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**The role of social media in the anticipatory
governance of GM technology: A comparative
analysis of Chinese and English-language social
media**

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The Department of Sociology

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Declaration

This thesis is submitted to the University of Warwick in support of my application for the degree of Doctor of Philosophy. It has been composed by myself and has not been submitted in any previous application for any degree. The work presented (including data generated and data analysis) was carried out by the author.

Abstract

Anticipatory governance—an up-to-date strategy of science governance—provides a forward-seeing option for policy-makers to govern emerging technologies in contemporary society. The present research serves as an explorative study attempting to introduce the great value of social media (Twitter and Weibo) to the implementation of foresight and engagement capacity, arguing that social media are able to play as a supportive forum for anticipatory governance. A comparative analytic study scheme is also applied considering the different backgrounds of social media. The user-generated content arising from the GM future related spontaneous discussion is collected respectively from Twitter and Weibo and later on analyzed with qualitative content analysis under the assistance of QSR NVivo software. The results of this research show that Twitter and Weibo are playing the role of a supportive forum for anticipatory governance, where GM future, which turns out to be a globally controversial issue in this research, is intensively conceived and debated via the wide participation of individuals in spontaneous discussion; GM future-related spontaneous discussion can be identified as an incomplete transition from the deficit one-way communication model to a two-way dialogue model; the appearance of quiet engagement suggests more possible formats for online engagement, which led me to a reconsideration of the definition of public engagement in an Internet environment; the term mid-politics is proposed to justify the unique style of sub-politics rooted in China, which is led by public intellectuals and pushed forward in the form of public debate by controversy or movement leaders.

Key Words:

Anticipatory governance, Science governance, Public engagement of Science, Social Media, Qualitative content analysis, Mid-politics

Chapter One. Background and Introduction

1.1 Contextualising anticipatory governance

In contemporary society, the innovation and development of science and technology have rapidly become the core driving force of social improvement (Wilsdon et al., 2002). Meanwhile, technology-driven social changes have blurred the traditional boundary between the natural and social sciences and created collaborations which have maximised social wealth through emerging science-based technologies, and have maintained or fought for social democracy (Wilsdon et al., 2002: 13; Macnaghten et al., 2005: 1). This cooperation between ‘two cultures’ can be clearly seen through the ways in which natural science research has involved social science research, for instance social science research can help scientists to consider the social implications of emerging technology, including the long-term implications of emerging technologies to inform the practitioners of science management e.g. governments (Barben et al., 2008). Following this trend of integration between disciplines, science governance is experiencing a massive revolution, transitioning from Public Understanding of Science (PUS) to Public Engagement of Science (PES) which later gives way to ‘a more systemic and networked perspective’ (Macnaghten and Chilvers, 2014: 530). Whatever dominates the mainstream model of science governance, the public, who was previously underestimated, is now given growing respect and empowered to make a substantial difference to decision-making. For example, anticipatory governance is a typical case of science governance characterised by public engagement and practicing in a systematic manner with foresight.

Given a shot in the area of Nanotechnology, anticipatory governance has seen initial success from the extensive public acceptance of Nanotechnology (Barben et al., 2008). This concept of science governance is broadly applied to a wider range of emerging technologies, which emerge with high expectations in their potential to creating social value such as ‘safeguards for workers engaged with hazardous production’ (Singh, 2014: 73) or massive controversy due to uncertainty as advanced predictions by technologies may be unreliable. Regarding the implementation of anticipatory governance, three

essential capacities should never be neglected, namely foresight, engagement and integration. In Guston's work on defining anticipatory governance (2014), these three capacities are clearly identified.

