In this way, it provides technical support on science and technology development strategy, and planning and policy research for other developing countries.

E. Current indicators (if any)
The main indicators for the scientific education practice include the impact factor of academic journals: *Forum on Science and Technology in China* and *China Science and Technology*. The strength of scientific education in CASTED can also be reflected by the numbers of international training courses, international forums, and various exchanges and cooperation. Also, as the first UNESCO Category II
Centre to focus on STI strategy research in the world, CISTRAT will build its unique strengths and step up efforts for organisational capacity, human resources, and administrative capacity building.

F. All points of improvement
a. Keep the high quality as well as improve the influence of the publications from CASTED. It requires contributors of the publications to use their profound theoretical background to investigate new questions and to make valuable achievements.

b. For the science education programme in CISTRAT, the improvement will be a focus on expanding the width and depth of communications, both with domestic and foreign research entities.

G. Agreed points of improvement, with action plans and indicators for success
UNESCO has evaluated the work of CISTRAT in the past five years. Dr Jummai Zainab Umar-Ajijola, the external assessor and chairman and CEO of Business People (tbp) Co., Ltd. conducted a document review of the centre in April this year. She spoke highly of the Centre’s efforts to fulfil its responsibilities and prepared a report recommending an extension of the agreement. As the feedback survey shows, the participants are generally satisfied with the topic selection and information on the seminar and hope to have the opportunity to further communicate and cooperate with CISTRAT.

As the only UNESCO second-class science and technology strategy and policy centre in China, CISTRAT shares experiences with other developing countries in sustainable development, science and technology strategy, and poverty reduction technology, aiming at improving scientific research and management capabilities in developing countries.

a. CISTRAT aims to become an internationally renowned centre for S&T strategy and policy research. CISTRAT will leverage CASTED’s advantages and strengths to carry out in-depth research (including international collaborative research) in extensive areas, including S&T indicator and statistical analysis, assessment methodology for STI strategy, policy and plan, technology forecasting and roadmap, STI-driven poverty reduction, S&T investment and financial policy for promotion of innovation, science parks and industry clusters, promotion of SME innovation and growth, development of S&T talent, application of S&T in natural disaster response, and STI-driven sustainable development.

b. CISTRAT aims to become a training base to improve the S&T strategy and policy capability of the third-world country. CISTRAT will not only improve its research capability in STI strategy and policy research but also actively share its research results with developing countries. For this purpose, CISTRAT will strive to ensure that one training course is organised every year. The main target groups of training are S&T officials, researchers and administrative personnel of S&T research institutions, administrative personnel of science parks, and university teachers of S&T policy from developing countries.

c. CISTRAT aims to become a bridge of cooperation between developing countries and developed countries. CISTRAT will carry out wide-ranging cooperation with Chinese and international S&T policy and strategy research institutions, universities, enterprises and local S&T strategy research institutions while deepening and expanding the existing cooperative relationships. CISTRAT will strengthen cooperation network with international organisations including UNESCO and OECD, developed countries including the U.S., Germany, UK, France, Russia, Japan, and Korea, as well as S&T policy authorities and research institutions of developing countries, to share its experiences for win-win cooperation.

H. Resulting matrix

<table>
<thead>
<tr>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
</table>

45
<table>
<thead>
<tr>
<th>Aspects of organisations</th>
<th>Providing education programmes to cultivate S&amp;T policymakers and researchers is one of CASTED’s organisational responsibilities.</th>
<th>CASTED’s researchers are willing to share their experience and work in China’s STI policy study. Science education is compatible with the national goal of developing S&amp;T. It also fits the idea of mutual development based on the Belt and Road Initiative through open collaborations with other developing countries.</th>
<th>The communications with other institutions and foreign entities could promote the science education practice of CASTED, for instance, MOST, UNESCO and other research institutions from other countries.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potential drivers for RRI</td>
<td>The most important mission of CASTED is providing STI policy studies for policymakers. Science education is not the core mission of CASTED.</td>
<td>Increasing the social and academic impacts of the publications from CASTED.</td>
<td>Inviting experts and scholars to attend lectures and researchers to deliver speeches.</td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>Strengthening the education programme for postdoctoral researchers and other young researchers.</td>
<td>The number of activities carried out by CISTRAT, including international training courses, international forums, and various exchanges and cooperation.</td>
<td></td>
</tr>
<tr>
<td>Most important potential organisational actions</td>
<td>The quality and the number of lectures and education projects for young scholars.</td>
<td>The impact factor of academic journals.</td>
<td></td>
</tr>
<tr>
<td>Several actions can be included</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicators of success</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential indicator for the improved performance of the dimension in the research activities/programmes</td>
<td>UNESCO has evaluated the work of CISTRAT in the past five years. In science education, in the future, it will expand the width and depth of communication, and both domestic and foreign research exchanges.</td>
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<td></td>
</tr>
</tbody>
</table>
6.2.7 Incorporation of AIRR dimensions into policies

Anticipation and reflexivity

A. Description of the practice and its development and an assessment of how well it currently works

From the research goal and obligation of CASTED, we could find the existing dimension of anticipation and reflexivity. As a think tank at the national level, it is responsible for paying attention to the frontier issues of S&T development and providing accurate and timely consultations to MOST and other ministries for their future policy decisions. From this perspective, the responsibilities in research are related to the issue of predicting the potential risks of certain policy changes, evaluating the impacts of S&T development and implementing related policies. In general, the purpose of research in CASTED is to improve the research on S&T macro development strategies and to meet the new requirements of improving the independent innovation and constructing an innovative country. Thus, its focuses on forward-looking, holistic and comprehensive strategic research. For this purpose, it has to have the vision of anticipation regarding the study of the social-economic needs and S&T development trend in future, so that it can provide MOST with S&T innovation strategic plans with the foresight activities of S&T innovation and the priority setting of critical technologies for policymaking. It also incorporates the vision of reflexivity in its study on S&T innovation, by articulating risks and uncertainties concerning R&I and by critically reflecting on the norms, socio-political contexts, regulatory and policy contexts in which R&I is undertaken.

Activities of anticipation and reflexivity are related to the core purpose of the organisation discourse. The leader and staff in this organisation are fully committed to the implementation of anticipatory vision within its S&T study. Anticipatory, reflexive knowledge are systematically combined, integrated and embedded into its S&T policy research.

B. Main barriers (structural, cultural or related to interchange dynamics)

One potential barrier can be seen as the instructional reason. An organisation like CASTED often follows the guideline policy or regulations from the upper level of governance. Namely, the purpose of the research is mainly realized in the form of top-down order. This may potentially limit the vision of reflectivity of CASTED.

C. Main drivers (structural, cultural or related to interchange dynamics)

First, the official obligation for CASTED is to facilitate the policy design for S&T development. The policy concerning the anticipation and reflexivity dimension is inevitably crucial for prudent decision-making. Carrying out research on the potential risks is encouraged by the concern from the government and the public. Thus it can be understood as the structural driver of ethics in this organisation.

Second, the international cooperation and communications with other policy-related research institutions play an important role. For instance, the research project which is collaborated both with EU and SPRU includes the issue of the responsibility of the scientific and technological innovation, ethics, risk and evaluations. In this way, these topics have been brought into the research vision of CASTED.

Thirdly, the driving force comes from the communication with domestic academic and business entities.

D. Best practices (or bad practices)

The studies on S&T innovation and implementation in CASTED always have the underlying dimension of reflection and anticipation. Taking their sociological research on the potential impacts of new S&T development for example, researchers from CASTED are interested in the changing public opinion on biotechnologies and GM food. The study shows that more people hold a negative
view on GM food. Most of the people are unwilling to try GM food and the acceptance of GM food among the public has a significant decrease (He et al., 2015). This study is to incorporate the vision of anticipation and reflection because the goal of this study is based on the articulation of risk and uncertainty of new S&T innovation. It also tries to reflect on the social-political and ethical norms and the regulatory and policy contexts of GM food.

E. Current indicators (if any)

F. All points of improvement

G. Agreed points of improvement, with action plans and indicators for success

H. Resulting matrix

<table>
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<tr>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspects of organisations</td>
<td>CASTED is responsible for providing accurate and timely consultations to MOST and other ministries for their future policy decisions. The anticipation and reflexivity dimension are essential for prudent decision-making.</td>
<td>The leader and staff in this organisation are fully committed to the implementation of anticipatory vision within its S&amp;T study. Anticipatory and reflexive knowledge is systematically combined, integrated and embedded into its S&amp;T policy research.</td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
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</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>An organisation like CASTED often follows the guideline policy or regulations from the upper level of governance. Namely, the purpose of the research is mainly realized in the form of top-down order. This may potentially limit the vision of reflectivity of CASTED.</td>
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<tr>
<td>Potential indicator for the improved performance of the dimension in the</td>
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</tbody>
</table>
Openness and transparency

A. Description of the practice and its development and an assessment of how well it currently works

CASTED, as a research institute under the leadership of governmental entity MOST, is to serve national government agencies with policy recommendations. Thus, due to this organisational nature, some of the policy analyses are confidential. Only part of the topics are open for public. In this aspect, CASTED created a popular publication for S&T communication with the public and it also disseminated S&T knowledge through its official website and other social media.

B. Main barriers (structural, cultural or related to interchange dynamics)

Structural barrier: Due to the nature of the CASTED organisation, some of the statistical survey data have certain confidentiality, and they are only partially accessible to the outside world in general, which may limit the implementation of open access in this organisation.

C. Main drivers (structural, cultural or related to interchange dynamics)

There are institutional reasons to motivate the openness and transparency of the organisation. CASTED could use the think tank report and investigation reports as the channel to support the communication between the government and the public.

D. Best practices (or bad practices)

CASTED runs a reputable journal, China Science and Technology, to provide timely highlights of domestic and international S&T news, insightful comments on the social, legal and ethical aspects of S&T development in China. It also dedicates to creating an innovative, accurate platform for not only academic exchanges among peers but also communications among scientists, policy-makers, and the public. Moreover, the official website of CASTED is a gateway for citizens, business people and policymakers to access S&T development reports and other policy research results both in Chinese and in English. This website also updates news on all academic activities from CASTED. This information includes knowledge about building an innovative country and improving its capacity for independent innovation, and forward-looking, comprehensive and comprehensive studies on strategic issues. Also, researchers from CASTED often participate in interviews on television and in newspapers, and write commentary articles for newspaper and other new media.

E. Current indicators (if any)

F. All points of improvement

G. Agreed points of improvement, with action plans and indicators for success

H. Resulting matrix

<table>
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<tbody>
<tr>
<td>Potential drivers for RRI</td>
<td></td>
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<td></td>
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</tbody>
</table>
Potential barriers to RRI

Since CASTED is a governmental research organisation, most of the research data have certain confidentiality.

Most important potential organisational actions

Several actions can be included

The openness of CASTED will be enhanced by providing more information on its official website.

Indicators of success

Potential indicator for the improved performance of the dimension in the research activities/programmes

Responsiveness and adaptation

A. Description of the practice and its development and an assessment of how well it currently works
   The major function of CASTED determines that this organisation has to be responsive to the fast change society and S&T development. CASTED needs to participate in the design of national S&T development strategies. The ground level study on the most current situations and the needs of S&T development from the public are the essential part of their consultation for the upper level.

B. Main barriers (structural, cultural or related to interchange dynamics)
C. Main drivers (structural, cultural or related to interchange dynamics)
D. Best practices (or bad practices)
E. Current indicators (if any)
F. All points of improvement
G. Agreed points of improvement, with action plans and indicators for success
H. Resulting matrix

6.3. Reflection on review findings, outlooks developed and ways forward

6.3.1 The integrated or fragmented nature of different responsibility related dimensions

In the common discourse of CASTED, open science and open access often come together. Although there are different definitions of these two terms, they both refer to the openness of data and knowledge sharing. Sometimes the concept of open science also comes with the concepts of public engagement and science education. Because within the concept of open science, there is a dimension indicating that not only the people in academia could freely share and use data, but also the public could get free access of new scientific results. In this way, open access can be understood as the means of science education. The concepts of science education and public engagement often come hand in hand. This is not only because they both target to assist the public, but also because science education is the basis for public engagement, especially in the case of S&T innovation and development strategies, in which CASTED
is interested. Without adequate science education, it would be impossible for the public to join in the process of decision-making. The concepts of ethics and responsibility often connect with each other in the context of the potential risks of S&T innovation. The bearers of responsibility often refer to scientists, the government and other entities which put forward adequate legislation and regulation. In this context, reflexivity, anticipation and RRI can be in the discourse as well. However, the concept of RRI is still a new concept for CASTED and also in the discourse in China. When it comes to responsible innovation, one of the most important content should be the consideration of the social and ethical consequences of the innovation. However, issue of gender is rarely seen together with RRI.

Researchers from a different discipline and research interests may perceive the meaning of responsibility in research and innovation differently. However, generally, In CASTED, the discourse of “responsibility” for scientific and technological innovation is often associated with the issue of scientific and technical risks, scientific and technological ethics and inclusive innovations.

There are changes to a trend in using these terms at different time. It depends on the social-political background of the S&T policy. In those terms, gender and inclusion were introduced to the discourse of CASTED long time ago. The concepts of ethics, science education and public engagement are getting more popular in recent years. The topics of open access and open science are just introduced in the research topic in CASTED, and these two terms are believed to be influential in the future.

According to the discussion in the earlier part of Section 6.2, we could find that the topics of “gender equality and diversity” and “science education” are integrated very well in CASTED compare with other aspects. Due to the existing organisation of CISTRAT, science education will continue to be the target in the outlook of CASTED.

6.3.2 Common barriers or drivers

As mentioned above, CASTED has significant contributions to the promotion of the gender equality in S&T research and science education project for the young researchers from developing countries. In recent years, the topics related to ethics and open access are becoming more popular in CASTED as well.

The common drivers across the RRI aspect in CASTED include as follows. (1) Resource availability. As a national owned S&T research institute, CASTED has many researchers with a strong background. Moreover, CASTED could access to data at all levels in China for its research study. (2) The mandates for its owner. CASTED is under the leadership of MOST mainly for policy consultancy. The research topic is often determined by the interests from the upper level. When there is a research proposal which is approved, CASTED can often get adequate research funding and other resources to make it happen. For instance, CISTRAT, under the guidance of MOST and UNESCO, it could have institutional support for their science education project. Thus, compared with other aspects of RRI, it has stronger legitimacy in CASTED.

However, the special nature of CASTED also lets it have a common barrier in implementing all aspects of RRI. It is largely due to the fact that CASTED is mainly a national owned research institute. It has to follow the urgent topic which the government concerns the most, sometimes, which restricts the research range of CASTED.

6.3.3 Final reflections and plan for follow-up

In this study, we found that in CASTED, the concept of RRI is often related to S&T innovation. This is because of the official responsibility and the nature of CASTED as a nation owned policy consultancy research institute. Researchers would associate this term with research topics which are related to their S&T policy, for instance, S&T risks, S&T ethics, and inclusive innovation. CASTED attaches great importance to the “responsibility” of technological innovation to support the decision-making of national S&T development and concerns the societal impacts on S&T development and other related issues.
We also found that CASTED has conducted extensive research and activities in the aspects of gender equality and diversity and science education. The ethical issues of S&T innovation and open access are the topics that will receive more in-depth study in the future. To be more specific, the improvement in ethics can be conducted by expanding the relevant research topics, such as the animal ethics, medical ethics and environmental ethics in S&T innovations. Regarding research integrity, ethical training projects can be initiated among researchers within the organisation. For promoting societal engagement, we call for more frequent and institutionalized arrangements for the communication among multiple sections (experts and the public, local, enterprise and other possible stakeholders). Currently, the development of open access is more advanced in universities. Thus, we believe that strengthening the exchanges and cooperation with universities and scientific research institutions in open access would be helpful to improve the implementation of open access in CASTED.
7. Organisational reviews and outlooks: research funder

7.1 Mapping of the organisation

Established on February 14, 1986, The National Natural Science Foundation of China (NSFC) was an institution directly under the jurisdiction of the State Council to administrate the National Natural Science Fund. By the government’s strategies and plans for the development of science and technology, NSFC is responsible for directing, coordinating and making practical use of the national natural science fund to support basic research, stimulate free exploration, identify and foster scientific talents, as well as to promote progress in science and technology and the harmonious socioeconomic development for the nation.

NSFC is administrated by its council which consists of the president, vice presidents and council members. A tenure system is adopted for the presidencies and council members of NSFC. The seventh term of the council is headed by one president and six vice presidents. Also, one secretary general and one deputy secretary general may be appointed to assist the council. The council consists of 25 members who are scientists, engineering and technical experts and management experts from the institutions of higher learning, research organisations, governmental administrations and enterprises. NSFC adopted the system of the plenary session of the council which is chaired by NSFC president or vice president authorized by the president. The function of the plenary session is to review, supervise and to advise on the performance of the National Natural Science Foundation of China.

From the organisational perspective, NSFC is considered as a “flat” organisation that includes three kinds of departments. The first is supervision committee, composed of scientists and administrative experts, whose primary mission is to guarantee the implementation of the principles for evaluation, safeguard the fairness and scientific value of the funding system and the rights and interests of the scientists and to promote scientific integrity and ethics for the healthy development of science funding. It independently conducts supervision function and reports to the plenary session of NSFC Council on its work. Within it, a standing committee with one chairman, two vice chairmen and sixteen members is formed. The second is 7 Bureaus and Offices including General Office, Bureau of Planning, Bureau of Policy, Bureau of Finance, Bureau of International Cooperation, Bureau of Personnel, and Bureau of Inspection, Supervision and Auditing. The third is the 8 scientific departments dealing with specific issues of basic research and funded projects in different scientific disciplines.

As a national fund institution covering all disciplines in natural science, NSFC plays a significant role in responsible research and innovation. On the one hand, NSFC’s primary duty is to support innovation in basic research and to lead the direction of scientific innovation. On the other hand, NSFC has built a bridge between the scientific community, government and society, and inmanent responsibility discourse has been embedded into the work of NSFC. It is the work of NSFC that reflects the understandings of responsibility existing in Chinese society and culture. How to establish a structure of RRI within NSFC will have a profound impact on the scientific community and the general public.

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13 In 2018, as a part of China’s deepening reform of state institution, NSFC changed its affiliation to Ministry of Science and Technology. All the descriptions of NSFC in this chapter are based on the information before the reform.
Until now, although there is a lack of an official theoretical structure of RRI, some practices of NSFC have embodied related aspects. NSFC contributes effort to the promotion of open access to the annual reports, funds, sharing service network, basic research knowledge base and other resources. There are general rules for the promotion of national science research in NSFC regulations. Specific guidelines, which include administration, protocol management, and other related documents, have been posted on NSFC’s office website. Naturally, NSFC perceives itself to be an organisation for the promotion of S&T research and communication in China. Further, NSFC will also be a critical part of the international S&T research process.

Figure 1: Administrative System of NSFC

7.2 Aspects of responsibility in organisational policy and practice

7.2.1 The conceptualisations of responsibility in the organisation
According to the function orientation of NFSC, its primary duty is to support fundamental research based on free exploration and to cultivate qualified scientists and technologists, which serves the development of society through scientific achievements in an indirect way. The direct research catering to requirements of domestic economy and industrial innovation is generally supported by other
technology development plans. For NSFC, with modern science and society bonded to each other closer and closer, emphasis on fulfilling the needs of both state and society emerges as the central part of the responsibility discourse. In the 11th Five-Year Plan of NSFC, it was clearly stated that NSFC should coordinate the needs of state development strategy and scientific advancement, and supporting both types of research based on the intrinsic motivation of scientists and researchers is economy or society oriented. In the 12th Five-Year Plan, it is also said that NSFC should focus more on the frontier, in other words, on management and support for the advanced research which could lead the technology, economy and society to develop further. In the 13th Five-Year Plan, innovation and social responsibility were regarded as one thing in two forms. For NSFC, it must function as guidance and provide science and technology support for national development strategy, helping to solve critical problems in people’s livelihood, industrial and domestic economy. The traditional concept of responsibility in innovation which was regarded as something outside the duty of NSFC now is experiencing a series of changes. NSFC is breaking the dichotomization between science and society to establish a comprehensive understanding of this issue.

In this transformation, even without an official theoretical structure for RRI, many significant aspects and concepts are taken into consideration, and NSFC has made efforts for improvement. Besides, due to the rapid development of community of S&T, RRI aspects become more practical which are embedded in the policies in NSFC. For instance, the application for funds should cover the content of the integrity and the ethics. Although until now, there is no specific department to initiate communication of the RRI aspects. However, Bureaus of Planning and Information Centre are working on the open access practice including two websites: sharing service website (http://npd.nsfc.gov.cn) and Open Repository of National Natural Science Foundation of China (http://or.nsfc.gov.cn). Moreover, NSFC also puts more attention on the sharing of the results of S&T. Further practical cooperation of databases between NSFC and publisher will be expected. According to the administrative structure of NSFC, management and policymakers usually target at the responsibility discourse. NSFC made documents to encourage the female scientists and researchers to apply funds and S&T process. The age limitation for the female application has been raised from 35 to 40 in the application requirement of the NSFC for Young Scientists of China.

Most of the RRI-related still focus on upstream. Primarily, the administrators begin to pay more attention to the practical action to embed RRI conception into the organisation of NSFC and the fund’s application. In summary, RRI practices in NSFC are still in the primitive stage. Moreover, since for NSFC, the primary mission is to support fundamental researchers, some issues out of the pure scientific areas, like social engagement or gender equality do not receive too much attention. Instead, they sometimes are put into the comprehensive plan of improving scientific achievements and cultivating qualified scientists and technologies in which they are usually validated. As a matter of fact, in many cases, it is due to the pressure from outside that these issues are entering into the agenda of NSFC’s work, for example, leaders attaching importance to related topics, attention from media or comparison and communication with other foreign institutions. Efforts are still needed for establishing an official theoretical structure of RRI within NSFC and raising people’s awareness for RRI aspects is a significant task all the time.

7.2.2 Ethics in the organisation
A. Description of the practice and its development and an assessment of how well it currently works

In the discourse of responsibility within NSFC, ethics has always been regarded as an essential part which has received attention both from outside and inside. Ethics here mainly refers to three aspects. The first is the ethical impacts of scientific research on the whole society and culture. The second is some controversial problems in the research process, for example, medical experiments with animals. The third is problems with research integrity.
Since the priority of NSFC is to support fundamental research and scientific advancement in which requirements from national and social development can be fulfilled, and issues in the first topic of ethics do not receive too much emphasis. Awareness of some related problems like environmental protection exists on a fundamental level. Moreover, the absence of actions and regulations on the management of chemical materials or wastes has been realized in which following improvement can be expected, even if it is not counted as the main duty or responsibility for NSFC.

There is no doubt that the second topic outweighs the first one. Moreover, the primary reasons for its importance are the pressure from outside. Two main issues under this topic, animal welfare and biomedical ethics, undoubtedly, are receiving significant attention at home and abroad. They stand out as both theoretical problems for ethics and social issues, which deserve researching and practicing. Moreover, even for the internalization goal of NSFC, problems like animal welfare cannot be ignored, let alone the pressure from media. Therefore, some actions have been taken to tackle problems in this aspect. Since 2005, it was clearly stated in the Project Guide of Department of Life Sciences that for projects involving ethical consideration, applicants must provide a certificate from the ethics committee of the department he or she belongs to or the superior department. For live things used in genetic engineering, a document is also required for its sources. If a donation from other labs is involved, applicants must also provide a certificate for agreement from the individual labs. The Project Guide of Department of Medical Science, a department divided from the Department of Life Science since 2010, also put great emphasis on medical ethics and informed consent of patients with a strict requirement listed. In 2014, requirements related to animal welfare and experimental animal ethics were added in the guide as well. Besides, on the official website of NSFC, the ethics-related regulations are also listed as an essential part.

Moreover, another big part counted in the responsibility discourse is research integrity. With the change in scientific research system, the role of NSFC in improving fundamental research grows bigger. Therefore, long-standing attention has been paid to research integrity with practical actions. Back in 1998, a special committee was established for integrity supervision whose primary duty includes carrying out dissemination and education for scientific activities and accepting complaint and report. In 2005, the supervision committee released the Methods for Tackling Issues of Academic Fraud and Misconduct, which functions as a guideline in problems of research integrity. Moreover, a particular office for research integrity was set for investment in related issues. Additionally, NSFC also started an academic misconduct information system, which can store and organise data from past cases. From the perspective of public education, NSFC also carried out a series of training and educational activities both for researchers and the public, which helps maintain the image of “openness, justice, fairness” of NSFC.