[F]oresight is a methodologically pluralist approach to plausible futures with an emphasis on such methods as scenario development that provide a more diverse and normative vision compared with other methods that seek to identify a single, most likely future. *Engagement* refers simply to encouraging the substantive exchange of ideas among lay publics and between them and those who traditionally frame and set the agenda for, as well as conduct, scientific research. *Integration* is the creation of opportunities, in both research and training, for substantive interchange across the 'two cultures' divide that is aimed at long-term reflective capacity building (Guston 2014: 9)

This 'forward-looking, engagement-oriented and result-seeking' (Barben et al., 2008: 991) strategy of anticipatory governance has drawn increasing interest ever since its first appearance in the Nano field. However, following the use of anticipatory governance numerous doubts have arisen questioning whether engagement exercises with the public have achieved their expected outcomes (Wildson et al., 2004; Rogers-Hayden et al., 2007; Joly et al., 2008). According to the assessment done by Joly and Kaufmann (2008), the practice of engagement could hardly replace a 'top-down' 'one-way' deficit model in terms of efficiency. The contradiction between 'inclusive governance approaches and traditional appeals to sound science and expertise' is also recognised (Hagendijk, 2004, cited in Macnaghten and Chilvers, 2014: 531). The dilemma that anticipatory governance comes across in practice inspired me to consider what alternative platforms might be able to accomplish public engagement at a more inclusive level. At this moment, social media came to my mind, arousing an interest to explore the potential of social media in performing the capacities of anticipatory governance.

1.2 Background: The GM controversy

Genetic modification (GM) technology, which is also known as genetic engineering, is defined as a technological way to alter the genetic material (DNA) of any organism, which ‘does not occur naturally by mating and/or natural recombination’ (WHO, May 2014). Correspondingly, GM foods refer to ‘the foods produced from or using GM organisms’ (ibid.), which, compared with the profound technology of genetic engineering, is no longer strange to the masses because of the considerable and long-lasting controversy associated with it (Pidgeon et al., 2005: 468; Attar et al., 2014: 241). After a successful experiment using laboratory techniques in 1946, according to the introduction given by Bawa and Anilakumar (2013: 1035-1036), GM technology was applied in practice for planting tobacco in the 1980s: in 1982 an antibiotic-resistant tobacco plant became the first genetically modified crop and in 1986 tobacco plants were engineered for herbicide resistance (Fraley et al., 1983; James, 1998). After that, the agricultural industry and food industry have successively employed GM technology for multiple purposes, like insect resistance or obtaining desired nutrients (Bawa et al., 2013: 1036). The controversy over GM has existed ever since the early stages of GM development in the 1990s, when European countries learned lessons from the ‘mad-cow’ crisis and realised the significance of involving scientists, policymakers, interested parties and the lay public into dialogues supporting decision-making in science (Pidgeon et al., 2005: 469).

The criticisms toward GM focus on several grounds, such as ‘the safety of GM foods’, ‘the environmental impact of growing GM crops’, and the commercialisation of GM technology (Jacoby, 2004: 135). One of the most illustrative events concerning GM issues in Europe was the ‘GM Nation? Public debate’ that took place across the UK in June 2003 (PDSB, 2003). This public debate was launched as a way of ‘gathering information about public views on GM food and crops in order to inform UK government decision making’ and exploring what people want from technology in the future (Pidgeon et al., 2005). However, the outcomes of this debate were problematic,

and went far beyond expectations due to the unreasonable adoption of the methods utilised for sampling and representing public opinions on GM crops. According to the analysis given by Campbell and Townsend (2003: 559), the results of the open debate showed an apparent bias in the public's attitudes towards future GM crop use. The majority of participants were those who 'have invested more' (Pigeon et al., 2005: 468) demonstrating inherent attitudes that leaned towards anti-GM opinions (Lichtenstein, 2004: 135) which was therefore unrepresentative of the entire general public. Nevertheless, this problematic result was finally taken account of by decision-makers in their decision-making process in 2004, which makes GM governance a controversial issue alongside other issues concerning GM-related controversy. With regard to the GM debate in the UK, methodological considerations about how to objectively collect an accurate record of public opinion becomes crucial for public engagement practices.

Moreover, instead of being solely a domestic issue, the controversy surrounding GM technology is a fiercely debated international concern which requires an urgent and suitable solution to deal with in developing countries such as China. According to a report given by the Chinese industrial information network (Chyxx, 2016), controversy over the commercialisation of GM crops dates back to the beginning of the application of GM crop cultivation technology in 1996. The main driver of negative attitudes towards GM came from mass media and non-profit organisations which advocated environmental protection and sustainable development. The main reason resulting in the negative attitudes comes from the development over using GM technology too quickly without knowing what the long-term issues might be, i.e. whether GM food will do harm to human health.

Simultaneously, it is notable that supportive views on GM development as a means of solving worldwide food shortage problems are always competing with negative ones. However, after eighteen years of debating back and forth the broadcasting of a TV programme on China Central Television (CCTV) in 2014 disrupted the balance between negative and supportive viewpoints and steered Chinese public opinion towards an anti-

GM attitude. The programme, entitled '*Xin Wen Diao Cha—Zhui Cha Zhuan Ji Yin Da Mi*' (News Investigation: Tracing Genetically Modified Rice) (CCTV13, 26th July 2014), exposed the wide distribution of genetically modified rice in the Chinese food market, and immediately triggered a massive nationwide GM food-related debate on Sina Weibo (one of the most popular social media in China). Apart from the remarkably high volume of relevant content being released on social media after this exposure, the longevity and the passion of GM discussion on Weibo is unprecedented: there have been more than 1 billion GM-related posts on Weibo since 26th July 2014 (Weibo, July 2017).

A spontaneous discussion over GM issues is taking place in an English and Chinese language environment on social media. On Twitter, the most popular microblogging service in the world, debates over GM are largely centred on specific news events, such as EU's new rules for genetically modified organisms (GMO) issued at the beginning of 2015. Among these discussions on Twitter, a great number of non-governmental organisations, like 'GMO Inside' and 'GMO Free USA', are trying to mobilise their registered users to reject GMO for various reasons, and contribute significantly to ongoing anti-GM movement information shared on social media. Meanwhile, on Sina Weibo the anti-GM movement takes a more dynamic turn regarding the number of participants involved, the range of GM-related issues covered and, importantly, the remarkably high diversity of opinions entangled in the debate and the debate's political influence on GM-related policymaking (Xia, 2013).

1.3 Building a connection between social media and anticipatory governance

Returning to the idea of applying social media as a way of making up the deficiency of traditional engagement practices, the research set out in this section establishes a connection between the advanced interactive function provided by social media and the demands of implementing anticipatory governance as a strategy. As described in the

thesis title, this study is dedicated to evaluating and comparing the role of social media in anticipatory governance within Chinese and English language contexts. Focusing on GM technology, a recent controversy in these two language environments, this research explores the potential of social media as a forum for supporting anticipatory governance. One of my goals was to create a valuable reference to enable policymakers managing science governance affairs to take better advantage of social media as a resource. As one of the main channels disseminating science information (Xia, 2013), I chose microblogs as the target platform in this research to compare representative microblog samples in an English and Chinese language context, namely on Twitter and Weibo.

Twitter has become a major site for science-relevant conversations to occur since its launch in 2006. Twitter remains a free platform for the wider public to participate in as everyone can access and read messages (tweets), although only registered users can tweet and interact with posts. Not long after the launch of Twitter, in 2009 across the Pacific Ocean a powerful competitor was carefully copying Twitter's success in China. This new social media platform was called Sina Weibo (hereafter Weibo), a Chinese version of Twitter which reached the same scale as Twitter in terms of users in half the time (Xia, 2013: 3). Nowadays, Twitter has 330 million MAUs (monthly active users), while Weibo exceeded 300 million in 2012 and reached 392 million at the end of 2017 thanks to the huge available market in China (Twitter, 8th Feb, 2018; PRNewswire, 13th Feb, 2018). These statistics clearly indicate Weibo's strong potential to become an influential platform for public engagement in China.

A comparison of spontaneous discussions concerning the future use of GM foods has not been attempted before via Weibo and Twitter. These platforms were selected with the intention of developing new insights on science governance rooted in two completely different political contexts, while exploring the possibility of introducing the concept of anticipatory governance into a Chinese context. Through comparing and analysing GM future-related discussions on Twitter and Weibo, an overview of the circumstances of science communication in two language-environments will be

presented. In addition to this overview, two research questions, namely ‘How is an alternative GM future projected on Twitter and Weibo?’ and ‘How are the major stakeholders of GM technology interacting on Twitter and Weibo?’, are designed to figure out (a) the thematic construction of GM future issues, and (b) the complicated interactions occurring among major stakeholders of GM technology. In approaching these topics and questions, the research aims to evaluate the potential of social media to perform the function of anticipatory governance and to also explore more ways in which the progress of science democracy could be promoted. It is also noteworthy that in a Chinese context the one-party political environment has deeply affected the status of science democracy. Therefore, additional concerns for this research are: as a third-party platform partially independent from governmental control, what role Weibo plays in the Chinese political environment, and what implications Weibo has, if any, for the science governance of China.