There is no wonder that NSFC has achieved a lot in the aspect of ethics. Even if it has not been embedded in the whole structure of RRI, it has always been regarded as the specific responsibility of NSFC. NSFC has developed policies for ethics, and applicable legal and soft law framework has been primitively established. There will be a more comprehensive system, and the different aspects of ethics will be dealt with in a more balanced way. Moreover, more emphasis on deontology of researchers’ conduct and regular educational activities are expected as the future practices.

B. Main barriers

As mentioned above, even if NSFC has taken actions to deal with ethical issues, it is hard to say that there is an overall system taking charge. Until now, there is no professional organisation responsible for the whole issue of ethics and hard and fast requirements are still absent. Lack of environmental ethics and social ethics regulations shows the imbalance among different topics. NSFC has paid attention to improving ethics in form and procedure, but still missed the point of cultivating deontology of researchers’ conduct, in which case, the ethics practices can be seen as superficial in some extent.
Moreover, restricted by the function orientation, NSFC takes scientific breakthrough and excellence as its primary goal. Ethics is extra in its agenda. At the same time, the motivation of society, economy and efficiency becomes potential barriers to the practice of the integrity and the ethics for NSFC. At present, China is on its historic period of transformation when its values swing between traditional and progressive ones. People on the one hand gradually pay more attention to issues like animal welfare, while some others believe it is impractical to risk scientific improvement for problems not urgent. In this controversy, it is also hard for NSFC to maintain a tight position and apply some strict policies.

Regarding the practices, there are still some points needed to be corrected and polished up. Concerning academic integrity, NSFC focuses more on specific practices but ignoring the systematic and structural measures. It requires more educational activities to raise the awareness for deontology of researchers conduct which should be embedded in the comprehensive understanding for RRI. Moreover, active cooperation with related organisations, sciences journals and other institutions does not work actively on ethics, and no united guideline exists to follow.

C. Main drivers

For research integrity, a basic structure has been established. The conception of integrity and ethics of research has been embedded into the regulations, plans, methods and guidelines of NSFC. The integrity office and the supervision committee of NSFC are responsible for the specific task of research integrity. An information system, which can be used to query the investigation of misconduct, has been settled up.

From the cultural perspective, currently, the administrator and the faculty both pay more attention to the integrity of scientific research. Moreover, the integrity of research has been treated as a critical index in the evaluation of the application.

Over the past several years, media and the public have gradually shifted the attention and focus more on issues out of core scientific activities for the closer relationship between science, technology and society. In this case, sometimes, they can function like supervision and motivation for NSFC to work on research ethics and it is essential for NSFC to maintain its image of “openness, justice, fairness.” Besides, the research integrity is closely related to the quality of scientific research and morality of scientific community, which requires NSFC’s influences on avoiding fraud and misconducts. Moreover, it has also received attention from the government.

For NSFC, the internalization of the management is one of its goals. Moreover, since ethics has been a hot topic debated and practiced in institutions in many countries, the international communication is also a significant factor of the dynamic of the practice of integrity and ethics for NSFC.

D. Best practices

As a funding organisation, NSFC conducts the ethics guidelines as an essential part of the funding policy making. However, the scientific researcher who want to apply the funding should not violate the ethics guideline of NSFC’s funding policy. Regarding animal welfare and biomedical ethics, mainly, requirements in the guideline are the usual practices, both straightforward and practical. Since 2005, in the project guideline of the Department of Life Sciences, it has been clearly stated that for projects involving ethical consideration, applicants must provide a certificate from the ethics committee of the department he or she belongs to or the superior department. For live things used in genetic engineering, a document is also required for its sources. If a donation from other labs is involved, applicants must also provide a certificate for agreement from the individual labs. In 2010, the Department of Medical Sciences was separated from the Department of Life Sciences, and in its project guideline, there is still stipulation that applicants should strictly follow the requirements of medical ethics and principle of informed consent for the patient in the application and research. In 2011, it was added in the guideline
that a written certification should be provided by the applicants from the ethics committee of the department he or she belongs to or the superior department. In 2014, issues concerning animal welfare and experimental animal ethics drew more attention and stipulation related to it was added as well. Besides, on the official website of NSFC, the ethics-related regulations are also listed as an essential part.

E. Current indicators

Ethics has been embedded in the responsibility discourse within NSFC, and there is raising awareness of ethical problems. Apart from the long-standing topic of research integrity, more related issues like environmental and animal ethics also enter the discussion.

In the guideline and regulations of NSFC, ethics especially research integrity is listed as an essential part. An overall system to tackle scientific fraud and misconduct has been gradually established. For example, a select committee was founded for integrity supervision whose primary duty includes carrying out dissemination and education for scientific activities and accepting complaint and report. In 2005, the supervision committee released the Methods for Tackling Issues of Academic Fraud and Misconduct, which functions as a guideline in problems of research integrity. Over the past years, NSFC has received many reports. For each report, a conservative investment was conducted, and following actions like revocation were quickly made.

Regular reports made both to the public, scientific community and superior government department help supervision from outside and encourage NSFC to keep working on ethics. All management and promotion of ethics is key to the image of “openness, justice, fairness” of NSFC in society.

Besides the integrity, the consideration of the ethics including environmental ethics and social implications is also embedded into evaluation index system. The IRB of scientific research institutions also has the approval system of environmental ethics and social impact. The research personnel of the applicable fund have added the content of environmental and social impact in the results.

F. All points of improvement

A comprehensive understanding of ethics should be achieved in the whole picture of RRI which will help construct a connection with other RRI aspects. On the one hand, it will contribute to the coordination of efforts in different aspects. On the other hand, comprehensive understanding for RRI can help cultivate awareness of responsibility within NSFC which is essential to the internal motivation for actions in the future.

For the aspect of ethics, the balance between different topics is expected. At present, the content of environmental ethics and social ethics is still absent in the guideline and policies. Moreover, there is no professional organisation taking charge of the overall affairs in ethics.

Regarding the practice for research integrity, there are still some points needed to be improved in existing policies. Firstly, it is necessary for NSFC policies to make it clear that in shaping ethics, the main duty falls on the shoulder of universities and research institutions. At present, requirements for their responsibility are both ambiguous and insufficient. While their actions can function at the fundamental level in ethics issues, NSFC should cooperate with the government to solve this problem. Secondly, data saving are a core issue in preventing scientific fraud and misconduct because forgery and tampering of data are common in such cases. However, in NSFC’s document, there is only a brief statement for data saving instead of specific requirement and stipulation which cannot have a practical effect on avoiding data manipulating (Guan et al., 2017). Thirdly, the content of ethics has not been reflected in the scientific review system. No practical suggestion and guide has been made to embed
ethics into the review system, and related research is still absent, while adjustment in the review system plays a prominent role in changing the traditional priority for excellence, quantity and efficiency. Besides, although for different types of cases that NSFC has made corresponding actions, there is still the lack of clear requirements for science journals, other fund institutions and science groups to make an improvement, which means different policies based on subjects also should be made. Last but not least, no protective policy for prosecutor remains a problem which may limit cases of fraud and misconduct to be revealed.

G. Agreed points of improvement, with action plans and indicators for success

NSFC will conduct a series of studies on STI ethics involving the Department of Life Sciences, Department of Information Sciences, and Department of Health Sciences.

H. Result matrix

<table>
<thead>
<tr>
<th>Aspects of organisations</th>
<th>Structural issues</th>
<th>Cultural issues</th>
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</tr>
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<tr>
<td>Aspects of organisations</td>
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<td>Policy learning, pressures from key stakeholders (owners, the public, etc.)</td>
</tr>
<tr>
<td>Potential drivers for RRI</td>
<td>The conception of integrity and ethics of research has been embedded into the regulations, plans, methods, and guidelines of NSFC. The integrity office and the supervision committee of NSFC are responsible for the specific task of research integrity. An information system, which can be used to query the investigation of misconduct, has been set up.</td>
<td>Currently, the administrator and the faculty are both paying more attention on the integrity of scientific search. Moreover, the integrity of research has been treated as a critical index in the evaluation of the application.</td>
<td>The public pressure, the requirement of government, and the international communication are significant factors of the dynamic of the practice of integrity and ethics for NSFC.</td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>There is no specific sector responsible for ethics supervision of scientific research. Lacking regulations on environmental ethics and social ethics.</td>
<td>NSFC takes scientific breakthrough and excellence as its primary goal, without enough attention to ethics.</td>
<td></td>
</tr>
</tbody>
</table>

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Most important potential organisational actions

<table>
<thead>
<tr>
<th>Several actions can be included</th>
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</thead>
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<td>NSFC will conduct a series of studies on STI ethics.</td>
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</table>

Indicators of success

| Potential indicator for the improved performance of the dimension in the research activities/programmes |

7.2.3 Societal engagement strategies in organisation

A. Description of the practice and its development and an assessment of how well it currently works

For NSFC, based on the principle of “openness, justice, fairness,” it is significant to have a societal engagement in making plans or project guidelines. It is also clearly stipulated in the Regulations on National Sciences Fund that in the case of making development planning and annual funding project guidelines for funds management institutions, advice from colleges and universities, research institutions, academic groups, related government department and companies should be widely taken; and discussion among related experts should also be organised.

Regarding the specific practice, NSFC has started joint funds with local government, industrials and international institutions to broaden the fund channel. In these joint programmes, NSFC will cooperate with local government, companies and international fund institutions to draw up project guides and to select research projects for certain needs. To better convey NSFC’s work and improve communication with the public, NSFC also established the Centre for Science Communication in 2016. Its main function is to propagate important innovative achievement, development strategy and policies of NSFC to the scientific community at home and abroad, government departments and the public. At the same time, the popularization of science has also been embedded in the whole structure of societal engagement which is counted as an important task for Centre for Science Communication as well. Under the circumstances of Chinese nowadays development, special programmes have been conducted to better serve the society in the technology development-oriented poverty reduction or digital-based scientific popularization. From the perspective of international cooperation, NSFC founded the Department of International Cooperation to organised related events. With DFG, these two institutions established the Chinese-German Centre for Science and Technology.

Since the basic selection mechanism of application projects for NSFC is peer evaluation and review, a comprehensive cooperation system was founded including an expert team with glossary members and contact network with related institutions, through which NSFC can keep regular contact with famous colleges and universities, research institutions and experts in different areas all around the countries, and feedback to NSFC’s work can be received continually.
Regarding the popularization of science, since 2016, in response to the requirements of official documents like 13th Five-Year Plan on Science Popularization and Innovation, NSFC has paid more attention to related issues. The establishment of the Centre for Science Communication has been an essential part of the whole practice. Through this platform, NSFC recruits and employs qualified members from society to form an expert team both with width and depth for human resources. Three departments within it have been set up including collection and making department, edit and publication department and new-media department, which cater to the present change in ways of dissemination of information in China. Besides, NSFC also focuses on improving scientific knowledge of specific targets. For instance, technology development-oriented poverty reduction project has been conducted to help farmers to grasp necessary agricultural knowledge and construct infrastructure in rural areas. In 2017, NSFC cooperated with institutions including China Association for Science and Technology to hold the Competition on Scientific and Technological Innovation for teenagers and students all around the world to take part in, which not only helps draw teenagers’ attention to science and technology in China, but also constructs a good international communication channel. Cooperating with several famous universities, NSFC also started a series of lectures called Shuangqing Classes to make its brand for scientific popularization. These lectures would focus on questions in the frontier of certain disciplines and convey the latest scientific achievements on these topics, which have gained great popularity. Moreover, to fully take advantage of modern new media, NSFC uses the website to promote latest research achievements. Also, facing the general public, NSFC also started a WeChat (a Chinese version of Line) platform using attractive pictures or graphic illustration to draw people’s attention.

In summary, NSFC has paid long-standing attention to societal engagement strategies, and it is an important part of NSFC’s responsibility which is recognized by both the government and the public. Achievements have been made in the societal engagement but further coordination with other RRI aspects is still absent. For societal engagement itself, NSFC mostly takes action within scientific community or with some institutions closely related to the scientific community. How to construct effective mutual communication and make pertinent policies remains a big challenge for NSFC in the future.

B. Main barriers

As mentioned before, lack of mutual communication with the public is a big problem for NSFC’s practice in the societal engagement which may to some extent reflects NSFC’s incomplete understanding of it. Most of the related affairs are mainly the internal affairs of the scientific community which limits the feedback from outside. From the cultural perspective, this phenomenon is affected by the technocracy and the elitism exiting in Chinese society. In a way, the traditional cognition of the dichotomy between science and society, and between scientists and public does not disappear from people’s mind and normally the public pays little interest in the engagement of basic scientific research. On the one hand, this kind of cognition will form a vicious circle in which retreating from the public will lead to further technocracy and it will make people lose confidence and interests in related issues. On the other hand, it reduces the pressure for scientific community to reconsider its responsibility and limits the development of RRI. For NSFC, it caused a lack of motivation from outside to work on issues of societal engagement which, in the long run, is not in favour of scientific advancement in China.

C. Main drivers

The principle of societal engagement has been included in the Regulations on National Sciences Fund which will drive NSFC to improve this aspect.

Until now, a regular mechanism has been set up for related practices. On the legislative framework aspect, NSFC works on increasing cooperation with the regional institution and international organisations. On the organisation aspect, the Bureau of International Cooperation and the Centre for
Science Communication are responsible for delivering the specific goal of the public engagement. On measure aspect, NSFC also started up joint funds with regional institute, industry and international organisation.

The communication channel is also the driver for NSFC’s public engagement that includes the communication system of the supporting institution and the communication with international foundations and regional foundations.

Within NSFC, raising awareness for the societal engagement has been observed and reflected in the work agenda. Since the relationship between society and science becomes more evident, increasingly, people come to realize the importance of communication with the scientific community. A responsibility discourse has gradually been formed in which the dichotomy between researchers and the general public should be broken. This trend will provide more pressure and motivation for NSFC to make efforts in the aspect of social engagement in the future.

D. Best practices

The practices of societal engagement are primarily conducted in three aspects including joint fund, related institutions and popularization of science.

In order to play a guiding role and further strength the linkage between knowledge innovation and technological innovation by boosting diversified investment, inter-sector cooperation, and sharing of resources, NSFC has set up a series of joint funds with relevant departments, local government departments and industries to support basic research in particular areas in line with national demands. For example, the Guangdong Joint Funds, cooperation among NSFC, Guangdong government and local industries, aims at solving development problems of economy and society in Pearl River Delta of China. Moreover, the funding policy also includes the promotion of the basic research with the participation of enterprise.

E. Current indicators

NSFC has integrated the public engagement and communication into policy system. It keeps constructing the channel of the public communication and engagement on three aspects including joint fund, related institutions and popularization of science. Communication channel on new media platform has been established, and investment in human resources also increased.

From the cultural perspective, the number of the soft scientific project about the public engagement and communication is growing. The familiarity of the publication among the internal faculties is also a potential indicator. Outside the institution, with the development of society and science, there are more and more requirements from government and the public, and more and more related activities have been added to NSFC’s work agenda. The number of projects in which public participation and communication are designed in the funding research projects is increasing as well.

F. All points of improvement

In the aspect of societal engagement, NSFC’s policies and actions are mainly restricted inside the scientific community and in most cases, only cooperated with institutions, having a close relationship with core scientific society. Therefore, a mutual communication system between NSFC and the general public which can reflect feedback and interests of regular people is still absent.
To improve, a comprehensive understanding of societal engagement embedded into the whole structure of RRI is necessary within NSFC. Related departments should take the responsibility to raise members’ awareness. After that, more specific actions and communication activities can be considered.

G. Agreed points of improvement, with action plans and indicators for success

Increasing the number of projects in which public participation and communication are designed in the funding research projects.

H. Result matrix

<table>
<thead>
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<td>Policy learning, pressures from crucial stakeholders (owners, the public, etc.)</td>
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<table>
<thead>
<tr>
<th>Potential drivers for RRI</th>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
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</thead>
<tbody>
<tr>
<td>NSFC set up Joint funding programme to promote the engagement of the regional institute, industry and international organisation.</td>
<td>The funding decisions are mainly dependent on the participation of external experts.</td>
<td>The communication with other funding agencies.</td>
<td></td>
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<table>
<thead>
<tr>
<th>Potential barriers to RRI</th>
<th>Structural issues</th>
<th>Cultural issues</th>
<th>Interchange related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lacking communication with the public.</td>
<td>It is mainly the internal affairs of the scientific community. Affected by the technocracy and the elitism.</td>
<td>Public has little incentive to engage.</td>
<td></td>
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<table>
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<tr>
<th>Most important potential organisational actions</th>
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<tr>
<th>Indicators of success</th>
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</table>
Potential indicator for the improved performance of the dimension in the research activities/programmes

Increasing the number of projects in which public participation and communication are designed in the funding research projects.

7.2.4 Gender equality and diversity strategies in the organisation

A. Description of the practice and its development and an assessment of how well it currently works

Although not always embedded in the whole picture of RRI, gender equality as a traditional social issue has received long-time attention within NSFC, which is connected to the grand social environment. Since the 20th century, with improvement in women’s social position and educational level, women gradually become a big part of scientific researchers. According to the survey, until 2014, over 2 million female scientists have contributed to the rapid growth of science and technology in China, which made up 40.5% of the whole human resources for science and technology affairs (Zhao et al, 2016a). However, due to some cultural and social factors in history, the occupational development of female scientists is still facing many challenges which limits their contribution to China’s scientific advancement and modernization progress. For NSFC, an institution which regards its duty as supporting fundamental research and coordinating the needs both from society and scientific community, it’s necessary for it to support and improve the occupational development of female scientists.

Taking actions to support female researchers’ scientific activities at a fundamental and basic level is not only what NSFC can do, but also what NSFC should do. Exactly in this sense, gender equality and diversity issue are understood in the responsibility discourse within NSFC. From three aspects, NSFC feels its responsibility to this topic. The first is the requirements from the public and government. In September 2009, All-China Women’s Federation cooperated with other ten institutions including the Organisation Department of the Central Committee of the CPC, Ministry of Science and Technology, Ministry of Education, and NSFC. Together, these institutions conducted a programme with the theme of female high-end talents development and related policies, demanding for actions from related departments and institutions. NSFC also paid great attention to this issues and started to study how to take advantage of NSFC to improve the gender equality in scientific research. At the same time, some supportive policies were also taken into practice. The second is the appeal within scientific community especially from female scientists who are always asking for policy adjustment which can provide support for funds application. The last factor is the cooperation with other foreign institutions. Since one of the important tasks for NSFC is the internationalization of the funds management. To cater to the global gender equality movement, the level of gender equality awareness and attention has become a significant indicator for internationalization. In 2010, in the 25 anniversary of NSFC’s found, an international evaluation paid great attention to NSFC’s actions on gender equality, pointed out some existing problems including that it is harder for female applicants to receive the funds or the age limitation may cause obstacles in resources distribution. The internationalization strategy provides both experience and motivation for NSFC to develop its policies on gender equality and diversity.

Regarding the specific practice, since “openness, justice and fairness” have always been the basic principle for funds application, which to some extent avoided the discrimination against female applicants. Before 2010, actions on improving gender equality were normally conducted in two aspects. The first is to fund female scientists’ research programmes and to increase the female beneficiaries. The
second is to take female scientists into the evaluation and review committee. However, even with the gradual increase in the percentage of female fund receivers and board members, the gap between the numbers of females and males remains, which revealed the insufficiency in the policies of NSFC. Not only emphasis on the abstract principle of equality is needed, but effective policies supportive for female scientists should be applied to fill the gap created by traditional social factors and gender differences. Therefore, it is necessary to avoid the accumulative gaps in different occupational stages and to provide help for female scientists in their early career life, which also becomes the fundamental principle for NSFC’s later work. In 2011, after in-depth research and a range of surveys, series of actions with consideration of the particular case of female scientists were taken, including extending the age limit of female fund applications, prolonging the due time of projects for pregnant female scientists and further increasing the percentage of female members in the evaluation and review committee. NSFC also started a dynamic monitor system to evaluate the level of gender equality in its work to offer a reliable foundation for further improvement.

The efforts made by NSFC have caused many positive impacts in both scientific community and society. Many researchers have set a high value on the related policies. In a word, NSFC has become an exemplary role in boosting gender equality for many other fund institutions and research institutions. However, one fact needed to address is that the gender equality is embodied not only in the percentage of female scientists in the whole research team, but also in gender difference and cognition in the content of research. For example, unique contribution to the scientific innovation from a female perspective is expected in the mainstream of international gender equality study. At present, NSFC has not taken these factors into consideration. Furthermore, an integration of gender equality and diversity into the whole picture of RRI is under discussion.

B. Main barriers

Concerning gender equality, there is still a lack of more practical policy for the pregnant and the elderly. Besides, three kinds of conflicts in the realm of the gender equality have been observed. Firstly, it is the conflict between gender priority policy and fairness, which requires a balance between support and bias. It means that the policies should be aimed at reducing the difficulties caused by gender difference under the existing system, which requires not only the direct support like funding policies, but also more fundamental methods that can fully release the potential of female scientists. The preferential policy, if made in a superficial way, may receive criticism of ignoring male scientists, at the same time leave the problems of female scientists unresolved. Secondly, it is the conflict between gender priority policy and scientific excellence. Since scientific excellence remains a priority of NSFC, it is necessary to have policies not only giving advantages to female scientists but also aiming at raising efficiency and productivity. From a cultural perspective, some social trends, including the two-child policy and the returning to the family, are also new challenges for female scientists to achieve work-life balance. Under this circumstance, on the one hand, there is possibility that in a certain period, a growing number of female scientists chooses to give birth to a new child, which may have a negative impact on their occupation. Thus accordingly, new supportive policies and methods are required. On the other hand, this kind of social trend may also lead to the change of social opinions, in which case, female scientists may have to bear unnecessary cultural pressure.

Moreover, even if NSFC has taken actions to improve gender equality, a comprehensive understanding embedded in the whole picture of RRI is still absent, which restricts the integration of gender equality with other RRI aspects. If gender equality issue is not internalized into the responsibility discourse, it will be harder to create inner motivation and further raise awareness within NSFC. Regarding diversity, another is that NSFC has paid more attention to the gender equality, however, to some extent, ignoring age, disability, ethnicity and other problems to be guaranteed. A broader understanding is needed.
Moreover, such comprehensive understanding is still absent even on the topic of gender issue which should not be restricted in the percentage of female scientists. For example, different impacts on females and males caused by research results should also be taken into consideration.

C. Main drivers

The drivers are both internal and external. To begin with, the guideline of NSFC covers the support for the female and the young scientists and researchers which reflects the long-time attention of gender equality within NSFC. Since 2010, favouring women applicants when all else was equal has been set as the guiding principle of project reviewing. In 2011, the NSFC increased the age limit for women applying to its Young Scientist Fund from 35 to 40 years old, while that for men remained at 35. Also in 2011, the NSFC pledged to increase the number of female scientists in review panels, although it did not set a quota.

Besides, improvement in women’s social position and educational level brings about the rising of new feminist movement with which respecting gender equality becomes a social trend. Moreover, media also pay considerable attention to related issues. Under this circumstance, to fully utilize female scientists’ intelligence and contribute to the development of scientific advancement and society, the government has also made emphasis on the issue of gender equality. For example, it has been clearly stated in the Progress Law that female scientists and technologists should enjoy the same rights in scientific activities. The pressure from both the public and government also turns into the motivation for NSFC’s work.

There is also pressure coming from the cooperation with other foreign institutions. Since the internationalization of the fund’s management is one of the critical tasks for NSFC. To cater to the global gender equality movement, the level of gender equality awareness and attention has become a significant indicator for internationalization, which requires improvement on practical policies and measures. Additionally, international cooperation also provides useful experience for NSFC.

D. Best practices

Before 2010, actions on improving gender equality were customarily conducted in two aspects. The first is to fund female scientists’ research programmes and to increase the female beneficiaries. The second is to take female scientists into the evaluation and review committee. However, considering the gap caused by historical factors and specific gender role of female scientists in their life, it is necessary to have more supportive policies embedded in the particular conditions.

In 2011, after in-depth research and a range of surveys, series of actions were taken to compensate for the weakness of past policies. Firstly, they extended the limitation of female age for applying funds to 40 years old, which is intimately connected to the consideration for female scientists’ reproductive activities. Since the upper limit of age used to be 35 years old, some female scientists missed the time of application for pregnancy and childbirth. Extending the time limit can effectively provide more chances for female scientists, thus raising the rate of female applicants.