To support this research, the connection between social media and anticipatory governance is theoretically made via a comprehensive literature review of the distinctive features of social media and the concept of anticipatory governance—foresight capacity and engagement exercises are believed to be embedded in GM future-related spontaneous discussion on Twitter and Weibo. In order to conduct an analysis into online engagement a theoretical framework of public engagement is set up composed of existing theories and academic studies, including: Irwin’s third-order thinking theory (2014), Nabatchi et al.’s three-type classification of participation (2015), Choi’s two-flow communication theory in Internet environment (2015), Jacoby’s public intellectual theory (2009), Beck’s sub-politics theory (1992) and Bertot et al.’s academic work on E-government (2012). This theoretical framework provides a theoretical basis for the forthcoming analysis. In total, 381 groups produced 3,194 pieces of user-generated content (UGC) that were collected and analysed with the assistance of QSR NVivo software. Qualitative content analysis was adopted as an instrument of this analytical work to provide an in-depth interpretation of every single group of data. In addition, a series of quality assurance methods, including

‘triangulation’, ‘reflexivity’, ‘thick description’, ‘transparency and procedural clarity’ and ‘deviant-case analysis’, were also introduced to secure a high degree of qualitative rigor.

1.4 A new concept of mid-politics

Aside from successfully addressing the research questions, the present research is the first academic attempt to deeply look into public engagement action on social media, and introduces a theoretical innovation by putting forward a new concept of mid-politics. This innovation not only contributes to the theoretical improvement of democratic politics, but reveals the existence of a new political culture in a one-party political environment, giving prominence to the status of Chinese democracy outside of the traditional political ecosystem. This raises two important points: the large diversity of emerging themes concerning the future of GM technology, and the interactions between experts and non-experts when debating this issue.

With respect to the alternative future of GM technology as framed on social media, spontaneous discussion on Twitter and Weibo has been primarily characterised by a remarkable diversity of themes. Firstly, a high level of overlap in the thematic distribution took precedence over any other similarity between Weibo and Twitter, suggesting that the controversy of GM crops has spread across national boundaries and become a global issue. Secondly, extensive debates about GM labelling provides an illustration of foresight capacity (the ability to envisage what will or might happen in the future). Foresight capacity intensively exemplifies the public’s general response to the uncertain future of GM technology; for instance, doubt exists parallel with support when discussing the long-term implications of GM technology. Thirdly, negative emotion turns out to be another salient theme commonly spread across Twitter and Weibo. While the specific emotions displayed on social media vary from platform to platform, they are also subject to different social and culture backgrounds.

With regard to the interactions taking place among major stakeholders of GM technology on social media, first of all this research pays attention to interactions between experts and non-experts and finds that wherever and whatever fields experts are rooted in, their voices or statements raise concern among non-experts but hardly have a persuasive effect. Furthermore, as a consequence of dynamic, public, online engagement with controversial emerging GM technology a massive anti-GM movement is found on Twitter and Weibo. In this cross-national anti-GM movement, public opinion leaders are playing a significant role in steering public and local government attitudes, even though the kind of opinion leaders found on Twitter (e.g. NGOs) and Weibo (e.g. public intellectuals) differ. The anti-GM movement carried out on Weibo is identified as mid-politics—a unique type of sub-politics rooted in a Chinese single-party political environment. This involves public debate pushed forward by public intellectuals with a detailed knowledge of controversies and movement leaders. The present research demonstrated these political actions makes a difference to Beck's theory of risk society (1992), which states that new forms of risk are produced by technology and people are constantly required to respond and adjust. What is more, the innovative concept of mid-politics arising from this research enriches Fung et al.'s theoretical model of democratic politics (2013) by elaborating on how Chinese citizens are equipped with political influence on the authorities. Last, but not least, the government makes limited use of social media as a means of E-government. A series of considerations prior to engagement practices with social media are drawn upon in this research to explain the dilemmas of the authorities when utilising social media for governmental means.