Secondly, it was stipulated that pregnant female scientists could prolong the due time of projects. This policy was also clearly stated in the official documents guide for projects. On the one hand, it can protect the fundamental rights of female scientists in their pregnancy and lactation. On the other hand, it can eliminate the worries and fear of missing the deadline which encourages female scientists in pregnancy and lactation to still devote themselves to the research activities without any misgivings.

Last but not least, NSFC continued to increase the percentage of female scientists in the evaluation and review committee for different disciplines and to expand the range in which female scientists can participate in the decision-making. Except for the measures above, NSFC also works on giving publicity
to the fund for female researchers, through which more positive examples will be set to the public. Moreover, a dynamic monitor system was established to provide organisational monitoring data for further improvement.

In summary, these measures can function in a straight way and have significant impacts on gender equality which utilize the unique role of NSFC in the scientific activities and development. In the short term, these actions will help to rise the number of female beneficiaries and increase participation of female members in decision-making. In the long run, they can improve the research ability of female scientists and further add their scientific achievement which will encourage female researchers to make more contribution to scientific innovation.

E. Current indicators

The principle of “openness, justice, fairness” functions at the fundamental level to guarantee equal opportunities and access to funding. Also, supportive policies were clearly stated in the official institutional guide showing their essential position.

Gender equality and diversity issues are managed at the institutional level, not only for the preferential policies for female scientists but also for the establishment of a dynamic monitor system which can provide organisational monitoring data. Since actions were taken in 2011, a significant change has been observed both in the number of female applicants or beneficiaries and members of the review panels. For example, the number of female funding applicants in 2015 is three times that in 2009. In 2009, the number of female applicants was only 10,130, while that has grown to 31,327 in 2015. Moreover, the percentages of female beneficiaries grew to near half in 2011 and stayed at a rather high level since then (from 36% in 2009 to 48% in 2015). Until 2015, 6593 female researchers have received the fund (Zhao et al., 2016a). Additionally, according to the survey for researchers, many male and female scientists speak highly of these policies. Moreover, in a survey conducted in 2016, most respondents believed that these policies would have a positive impact on the participation of female scientists in the scientific activities.

NSFC continued to have active interactions with other international institutions and organisations in receiving funding. NSFC also entrusted some research institutions to do related study and evaluation on its work of gender equality and diversity including Chinese Academy of Science and Technology, whose final report became an essential reference for NSFC’s work in the future.

F. All points of improvement

As mentioned above, the understanding of gender equality should not remain at a superficial level of some female scientists or applicants. The international gender equality movement calls for more reflections of awareness of gender difference in the composition of the research team and the content of research projects. Different impacts on females and males caused by research results should also be taken into consideration. Besides, a study on the unique contribution to the scientific innovation from a female perspective is also expected. In the future, NSFC may set up soft scientific research projects about the gender-related content.

Moreover, more specific principles for improving gender equality should be reflected in the project guide, which can be achieved in the integration of RRI aspects. In this way, a comprehensive understanding of gender equality and diversity issue can be embedded in the whole picture of responsible research not only for scientists but also for members of NSFC. A theoretical structure of RRI is needed for this purpose.
Furthermore, NSFC should increase the frequency of the related dissemination for both internal and external. Within the institution, related policies should be made to raise members’ awareness of gender equality and diversity. Out the institution, NSFC may increase interactions with organisations in receiving funding, and working on raising awareness at a senior level in funded organisations. Moreover, some training programme can be implemented to achieve the goal. In the international aspect, more international cooperation and communication are expected, and the related report should be increased as well.

G. Agreed points of improvement, with action plans and indicators for success

At present, NSFC works on increasing the number of high-level female researchers or funding applications and adjusting the gender composition of the research team. To achieve more comprehensive understanding of gender equality, they will encourage more gender-related content in research projects.

H. Result matrix

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<td></td>
<td></td>
</tr>
<tr>
<td>Potential barriers to RRI</td>
<td>The conflict between gender priority policy and fairness. The conflict between gender priority policy and scientific excellence.</td>
<td>Social trends, which include the two-child policy and the returning to the family, are new challenges for female scientists in work-life balance.</td>
<td></td>
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</tbody>
</table>

| Most important potential organisational actions | Several actions can be included | |

| Indicators of success | Encouraging more gender-related content in research projects. Adjusting the gender composition of the research team by considering the gender equality. Increasing the number of high-level female researchers | |

### 7.2.5 Open access and open science strategies in the organisation

Description of the practice and its development and an assessment of how well it currently works

Although without an official theoretical structure of responsible research and innovation, informal discourse on it within NSFC has been formed, in which open science as a central part has received long-time attention. Built on the communication with foreign organisations, actions under this attention are not only responses to the worldwide open science movement, but also reflections on how to further adjust scientific communication and dissemination to a modern information-based society, which is intimately connected to the development of scientific activities in China. Improvement on open access and open science will both provide more abundant information resources for researchers and open up the gate to the public which can stimulate the innovation out of scientific community. It will further speed up the process of transforming scientific knowledge into innovative sources and capability of the whole society and support the building up of an innovative nation which is taken into account as the duty of NSFC. Currently, NSFC also conducts some policy research projects, including the investigation of the attitude and the demand of China’s scientific researchers, for the purpose of the construction of the open science platform

Within NSFC, the concept of openness is regarded as both internal and external in two ways. The transparency of the work of NSFC and the results of specific scientific programmes are embedded in
the bigger scale of the openness inside and outside the scientific community in which open access is available to researchers and the general public. Precisely in this sense, a far broader connection between open science and other RRI aspects like social engagement, science education and gender issues is widely recognized and understood.

In terms of the specific practices, back in 2004, on behalf of the whole institution, the chairman Chen Xiyu signed the Berlin Statement on Open Access of Natural Science and the Humanities. During the past decade, a series of actions have been taken to implement the principles of openness. In 2014, the Declaration on Open Access for Funded Programmes was released. Two months later, the sharing service of scientific funds website was opened for people to get access to information on funded programmes in detail. In 2015, Open Repository of Natural Science Foundation of China was released, which marked a significant step for public access to scientific knowledge. The functions of Open Repository is to collect research papers (full version) from scientific programmes funded by NSFC, offer open access to the public, fulfil its duty of disseminating knowledge at the leading edge of foundational research and to contribute to the advances in science.

To make the open access process organised, Measures for the Control of Scientific Achievements of Funded Programmes was passed by NSFC in the same year, in which promoting the sharing and dissemination of scientific achievements of funded programmes was explicitly stated as an essential duty of NSFC and the responsibility of related institutions and organisations was stipulated including setting up programme results file systems and results in submission and report.

Now Centre for Science Communication and Information Centre are responsible for the specific project of the open access. With the requirements both from the scientific community and the public, even in the early stage, further improvement on open access and open science is expected. During this process, more integration of different policies and institutions may be needed when facing inevitable conflicts.

B. Main barriers

At present, the operation of the open publication is still absent in the funding policy. On the one hand, the communication and negotiation with publishing companies are necessary for open access. Moreover, since they have more control over the prices with the open access movement rising in different countries and China has massive annul papers released, it has been a severe problem for the price negotiation, but the official negotiation role is still missing. On the other hand, for the mechanism of NSFC, an integrated payment system is expected in the process of resources collecting. However, without the support of the Ministry of Finance, it will be hard to take such system into effect. Besides, there are worries that if the Ministry of Finance does take action to afford, the capital flow may draw criticism from media and the public.

From the cultural perspective, there are worries about issues of the intellectual property right protection, privacy, and extra cost of the open access practice. For the work of NSFC, the open access is bonded to the open science, and they have paid more attention to the openness of data in recent years. Unfortunately, researchers have divided attitudes towards this issue. Considering the security of data, some scientists show opposition and doubt to it.

C. Main drivers

The openness and the transparency have been covered in the 13th Five-Year Plan of NSFC. The specific sectors are responsible for the open access. The fund sharing service network and basic research knowledge base have been built. So traditionally, the openness and the transparency are critical parts of the culture in NSFC. Additionally, open access is one of the most attractive topics in the scientific and
social areas and open access movement has gained popularity in different countries which has created an excellent cultural background for open access practice in NSFC.

The institution establishment also has achieved initial success. At present, Bureau of Communication and Information Centre are responsible for the open access. The fund sharing service network and basic research knowledge base have been built.

From the interchange perspective, NSFC has a long tradition of cooperation with foreign institutions and can learn successful experience from them. In 2004, NSFC joined in the Berlin Declaration. With the rising of open access movement in more countries and NSFC’s efforts in this issue, increasingly, more publishers are trying to cooperate with NSFC to accelerate the process of open access. With the developing trend of the open access, apart from researchers and colleges, outside the scientific community, the public such as industrial organisations also has the demand of the openness for accessing to scientific resources.

D. Best practices

As mentioned above, the practice of NSFC expands in two directions and improves transparency both internal and external. Moreover, cooperation with other institutions is a significant part of this process.

In May 2014, the Declaration on Open Access of Funded Programmes was released, which claimed the demand for open access that all or part of the papers published from funded programmes should be achieved in the Open Repository of NSFC. The length of permitted embargo should be shorter than 12 months which could be shortened if publisher’s permission has been earned.

In July 2014, the sharing service of Scientific Funds website was opened, aiming at improving the openness and transparency of the work of NSFC and ameliorating the sharing of fundamental research information resources. This website functions as a comprehensive report on the achievements of scientific funds which helps strengthen the supervision and ethics of scientific society. From this website, information on funded programmes from 1986 to 2016 can be found in detail, such as the title, programme type, necessary information of applicants, research allotted time and total expense. Moreover, links are provided for the final reports and published results of ended programmes. For programmes between 2003 and 2016, a search engine based on area and category can be used.

In May 2015, the Open Repository of National Science Foundation of China was officially released by NSFC along with the Regulations on Open Repository. The Open Repository will collect papers (full version) from scientific programmes funded by NSFC and offer open access to the public, fulfilling its duty of disseminating knowledge at the leading edge of foundational research and contributing to the advances in science.

Four months later, in September, Measures for the Control of Scientific Achievements of Funded Programmes was passed, in which promoting the sharing and dissemination of scientific achievements of funded programmes was explicitly stated as an essential duty of NSFC. Besides, there are requirements for related institutions that they should set up programme results file systems and submit and report research results in time. Consequently, they can help the using, transforming, sharing and disseminating of existing research achievements and boost both the social impacts and economic profits of it.

All practices mentioned above, in some way, have formed the basic structure of open access in NSFC. Further expansion and integration are expected in development.

E. Current indicators
The popularity of the policy of the open access is still rising, and awareness of open access policies is increasing as well.

Since the release of the NSFC-OR and the sharing service website, the number of visitors grows gradually which shows the expansive influences and people’s attention for open access. In NSFC-OR’s case, a total number of 51,8524 papers have been stored which cover the scientific research results from 1792 institutions and 78,1193 researchers, and the total download times have amounted to more than five million. In sharing service’s case, there are 20,1382 ended projects in storage and more than 3 million result items archived. Both have made incredible achievements.

At the same time, from the policy perspective, the budget will cover the financial source of open publication. Moreover, the institution is formulating a more practical and trustable plan for the open publication.

F. All points of improvement

The sharing service website is still upgrading. Moreover, more value-added services of NSFC-OR are also expected which can be developed in aspects like research data access, information presentation and knowledge services. For example, a coordination system between sharing service website and NSFC-OR can be established so that real-time data release will be achieved through a mutual data exchange channel. Moreover, in-depth analyses of data in NSFC-OR, such as projects, results and institutions, will offer more practical suggestions to fund applicants who will help to improve knowledge services and the value of NSFC-OR. (Cui et al., 2017)

The more practical funding policy of the open publication will be clarified as well. Moreover, to fulfil the goal, NSFC will consult with the Ministry of Finance, publishing companies and research institutions to make a plausible plan.

From the internal perspective, the policy of the open access will become an integral part of the internal dissemination. From the external perspective, NSFC will further disseminate the policy of open access to the supporting institution and the public. Moreover, to coordinate the work with different foreign databases, development of IT infrastructure to support open access and open data archiving is needed.

G. Agreed points of improvement, with action plans and indicators for success

NSFC plans to organise a survey of Chinese researchers’ attitude to and demand of the open science.