1.5 The research roadmap

The thesis is structured by six chapters in order to present the research clearly and completely. After extracting the core concept of anticipatory governance from a broader context of science governance, Chapter 1 introduces the controversial background of GM technology and briefly identifies the aims and questions that were undertaken in

the research, followed by some main outcomes related to the new concept of mid-politics. Chapter 2 is dedicated to outlining the outlook and the core capacities of anticipatory governance, followed by the establishment of a theoretical framework of public engagement to provide theoretical evidence explaining actions of engagement which take place on social media. Specific methodological concerns are elaborated on in Chapter 3, including research design, the sampling approach, reasons for choosing the analysis method, coding and quality assurance methods. In the following two chapters (Chapters 4 and 5), substantial analytical work and a full range of findings are presented, connected to the two research questions of the study. Subject to quality assurance requirements, the result chapters culminate with a deviant case analysis to secure the highest degree of academic rigor. As the last chapter of the thesis, Chapter 6 begins with a summary and reflection on the research, and draws the outcomes back into a broader academic context, discussing the implications and contributions of the present research in a deeper sense.

Chapter Two. Literature Review

2.1 Changing Trends in Science Governance

2.1.1 From 'PUS' to 'PES': The upstream revolution of science communication

A revolution of science and technology has dramatically driven social changes in a deep sense, blurring the traditional boundary across the natural and social sciences. The interactions between science and society have become increasingly frequent. Generally speaking, the extensive application of science-based technology acts like a catalyst for economic growth and has reshaped the structure of industrial processes (Wilsdon et al., 2002: 13; Macnaghten et al., 2005: 1). Reciprocally, society retroacts on (accommodates, coordinates and monitors) science by binding science innovation to a complex network of relationships with political, financial, and social consensus investments (Guston et al., 2002: 93), suggesting that neither science innovations nor innovators are likely to be entirely isolated from the social network woven by a wide range of social interactions taking place amongst all kinds of institutional settings (Wooden, 2006: 1058). Furthermore, this relationship seems even more intense in the case of emerging technology, which provides high expectations and many uncertainties. GM technology and Nanotechnology are two such technological advancements. Guston and Sarewitz describe the collaboration between nanoscale innovation and social science as a 'complex lineage' (2002: 94), owing to the inherently wide range of stakeholders involved in Nanotechnology spanning from engineering to material manufacture. Meanwhile, we can make use of the traditional metaphor that critiques science and technology as a 'black-box' to the world, in other words funding goes in and outputs are produced with no idea of what occurs inside the box. Outside of the scientific community this black-box approach has been treated with distrust by the public. Science and technology have been accused of a lack of transparency surrounding how technologies are progressing, as stakeholders hold shares and taxpayers' money funds research there has been a call towards opening the black-box (Nature, 2004). Thus, science is not 'completely unfettered from public opinion' because scientific research has to be responsible for 'contemporary concerns about

social value and ethics' (Wooden, 2006: 1058).

In 1985 the 'Bodmer report' was produced by the London Royal Society requesting transparency in science and technology practices. There had been a growing concern throughout the 1970s and 80s about the public's understanding of science as discussed by Nelkin (1987) and Gregory et al. (1998). A public understanding of science (PUS) is concerned with 'an effort to improve the general public's overall scientific knowledge and attitudes towards science' (Short, 2013: 39). By exposing previously inaccessible scientific knowledge to the public, and endeavouring to cultivate their scientific literacy the goal was to secure public credibility within a scientific context (Nelkin, 1987). Alan Irwin (2008) includes PUS in his framework of 'third-order' thinking in science communication. In his theory, PUS is characterised by the undisputed tone of authorities' statements about scientific fact; science-oriented content; and a 'top-down' communication model with the exclusion of dialogue with the public (ibid).