NSFC also plans to organise a seminar related to the open science.

H. Result matrix

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<td>The practical operation of the open publication is still absent in the funding policy.</td>
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<td>The business strategy of the publishing company conflicts with the financial management system of the state. The open access is bonded to the open science. Researchers disagree on the</td>
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<td>Most important potential organisational actions</td>
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<td>Potential indicator for the improved performance of the dimension in the research activities/programmes</td>
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### 7.2.6 Science education integrated into research
Science education as an aspect of RRI does not enter the responsibility discourse within NSFC. Even talent cultivation has been embedded in the work of NSFC; science education is not counted as an essential task for NSFC. Typically, education within NSFC means professional education for scientists or researchers to improve their speciality or research skill instead of formal scientific education for the general public. This situation is closely related to the function-orientation of NSFC as a fund institution which is connected more to the basic research and scientific community. However, it also to some extent reflects the lack of comprehensive understanding of responsibility.

Regarding the specific practices, compared with other RRI aspects, practices in science education are far less. One outstanding example is the Tianyuan Fund for Mathematics, in which a project called Mathematical Culture and Dissemination is included. In the project guide, it was stipulated that this project aims at raising students’ (in primary schools, high schools and universities) interests in math learning and the math education level of the public. However, the mathematical education here more inclines to scientific popularization instead of formal education activities.

In summary, the aspect of science education has not received much attention which is always replaced by science popularization. On the one hand, the cognition of science education as NSFC’s responsibility has not been widely realized among the NSFC members.

On the other hand, even there are specific requirements from the public, the task has always been put on the shoulder of universities or research institutions, which is directly related to the research activities. However, the pressure on NSFC gets lower.

### B. Main barriers
Supporting basic research and activities related to the primary task of NSFC. Moreover, in the state system of S&T and foundations, NSFC is not responsible for the scientific communication and education.
Therefore, as a matter of fact, there is no formalized pressure to fund or engage in science education activities. As mentioned above, the public also do not regard science education like training activities or continuous education as one of the tasks of NSFC.

C. Main drivers

There are guidelines of talent cultivation in the funding system of NSFC. For instance, the Tianyuan Fund supports the young talent in the mathematical area.

D. Best practices

The typical practice in science education is the Tianyuan Fund for Mathematics. It was supported by the Ministry of Finance and organised by NSFC. Talent cultivation including student training and teacher training is an integral part of this fund.

Concerning the specific practice under the Tianyuan Fund, NSFC has organised the summer camp for junior high school students, summer school for graduate students and cooperated with CIMPA to hold the mathematics lectures in the graduate level. Besides, NSFC also carried out a particular project of training for young teachers in the western area. With ICTP, NSFC also selects young teachers and graduate students to go to Italy and engage in advanced studies in ICTP. For the Mathematical Culture and Dissemination Project, in the project guide, it was stipulated that this project aims at raising students’ (in primary schools, high schools and universities) interests in math learning and the math education level of the public. To fulfil the goal, NSFC has supported the publication of journals which were related to the mathematical culture, dissemination and education and helped these journals to expand their influence among the general public.

E. Current indicators

F. All points of improvement

G. Agreed points of improvement, with action plans and indicators for success

H. Result matrix

<table>
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<tr>
<td>Most important potential organisational actions</td>
<td>Several actions can be included</td>
<td></td>
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### 7.2.7 Incorporation of AIRR dimensions into policies

#### Reflexivity

**A. Description of the practice and its development and an assessment of how well it currently works**

Reflexivity has been an important principle for NSFC’s work. Any improvement made in practices is based on reflection on two levels. The first is the reflection on the research and innovation of NSFC’s own work. The second is the reflection on the research and innovation of specific scientific researches within scientific community under NSFC’s support. These two levels combined together lead to reflexivity in different aspects for NSFC including reflection on purposes of motivations and values underpinning research and innovation, reflection on the broader societal, political, ethical and environmental dimensions of research and innovation, reflection on institutional practices, behaviours and approaches to knowledge production for research and innovation, and reflection on the norms, socio-political contexts, regulatory and policy contexts in which research and innovation are undertaken. In this way, a discourse for responsibility has been established.

For NSFC, in different RRI aspects, the communication with both scientific community and society becomes the motivations for further practices. These practices, in return construct increasing communication and also provide evaluations and feedbacks for improvement in the future. In aspects to which NSFC has paid more attention, this kind of reflexivity shows more importance in related practices. For aspects that have gained less attention, the practices are restricted so that a process of reflexivity is also limited.
B. Main barriers

The cognition of reflexivity in research and innovation, even embedded in the responsibility discourse within NSFC, is closely related to the specific practices of RRI, in which case, reflexivity is more passive than active in constructing new policies or strategies. Moreover, as mentioned above, in different aspects, for the different levels of attention, to what extent can reflexivity show its impact varies a lot. For NSFC, since its administrative structure and its position in the Chinese political system, its main duty is to follow the national policy and to serve the development of society in which the interests of scientific community have been more considered. As a result, the reflection on the motivations and values is sometimes weakened. Besides, the reflection on the broader societal, political ethical and environmental dimensions is also restricted to areas closely related to the scientific community. Some broader issues do not have enough response and attention to construct the process of reflexivity which can boost the improvement on the practices. In other words, external motivation is necessary for NSFC to have further move, for example, pressures from the prior department or leaders.

From the organisational perspective, there is still no overall institution taking charge of the whole issues of RRI and coordinating the reflection in different aspects which can improve the efficiency of practices. It also reflects the lack of consciousness within NSFC towards this issue.

C. Main drivers

Even an overall and systematic understanding of reflexivity in RRI has not been achieved until now. In specific practices, more reflection has been made for further improvement. Within NSFC, active reflection has received more attention and is widely recognized. For example, NSFC has cooperated with more experts and social institutions to work on RRI practices in which sometimes the cooperation itself constructed the best practices for RRI aspects like societal engagement. At the same time, NSFC also conducted multidisciplinary collaboration and invited scholars of social science to do related research and evaluation.

On the other hand, as a bridge between society, government and scientific community, NSFC has more sources and chances to make mutual communication among these three and practices of RRI can also be achieved in the broader context.

D. Best practices

One example is the joint funds. In order to play a guiding role and further strength the linkage between knowledge innovation and technological innovation by boosting diversified investment, inter-sector cooperation, and sharing of resources, NSFC has set up a series of joint funds with relevant departments, local government departments and industries to support basic research in particular areas in line with national demands. In this case, NSFC cooperated with multidisciplinary experts and worked in the broader social context to reflect on the social dimensions of research and innovation.

NSFC also actively reflects on their own work on RRI aspects. In terms of gender equality, before 2010, actions on improving gender equality were customarily conducted in two aspects. The first is to fund female scientists’ research programmes and to increase the female beneficiaries. The second is to take female scientists into the evaluation and review committee. However, considering the gap caused by historical factors and specific gender role of female scientists in their life, not only emphasis on the abstract principle of equality is needed, but effective policies supportive for female scientists should be applied to fill the gap created by traditional social factors and gender differences. In 2011, they extended the limitation of female age for applying funds to 40 years old, which is intimately connected to the consideration for female scientists’ reproductive activities. Since the upper limit of age used to be 35 years old, some female scientists missed the time of application for pregnancy and childbirth. Extending
the time limit can effectively provide more chances for female scientists, thus raising the rate of female applicants. This kind of practice, in return, provides good feedback for NSFC to make further improvement on certain issues. It is through this self-improved process that NSFC embeds reflexivity into their work for research and innovation.

E. Current indicators

There is clear evidence of a commitment to reflection concerning research and innovation in organisational mission, policies and communications. In specific practice, there is cognition to conduct reflection both internal and external. Reflection is incentivized and recognized by the institution, and NSFC is striving to achieve a more responsive model of research and innovation.

NSFC also actively cooperates with experts and stakeholders from the whole society. On the one hand, it is to add new blood to the practices of RRI aspects and to fulfil the requirements for certain aspects like societal engagement. On the other hand, this kind of engagement provides more chances for NSFC to reflect on its own work from more perspectives and to make further improvement. Meanwhile, multidisciplinary collaborations, notably across sciences, humanities and social sciences are made which embeds social scientists and ethicists in projects. For instance, NSFC usually invited scholars from these disciplines to make evaluation for NSFC’s work, which will become important references for improvement in the future.

F. All points of improvement

Within NSFC, no systematic understanding for reflexivity has been achieved so that reflections are scattered in specific practices of RRI aspects, in which case, the reflexivity appears to be more passive than active. It means reflexivity within NSFC is normally short of intrinsic motivation and is restricted by several factors. The first is the lack of responsive institution. The second is that whether the process of reflection can take effect mainly depends on the consciousness of members and the work plan or orientation of NSFC. Moreover, an overall reflection is hard to achieve under this circumstance. Therefore, to better integrate the principle of reflexivity into the work of NSFC, actions should be taken to raise members’ understanding and consciousness for this principle. From the organisational perspective, an overall institution should also be established to take charge of the whole practice and make supervision.

Another problem is related to the functional orientation of NSFC. Since the main duty for NSFC is to support basic research and to serve the needs of national development. As a result, the reflections on the motivations and values are sometimes weakened. Besides, practices and reflections are always restricted in the scientific community and areas closely related to it. Some broader issues do not have enough response and attention to construct the process of reflexivity which can boost the improvement on the practices. To change this situation, a theoretic structure for RRI should be established and function to clarify NSFC’s responsibility in research and innovation.

G. Agreed points of improvement, with action plans and indicators for success

NSFC will continue to make improvement through the process of reflexivity in specific practices. More multidisciplinary collaboration will be made between NSFC and other social institutions or experts.

Reflection concerning research and innovation will be embedded into the core of the organisational discourse, being prominent in its values, strategies, policies and communications. To reach this goal, the establishment of the institution which is responsible for evaluation and supervision is under discussion. A corresponding theoretic model of RRI should also be set up through both research and education.
### H. Result matrix

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| Potential drivers for RRI | NSFC has more resources and chances to make mutual communication and practices in broader context. | Active reflection has received more attention and is widely recognized. | Cooperation with experts and social institutions |

| Potential barriers to RRI | No overall institution exists to take charge of the whole process of reflexivity | Lack of an overall and systematic understanding of reflexivity in RRI | Cooperation and communication usually are restricted within scientific community and areas closely related to it |

| Most important potential organisational actions | Establishing institution for evaluation and supervision | Research and education to set up theoretic model of RRI aspects | More multidisciplinary collaboration |

| Indicators of success | Clear evidence of a commitment to reflection concerning research and innovation in organisational mission, policies and communications | Reflection is incentivized and recognized by the institution | NSFC actively cooperates with experts and stakeholders from the whole society |

| Potential indicator for the improved performance of the dimension in the research activities/programmes | Reflection concerning research and innovation will be embedded into the core of the organisational discourse | | |
7.3. Reflection on review findings, outlooks developed and ways forward

7.3.1 The integrated or fragmented nature of different responsibility related dimensions

As mentioned many times in each aspect, the whole practice of RRI is fragmentally embedded in the work of NSFC. The main reason for this phenomenon is that there is no conventional theory structure for RRI so that the understanding and cognition of responsibility are not united or cannot enter the discourse in an integrated way. For NSFC, according to its functional orientation, how to conduct the national policy and serve the needs of national development is counted as its primary duty. To fulfill the task, NSFC needs to follow the official policy instruction and to guarantee the appropriate fund distribution through a fair and transparent procedure. Therefore, although innovation or leading the direction of innovation has received the attention of the NSFC, its impact on social and economic development is the primary focus. The social influence like ethics problem or the concept of RRI both for NSFC and scientists is not the primary aim of NSFC’s work.

Under this circumstance, for issues closely related to scientific research and production like ethics (especially research integrity), open access and gender equality, NSFC has done more work to improve, and these principles are also clearly embedded in the policy, guideline or management strategy. Concerning ethics, the problem of research integrity has always been emphasized and special institution and review system have been established for supervision. Other fundamental ethical issues contained in the research of Department of Life Science and Department of Medical Science also received some attention, and related requirements also are made to set a standard. Other RRI aspects practices, like science education and societal engagement, remain in the primitive stage which is restricted mainly in the area of the scientific community, instead of a comprehensive social level.