It is not surprising that PUS was criticised as a 'questionable assumption' (Wilsdon et al., 2004: 17) due to the 'top-down' and uncritical model it applied to public communication (ibid.; Wooden, 2006; Irwin, 2008) and the misunderstanding about the relationship between public acceptance and scientific information (Wynne, 1995). The aim of PUS was to ease the tension between the public and the government which resulted from problematic events such as mad-cow disease. Despite willingness to increase accessibility to scientific issues, Wynne believes that PUS is fundamentally flawed in its execution because it is generated from a broad misunderstanding among scientists and policymakers, who believe that the public is unable and unwilling to correctly 'understand [...] messages about risks as given to them by the experts' (1995: 281), which to some extent ignores the lay public's intellectual aspirations encompassing scientific knowledge. As described in Guston's report about the research centre at Arizona State University (2007: 377) lay-people have known more, and had a much deeper comprehension of science and technology than experts expect and, as argued by Alan Irwin, they should have been trusted more to 'respond rationally to

openness' concerning scientific issues (2008: 5).

Secondly, Wynne's analysis on the problem of understanding public thought proposes that the most significant factor influencing the public acceptance of science has been misunderstood. The solution is not simply increasing public knowledge, as what matters most to the public's uptake of science is personal experience about scientific events, which is formed through 'social relationship, interactions and interests' rather than informed knowledge. In other words, understanding science on its own, without additional trust and credibility placed in science, fails to make a contribution when the negative consequences of technology arise in practice, however, additional trust and credibility placed in science could minimize the risk of damaging public relations. Besides this point, it is notable in Wynne's work that alongside his critique of PUS he contemplates the transition from 'what people knew' to 'what people experienced' (1995). It is a significantly big step for science communication to concentrate on how to 'bridge the preconceived gap between experts and lay man' (Short, 2013: 4) to secure the public's acceptance of science.

Although the last decade of 20th century saw pieces of work criticising the irrationality of PUS, what really swayed the position of scientists to understand public perspective and its importance for science was the occurrence of some problematic events and their subsequent adverse impact: such as the critique towards 'GM Nation?', the BSE scare, and the ethical controversy of cloning. Failing to properly dealing with these unexpected incidents worsened the public's, already weak, trust towards science. As a consequence PUS has forced governments to regain the public's trust, one method being public engagement of science (PES).

With respect to this new approach of science communication, Alan I. Leshner offers a definition: 'to engage the public in a more open and honest bidirectional dialogue about science and technology and their products, including not only their benefits but also their limits, perils, and pitfalls' (2003: 977). At the same time, Alan Irwin regards public

engagement as a shift of science communication culture from ‘first-order’—the top-down one-way model—to ‘second-order’—a two-way dialogue model of communication (2008: 5). Different from the expert-oriented model, public engagement communicates information to laypeople as individuals, trusting that they are capable of responding rationally to scientific issues. Public engagement initially acknowledges the inherent uncertainties of science and technology. This strategy gives full respect to public opinions and then actively engages the stakeholders of technology and the lay public through debate (Wilsdon et al., 2004).

If done well, PES encourages participation, offers greater transparency and more possibilities for the lay public to influence final political decisions. Extending her efforts to policymaking, Ruth Wooden picks out a basic principle of public engagement: that it is committed to improving the decision-making process through ‘breaking down the ambivalence between science and citizens and taking responsibility for a partnership of respect and working hard to build and keep trust with the public’ (2006: 1062). Rather than coping with scientific risks in a timely manner, to diminish the conflict by comforting the public or distracting public attention without any effort in a substantive sense, instead, in engaging with the public. Richard A. L. Jones argues (2011: 3) ‘research priorities and the trajectory of technologies are steered with reference to public values’, which creates a public engagement movement likely to democratise the scientific field. To summarise, from the beginning of 21st century onwards, PES has gradually replaced PUS and has been regarded as a mainstream procedure for managing science communication (Jasanoff, 2003: 238); a procedure which is applied to a wide range of scientific fields (Weingart, 2002).

For more than a decade, the PES model has seen initial success in practice, e.g. in Nanotechnology (Currall et al., 2006; Zenka, 2006; Barben et al., 2008). Based on the idea of public engagement with science, Alan Irwin provided a ‘third-order thinking’ (2008: 199) model dividing science communication into three sub-paradigms, namely ‘top-down communication’ (ibid.), ‘from deficit to dialogue’ and ‘moving engagement

upstream' (Wilsdon et al., 2004: 17-18). Although Irwin terms these 'orders', the three models are shown as neither historical phases nor as an inevitable sequence (Irwin, 2008: 1). The co-existence of these 'orders' frequently occurs in practice as a moving back and forth between them, subject to the demands of actual circumstance.

What distinguishes Irwin's third-order thinking from other peers' theories is the emphasis he places on how public engagement drives scientific democracy forward. In third-order thinking, a multiple-framed science communication model brings an 'upstream' movement into public engagement that entails early public discussion around potentially controversial issues. For instance, in the definition given by The National Co-ordinating Centre for Public Engagement (NCCPE), upstream engagement 'has meant that scientist, academics and political decision makers are trying to find ways to engage the public meaningfully in very early stages of research and development' (NCCPE, year unspecified). Apart from including the public in earlier discussions, 'upstream' also implies a higher level of transparency in the public sector (Stilgoe and Wilsdon, 2009: 3). On the one hand upstream engagement puts public engagement on the agenda before any decision is made and on the other hand puts emphasis on the value of public opinion towards policy-making. (ibid.).

Being engaged in the research of upstream public engagement, Eric Jensen believes that some 'the core principles' are: the transparency of the decision-making process, the clarity of investment scope and future development directions, 'as well as ensuring that their views are fully analysed and included (not cherry picking feedback based on decisions already made about the form and content that developments will take prior to the public engagement activity)' (Jensen, 2011a: 8). Bound up with the idea of scientific democracy, upstream public engagement views scientific governance and communication as a matter of dynamics benefiting 'social and scientific progress in democratic societies' (ibid.: 11), which could be understood as the suggestion of giving initiative, or autonomy, to the lay public, rather than the engagement being led by the authorities. More interestingly, the perspective of upstream engagement happens to

hold a comparable view with Ulrich Beck's theory of sub-politics (1992). Sub-politics refers to forms of politics 'outside and beyond the representative institutions of the political system of nation-states' (Beck, 1996: 18), which undoubtedly includes self-organised, grass-roots-initiated engagement behaviours such as those exhibited on social media.

2.1.2 The “hard road” of China’s science communication revolution

Science communication in a Chinese context can be dated back to the mid-1970s after the Cultural Revolution (from 1967 to 1977). Since then, promoting scientific popularisation and improving public scientific literacy became the emphasis of science communication work in China (Jia et al., 2014). A new concept of science communication was introduced to China at the beginning of the 21st century, and a transformation occurred from 'science popularization' to 'public engagement of science' in the landscape of Chinese science governance. A transformation which is believed to be crucial, even revolutionary, but remains 'in its infancy' (Callon et al., 2009; Jelsøe et al., 2006: 45–49; Jia et al., 2014; Zhang, 2015: 2). At this stage, the government has not yet reacted to, or realised, the importance of timely transformation whilst scientists were believed to be 'inactive' regarding engagement practices (Chen et al., 2009; Jia et al., 2014; Zhang, 2015).

Some academic works attribute scientists' reluctance to engage with the public as a consequence of either the traditional academic culture in China, or the loss of public intellectuals' social responsibility in contemporary society (Jia et al., 2014), which, in Zhang's argument (2015: 2), did not refer to the essential ingredients of Chinese science communication. Investigating the 'entangled web of influences underlying China's science communication, with a focus on the views of Chinese scientists' (ibid.), Zhang's research attempts to give explanations for scientists' reluctance to engage, and illustrates how the credibility of science in Chinese society is affected by the 'over-politicization' of science communication in China where science communication is

sponsored and organised by the government—following the top-down deficit model of engagement (Zhang, 2015:1). This marks a ‘credibility paradox’: from the perspective of scientists in Zhang’s research, ‘visible institutional endorsements’ imposes political pressures on scientists, making them willing to engage but inactive, which, partly, results in the development of science governance lagging behind most Western countries. Based on a reflection of China’s science communication status, Zhang suggests that a more relaxed and open environment for public engagement where ‘political directives’ are less embedded establishes better efforts toward the reformation of science communication.

Nevertheless, scientists’ concern is only one aspect of the “hard road” that faces China’s science communication. As the only sponsor and organiser of science communication in China, the government’s response to the changing model lags behind the Western world (Jia et al., 2014; Zhang, 2015). Investigating the reasons underlying China’s science governance strategy remains an unexplored field of research. The next section will explain why anticipatory governance—an advanced model of science governance raising from Western countries—is likely to provide Chinese policymakers with advice worth taking into consideration.