Although different principles of RRI aspects are scattered in the work of NSFC, for which an interpretation is urgently needed. However, for the practices of each aspect, as a matter of fact, growing attention and following increasing policies have been observed over the past decade. The improvement is primarily made in two aspects. The first is the growing consciousness and the second is the more in-depth understanding. Even for the long-standing issue like gender equality, a transformation from the emphasis on equality to gender difference has appeared. In a word, core requirements directly from the development of society like gender, open access and research integrity are fulfilled more than the marginalized issue, for example, communication with the general public. Moreover, the former aspects are also better integrated into the organisation. In a word, NSFC is much more embedded into the official political system, thus demands from the bottom normal weigh less than the official stipulations or policies.

In the future, it can be expected that NSFC will continue its work on aspects of gender, research integrity or open access. More related ethical problems like animal welfare or environmental protections are also listed in the agenda. Improvement on societal engagement and science education may need more integration of NSFC itself into the society. However, until now, awareness for these aspects is growing within NSFC and scientific community, further research and practices may also increase in the future within a more integrated and coordinated RRI structure.

7.3.2 Common barriers or drivers

For NSFC, the practice of RRI aspects is directly related to the functional orientation and resource of the fund. Moreover, frequently, the drivers and barriers depend on for whom NSFC is responsible. Since the primary source of fund of NSFC is the Ministry of Finance, basically, the government, the government also becomes the priority for NSFC to be responsible to, in which case, NSFC’s primary function is to follow the macroscopic policy and strategy and to further serve the needs of the nation. As for two main tasks of NSFC, one is to support the scientific research which is intimately connected
to the development of society and state, the other is to reply to the demands and requirements from prior departments. For issues concerned by prior departments or leaders, NSFC has to pay more attention to conducting related practices. Since NSFC is an institution embedded in the political system of China, it normally receives pressure in an up-to-bottom way. How to coordinate the two aspects of its mission, fulfill the demands from prior departments and leaders, and at some time, to answer to the needs from the scientific community becomes the main point of NSFC’s work. In this case, for example, when gender equality was included in the strategy of state for scientific development, NSFC would make more policies to support and improve gender equality and diversity in scientific research.

Besides, the tradition of internalization also becomes the primary driver for certain RRI aspects. On the one hand, internalization affects the opinions of the decision-making of prior departments which further has the impact on NSFC. On the other hand, during the process of international communication, NSFC also receives influence and learns experience from other foreign institutions. For example, the rising environmental protection movement and animal welfare movements in recent years, to some extent, played a role in related policy-making of NSFC.

However, compared with the pressure from government and scientific community, sometimes, the voices of the general public are more or less neglected. Meanwhile, in Chinese society, even the dichotomy between scientific community and society has been gradually broken, and the traditional cognition does not change so much. As a result, aspects related to the general public do not receive much attention from ordinary people, let alone pressure from the public to NSFC. That is one of the main reasons that social engagement and science education are always restricted within the scientific society and areas closely related to it.

7.3.3 Final reflections and plan for follow-up
In summary, the whole institution of NSFC functions is in the political system of China, in which an up-to-bottom responsibility system has been established. Therefore, in the future, the responsibility discourse within NSFC will still face the prior departments and leaders. The progress of RRI aspects embedded into the work structure of NSFC will mainly depend on the demands and concerns of upper leaders. Besides, urgent needs from society will be considered as well.

With development of Chinese society and science, more communication and a closer relationship between the two can be expected. Responsible research and innovation will gain growing importance in China and NSFC, which will be motivated not only from abroad but also from inside Chinese society. The establishment of a comprehensive RRI structure will be a bi-directional promoting process. On the one hand, NSFC will enlighten people’s understanding for their role in the development of society and science and requirements from the general public will further encourage NSFC to conduct evaluation and improvement on related practices. A discourse for responsibility will be established with the consideration of particular cases and traditions in China.
8. Summary of findings on each responsibility dimension
This will follow the structure of Chapter 5, and only in this chapter the sections will summarise what is included both under the national mapping and under the two organisational studies.

It will be interesting here to reflect on how the national policies on the different aspects seem to work out in practice.

8.1 The concept of responsibility

- The responsibility of China’s STI is to serve economic and social development and to drive comprehensive social development based on economic development. Under the setting of China’s science and technology system, NSFC and CASTED each play their special duties.

- For CASTED, the concept of responsibility is to help the government establish and improve policy system for science and technology innovation and development. In addition, it is also responsible for providing better understanding of the social impacts of S&T development.

According to the function of NFSC, its primary duty is to support fundamental research based on free exploration and to cultivate qualified scientists and technologists, which serves the development of society through scientific achievements in an indirect way. However, the traditional concept of responsibility in innovation which was regarded as something outside the duty of NSFC now is experiencing a series of changes. NSFC is said to function as guidance and provide science and technology support for national development strategy, helping to solve critical problems in people’s livelihood, industrial and domestic economy.

8.2 The notion of “RRI”

- The notion of Responsible Research & Innovation is formally written in the 13th Five-Year National Science and Technology Innovation Plan (2016–2020). Article 24 “Creating A Social and Cultural Atmosphere for Encouraging Innovation” of Chapter 7 “Strengthening Science Popularization and Construction of Innovation Culture” mentioned: “promoting responsible research and innovation, strengthening research ethics, enhancing research ethics education, raising science and technology personnel’s awareness of scientific research ethics, and guiding enterprises to pay attention to and undertake social responsibility for protecting ecology and ensuring safety in technological innovation activities.”

- In CASTED, the notion of RRI is introduced from EU through EU founded international policy research projects.

- In NSFC, RRI was not well-known until the RRI-PRACTICE project introduced to them.

8.3 Ethics

- Research integrity and “ethics.” “Ethics” in China’s science and technology system mainly refers to “moral norms” rather than “value controversial issues.”

- As a think tank for national level decision-making, the mandated responsibility of CASTED is to provide policy recommendation to facilitate the development of S&T innovation. Ethics is one of the aspects that policy-making should take into consideration. Following the research ethics, especially the research integrity is the essential requirement for each of the staff member in CASTED. MOST and other governmental entities or research institutes would entrust CASTED to do investigations on ethical issues as policy-making consultations.
Ethics in NSFC mainly refers to three aspects. The first is the ethical impacts of scientific research on the whole society and culture. The second is some controversial problems in the research process, for example, medical experiments with animals. The third is problems with research integrity. Issues in the first topic of ethics do not receive too much emphasis. For the second, there are requirements in Project Guide of Department of Life Sciences and Department of Medical Sciences on protection of human subject and ethical review. For the third, long-standing attention has been paid to research integrity with practical actions: a special committee carrying out education and accepting complaint; a guideline; a particular office for investment in related issues; and an academic misconduct information system.

8.4 Societal engagement

- Scientific research should benefit the society. Further, the public can acquire scientific knowledge and participate in scientific research, which is written in the Constitution. China has issued three important laws directly related to the social functions of science and technology: (1) Law of the People’s Republic of China on Scientific and Technological Progress (2007 Revision); (2) Law of the People’s Republic of China on Promulgation of Science and Technology; and (3) Law of the People’s Republic of China on Promoting the Transformation of Scientific and Technological Achievements (2015 Amendment). In addition to being embodied in laws, societal engagement of science is also reflected in more effective and guided national strategies and policies such as Mass Entrepreneurship and Mass Innovation.

- As a policy research institute and a think tank, CASTED posts its research reports on its website, and publicizes S&T development news through its publications. Also, researchers from CASTED also dedicated to investigating public opinions towards S&T topics. Researchers in CASTED are motivated for knowledge sharing with the public. Public opinions on the specific issue are the solid factual basis for policy recommendation that CASTED could inform the decision makers with the relevant policy-making consultations.

- For NSFC, (1) there is societal engagement in making plans or project guidelines; (2) there are joint funds with local government, and industrial and international institutions in which NSFC will cooperate with local government, companies and international fund institutions to draw up project guides and to select research projects for certain needs; and (3) there is the Centre for Science Communication in charge of public communication.

8.5 Gender equality and diversity strategies

- In China, diversity in science and technology is reflected not only in gender equality but also in the diversity of geographic regions and ethnic groups. All of these three parts are stated in the Progress Law.

- Regarding gender equality and diversity in CASTED, the way of their effort is the integration of these dimensions in their research. CASTED could inform the decision makers with the relevant policy-making consultations on the development of female scientists.

- In practice, NSFC’s gender equality is the most effective, especially the funding policy that extends the age limit of female applications for the youth fund. Besides, NSFC also prolongs the due time of projects for pregnant female scientists and further increases the percentage of female members in the evaluation and review committee.

8.6 Open access and open science strategies

- In terms of open access, at present, China’s relevant policies and measures mainly include science and technology reporting system, open research infrastructure, and science and technology literature sharing. The main driving force behind the reporting system and the opening of scientific research
infrastructure is the government sector, led by the Ministry of Science and Technology. The main driving force for science and technology literature sharing is universities, which constitute the Confederation of China Academic Institutional Repository (CHAIR), and scientific research institutions, which are represented by the Chinese Academy of Sciences.

- CASTED now hardly has any institutional policy on open access, but only some research interests on this topic, as open access is a trend which will have a crucial impact on the future S&T innovation.

- In 2004, NSFC joined in the Berlin Declaration of open access. After that, NSFC established its sharing service website, institutional knowledge base. There is a policy that requires papers published in all or part of the NSFC-funded project to be stored in the institutional knowledge base, and become OA no later than 12 months after publication. Besides, NSFC has funded some policy research on OA policies and scientists’ attitude on this issue.

8.7 The inclusion of science education into research

- Conducting science education is the responsibility of the state stipulated in the Constitution. To this end, China has the Promulgation Law, and the government implemented the National Science Literacy Action. The specific executor of this action is mainly CAST. However, although many researchers participated, it was not really integrated into their research. Another major enabler of science popularization and education is CAS. Since CAS is China’s largest institution engaged in scientific research, the science popularization and educational activities carried out by CAS will be more closely integrated with research work.

- The major functions of CASTED include conducting research on crucial strategic S&T issues and cultivating researcher on S&T strategies. Thus, science education on S&T innovation strategies and policies is part of the official function of CASTED. Researchers in CASTED mainly have their research focuses on the policy research on S&T innovation strategies. Science education on forefront S&T development and related issues are necessary to support the research culture of the institute. CASTED follows the guideline of MOST and UNESCO and promotes the science education project of CISTRAT.

- Science education is not counted as an essential task for NSFC. This situation is closely related to the function-orientation of NSFC as a fund institution which is connected more to the basic research and scientific community. However, it also to some extent reflects the lack of comprehensive understanding of responsibility.
9. Discussion of findings

The old STI system in China can be characterized by three key words, namely developmentalism, scientism, and top-down management system. Developmentalism set promoting economic development as the first priority. Thus the key target of science and technology development was to serve the needs of economic development, which led to an over-emphasis on the economic dimension of innovation and neglect of social impacts of STI. The Chinese government and the public have a very high evaluation of the power of science and innovation since the last century. Though the prevalence of scientism provided an ideal environment for STI development, it also led to ignorance of potential risks brought by STI and a lack of reflection on the negative impacts of innovation. Last but not the least, the top-down STI management system limited public engagement in science and technology governance. These characteristics were basically contradictory to RRI principles.

As China has now entered a new era of Socialism with Chinese characteristics, the principal contradiction and challenges faced by our society have also changed. To cope with new social challenges, China’s development philosophy evolved into five key concepts, namely innovation, coordination, green development, opening up and sharing. Listed as the leading development concept, innovation is a comprehensive concept that includes not only science and technology innovation, but also social innovation, institutional innovation, inclusive innovation, responsible innovation, etc. The mode of economic development has also changed from the investment and factor-driven one to innovation-driven one. The tremendous social transition in China provided a preferable environment for the introduction and development of RRI. During the process, social actors for responsible research and innovation, such as the public, the scientific community, enterprises, and government, are emerging. RRI has been written into the latest national plan for STI development, which shows that this concept already has, to a large extent, been accepted by the Chinese government and society. As we described in this report, many principles of RRI, including the five keys, have already been embedded in research and innovation in China, even though they might not be labelled as “RRI.”

Ethics. In the Chinese context, ethics in science and technology in China is mainly related to research integrity. Abundant policy documents and norms are issued to maintain the scientific integrity. In recent decades, however, facing the ever-growing public pressure, Chinese scientific community and government are becoming more concerned about STI ethics as moral/social norms, as well as controversial value issues. Especially in newly-emerging technology fields, such as AI, big data, and bio-technology, ethical discussion and consideration have been integrated into the research and development process.

Gender equality. “Women hold up half the sky” was a popular slogan in Mao’s era intended to highlight the importance of women in all spheres of public and private life. In STI field, policy measures to promote the occupational carrier development of women scientists were issued by the Ministry of Science and Technology, National Science Foundation of China, Chinese Association of Science and Technology, etc. Women scientists are gradually developing into an indispensable part of the scientific human resource. Beyond that, diversity in science and technology is also reflected in the diversity of geographic regions and ethnic groups.

Public Engagement. To realize the limits of scientism and top-down management system, Chinese government is taking measures to construct a new STI governance system involving various stakeholders. Promoting public engagement is one of the endeavors. New methods and channels for public engagement, such as the public survey, focus groups, and consensus conference are explored. Communication among the scientific community, public and government are becoming more frequent.
The recent movement of Mass Entrepreneurship and Mass Innovation has brought about a new tide of public engagement in STI.

*Open access and open science.* As China’s science is increasingly opening to the world and society, open access and open science have become a hotly discussed issue. Current practices mainly focus on science and technology reporting system, open research infrastructure, and literature sharing. The concept of free access offers an opportunity for China’s researchers, government, publication industry, and the public to re-understand the production of scientific knowledge. However, open access still needs to be developed from a theoretical concept to practical action in China. Both CASTED and NSFC will invest more resources in the research of open science. Public and industry are also actively participating in the emerging open science practice.

*Science education.* In China, science education is often connected with science popularization, with the purpose of increasing the scientific literacy of the citizen so that they can adapt to the social development and have the ability of innovation and practice. Various policy measures have been implemented to encourage scientists to participate in science education. Moreover, market force is also absorbed in science popularity in China. There are several types of business within the industry of science popularity, which covers sub-industry of science popularity, including tourism, publication, exhibition, and ICT. The industrialization of science education will enhance the connection between science, industry, and the public.

The rapid development of RRI in China is indicated in two organization case studies as well. CASTED is not a pure research organization, but a national-level think tank that plays a key role in national STI policymaking. Therefore, in this case, we mainly focused on how CASTED tried to introduce the ideas of RRI into the national STI policy system through policy research and advisory, rather than how CASTED implemented RRI principles in its own organization level.

NSFC is the most important funding organization for basic research in China. The main target of NSFC is to implement the state policy orientation on basic research and to promote excellent research and innovation through an open, fair, and transparent funding procedure. Though RRI is not yet within the scope of main work content and functions of NSFC, we can see some of the RRI keys, such as ethics, gender equality, and open science are already involved in NSFC’s organizational practice.

The development of RRI in China is stilling facing grand challenges. Balancing the targets of driving economic development and taking social responsibilities is an extremely difficult practice. The reform of the STI system and institutions is inevitable to reach the target.
10. Conclusions

10.1 Policy recommendations to national policymakers

A. Strengthen the institutional construction for RRI.
   a) Promote the research organizations to build up ethical committees.
   b) Further complement the code of ethical norms in research and innovation.
   c) Provide training course of STI ethics to researchers.
   d) Issue more preferable policies to promote the occupational career development of women scientists.
   e) Increase the incentives of scientists to communicate with the public by reforming the science management system including evaluation system.

B. Build up platform and channels for public engagement in STI.
   a) Collect the public needs of engagement in STI.
   b) Explore channels of public engagement that fit the Chinese reality best.
   c) Construct the platform of communication between scientists and the public.
   d) Strengthen the science popularization to improve the capacity and quality of public engagement.

C. Invest in RRI.
   a) Fund more research projects on how to ensure the responsibility of research and innovation.
   b) Strengthen the international cooperation on RRI theory and practice.

10.2 Policy recommendations to European policymakers

A. Keep on funding research projects on RRI theory and practice.

B. Share the experience of RRI practices with other countries.

C. Conduct international comparative studies on RRI.

10.3 Recommendations to research conducting and funding organisations

A. Involve the principles of RRI in organizational charts and institutions.

B. Explore the best fit measure to practice RRI in organizational daily work.

C. Monitor and regularly evaluate the RRI practice. Include the performance of RRI in organization’s annual report.
10.4 Best practices scalable to European or national level

A. Include RRI concept in national plan of science, technology and innovation

B. Conduct large-scale survey to collect the needs of the public in RRI

C. Favourable policies to promote women scientists’ occupational carrier development
11. Annex 1: reviewed documents

Laws:

- Constitution of the People’s Republic of China

The first Constitution of the People’s Republic of China was promulgated in 1954, and another two versions were drafted in 1975 and 1978 respectively. The year 1982 saw a fourth version, which is the Constitution now in force. This version underwent revisions in 1988, 1993, 1999, 2004 and 2018. These continuous revisions are evidence of efforts made to adapt the Constitution to new situations and conditions.

- Law of the People’s Republic of China on Scientific and Technological Progress (2007 Revision)

Issued in 1993, revised in 2007, the Progress Law is the basic law in the field of science and technology in China. It clearly stipulates the strategic position of science and technology in the development of China’s modernization, determines the basic principles and basic policies for China’s development of science and technology, and determines the main system for promoting scientific and technological progress. At the same time, it also comprehensively stipulates the goals, functions, sources of funds, and science and technology reward system of China’s science and technology development, and becomes the basic law guiding China’s scientific and technological development.

- Law of the People’s Republic of China on Promulgation of Science and Technology

In 2002, China issued the Promulgation Law, which is the first law on science popularization in the world. It requires that “national organs, armed forces, social organisations, enterprises and institutions, rural grassroots organisations and other organisations should carry out science popularization”; “the state supports science popularization in ethnic minority areas and poverty-stricken areas”; “the state protects legitimate rights and interests of workers and organisations who conduct science popularization, encourages organisations and workers to carry out their own science popularization activities, and establishes science popularization projects according to law.”


Issued in 1996, revised in 2015, the Transformation Law is an important law that is compatible with the Progress Law. It defines the principles that should be followed in the transformation of China’s scientific and technological achievements, and provides safeguard measures, the attribution and sharing of rights and interests in the transformation of scientific and technological achievements in order to promote transformation. The law stipulates that under the conditions of not harming the public interests of the state and society, the transformation of scientific and technological achievements can be carried out voluntarily or in accordance with the contract, and enjoy the benefits and bear the risks; and the intellectual property rights in the transformation of scientific and technological achievements are protected by law.

Plans and strategy:

- National Medium and Long-Term Science and Technology Development Plan (2006–2020)

- Issued in 2006, the Plan defines the guidelines for scientific and technological work from 2006 to 2020: “independent innovation, focus on leapfrogging, supporting development, and leading the future.” The overall goal of science and technology development was put forward: “the ability of independent innovation has been significantly enhanced, the ability of science and technology to promote economic and social development and safeguard national security has been significantly enhanced, and it has provided strong support for building a well-off society in an all-round way;
the comprehensive strength of basic science and cutting-edge technology research has been significantly enhanced, […].”

• National Innovation-Driven Development Strategy Outline

Issued in 2016 by CPC Central Committee and the State Council, the outline clarifies the overall deployment of the implementation of the Innovation-Driven Development Strategy, emphasizing the needs to “adhere to two-wheel drive, build a system, promote six major changes” to lay out and build a new development dynamic system. Two-wheel drive is the coordination and continuous development of the two wheels of technological innovation and institutional mechanism innovation. One system is to build a national innovation system. The six major changes are a series of changes in development methods, development factors, industrial division of labour, innovation capabilities, resource allocation, and innovation groups.

• The 13th Five-Year Plan for Science, Technology and Innovation

Issued in 2016 by the State Council, the 13th Five-Year Plan focuses on supporting the country’s major strategies, giving full play to the core leading role of scientific and technological innovation in promoting the industry to move towards the mid-to-high end, adding new development momentum, expanding new development space, and improving development quality and efficiency. The first is to build a national first-mover advantage and to strengthen the major strategic layout of the current and long term. The second is to strengthen the original innovation ability and to cultivate important strategic innovation forces. The third is to expand the space for innovation and development, and to coordinate the two major domestic and international situations. The fourth is to promote the innovation of mass entrepreneurship and to build a good innovation and entrepreneurship ecosystem. The fifth is to comprehensively deepen the reform of the science and technology system by breaking the institutional barriers that constrain the innovation and the transformation of results. The sixth is to focus on the innovation of the mass and social foundation, and to strengthen the construction of popular science and innovation culture.

Opinions and speech:

• The State Council’s opinions on promoting certain policies and measures for Mass Entrepreneurship and Mass Innovation

Issued by the State Council in 2015, the opinions clarified 96 policy measures from 30 aspects of 9 major areas. The first is to innovate institutional mechanisms to facilitate entrepreneurial facilitation; the second is to optimize fiscal and taxation policies and to strengthen entrepreneurial support; the third is to invigorate financial markets and to achieve convenient financing; the fourth is to expand venture capital and to support entrepreneurial growth; the fifth is to develop entrepreneurial services and to build entrepreneurship ecology; the sixth is to build a platform for entrepreneurial innovation and to enhance support; the seventh is to stimulate creativity and to develop innovative entrepreneurship; the eighth is to expand urban and rural entrepreneurial channels and to achieve entrepreneurship to drive employment; the ninth is to strengthen overall coordination and to improve coordination mechanisms.

• The State Council’s opinions on strengthening the implementation of the Innovation-Driven Development Strategy to further promote the in-depth development of Mass Entrepreneurship and Mass Innovation

Issued by the State Council in 2017, the opinions proposed policy measures in five areas. The first is to accelerate the transformation of scientific and technological achievements, focus on breaking through institutional barriers to transfer scientific and technological achievements, protect intellectual property rights, activate technology transactions, enhance entrepreneurial service capabilities, optimize incentive mechanisms, share innovative resources, and to accelerate the transformation of scientific and
technological achievements into real productivity. The second is to optimise financing channels, continuously improve financial and taxation policies, innovate financial products, expand credit support, develop venture capital, optimize investment methods, and to promote the financing problems of innovative and entrepreneurial enterprises. The third is to promote the transformation and upgrading of the real economy, focus on strengthening the construction of innovation and entrepreneurship platforms, and fostering the emerging sharing economy, transform traditional industries with new technologies, new formats and new models, enhance core competitiveness, and to achieve coordinated development of emerging industries and traditional industries. The fourth is to improve the incentive mechanism for talent mobility, fully stimulate the vitality of talent innovation and entrepreneurship, reform distribution mechanism, introduce high-level international talents, promote the rational flow of talents, improve the security system, and to accelerate the formation of a team of innovative and entrepreneurial talents with large scale, reasonable structure and high quality. The fifth is to innovate the government management mode, continue the “distribution management” reform, increase the support of inclusive policies, improve the business environment, relax market access, promote pilot demonstrations, strengthen cultural construction, and to promote the formation of interactive innovation and entrepreneurial ecology of government, enterprises, and society.

- President Xi Jinping’s speech at the 19th Academician Meeting of the Chinese Academy of Sciences and the 14th Academician Meeting of the Chinese Academy of Engineering

The speech in May 28th 2018 is the latest most important document on science, technology and innovation which reflects the will of the Party and the state. In the speech, President Xi stressed that it is necessary to fully understand that innovation is the first impetus, provide high-quality technology supply, and to focus on supporting the construction of a modern economic system. We must be determined to innovate independently, strengthen our confidence in innovation, and to focus on enhancing our ability to innovate independently. It is necessary to comprehensively deepen the reform of the science and technology system, enhance the efficiency of the innovation system, and to focus on stimulating the vitality of innovation. We must deeply participate in global science and technology governance, contribute to China’s wisdom, and strive to build a community of human destiny. It is necessary to firmly establish the strategic position of talents to lead development and gather talents in an all-round way, and to focus on the innovation and development of talent base.

12. **Annex 2: definitions**

- PRC: the People’s Republic of China
- CPC: the Communist Party of China
- MOST: Ministry of Science and Technology
- CASED: Chinese Academy of Science and Technology for Development
- NSFC: National Natural Science Foundation of China
- CAS: Chinese Academy of Sciences
- CAST: Chinese Association of Science and Technology
- NAIS: National Academy of Innovation Strategy
- NGO: Non-Governmental Organisation
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