2.1.3 Anticipatory governance: An advanced model of science governance

As mentioned in Section 2.1.1, the PES model is regarded by scholars as a mainstream model concerning the political communication of science (Jasanoff, 2003: 238; Wilsdon et al., 2004; Davis et al., 2012). PES replaced unsatisfactory results generated by the PUS model. In the context of Nanotechnology, anticipatory governance has drawn growing attention not only because under the assistance of anticipatory governance, Nanotechnology—the first technological area that anticipatory governance was applied to—has achieved prosperity and wide public acceptance (Currall et al., 2006: 153; Zenka, 2006: 43; Barben et al., 2008: 979), but also because anticipatory governance has already been applied to a broader range of areas, such as global climate change

research (Quay, 2010:496-511) and Synthetic Biology (Weick et al., 2011), suggesting that it can be applied to other areas such as GM technology.

Compared with Nanotechnology, the term ‘anticipatory governance of Nanotechnology’ is like a neonate (new born child) who is thriving with special nutritional support. As the baby grows up its nutritional needs are updated and ameliorated to better fitting the baby’s changing requirements. The same metaphor can be applied to public engagement of science (PES), the dominant idea of anticipatory governance (Barben et al., 2008; Guston, 2014). I will now briefly review the short history of anticipatory governance, including the development of PES.

Learning from the lessons of the “GM Nation?” in 2003 (The Royal Society & The Royal Academy of Engineering, 2004; Wilsdon and Willis, 2004), the British government and scientists specialising in Nanotechnology realised that ‘a new mood for’ a set of ‘direct, open, and timely public dialogues’ (House of Lords, 2000) has been generated among the public to replace the previous deficit model as presented in ‘GM Nation?’ (Joly et al., 2008: 3). From then on, the advocacy of public engagement was prevalent throughout the Nanotechnology industry. Real-time technology assessment (Guston and Sarewitz, 2002), incorporating a series of social research methods, was established as an engagement activity to monitor and advise technologists. For example, as shown in the report ‘Nanoscience and Nanotechnologies: Opportunities and Uncertainties’ (The Royal Society & The Royal Academy of Engineering, 2004), deliberations taking place among stakeholders and the public have been taken account of.

A number of ‘possible approaches to dialogue’ (ibid.: 64) were laid out in the report for gathering public attitudes towards Nanotechnology. Bearing in mind that ‘dialogue on nanotechnologies is likely to be taken forward over the next few years in a diversity of ways’ (ibid.: 67), people in 2004 had very limited knowledge about the capability of public engagement, especially at the level of investigating public opinions about

Nanotechnology for feeding the political decision-making process. At the time, there was a gradually expanding acceptance of Nanotechnology (Wilsdon and Willis, 2004) suggesting that real-time technology assessment had a good shot in Nanotechnology, which led scholars to conceptualise the concept ‘anticipatory governance of Nanotechnology’ (Guston and Sarewitz, 2002; Guston, 2007; Barben et al., 2008).

Around 2002, when the term anticipatory governance mainly referred to a government’s capacity for ‘foretelling the future and preparing for it’ (Mendoza and Gonzalez, 2002; Guston and Sarewitz, 2002), scholars remained ‘unselfconscious’ about the significance of public engagement, which was not clearly pointed out and articulated in the concept of anticipatory governance. This situation did not dramatically change until 2007, when Guston explicitly defined the term anticipatory governance as ‘the ability of a variety of stakeholders and the lay-public to prepare for the issues that NSE [nano-scale science and engineering] may present before those issues are manifest or reified in particular technologies’ (2007: 380), which first specified the idea of engagement in the context of anticipatory governance. However, the connotation of public engagement is rather vague in expression and, to some extent, focuses on some specific approaches, such as ‘opening the doors to previously closed expert forum[s]’ (Jasanoff, 2003: 238) and ‘giving non-specialists access to a range of different perspectives on a particular topic, and allowing them to develop their own recommendations through structured discussion’ (Nature, 2004: 883). In other words, public engagement was more frequently regarded as a method facilitating the governance of public concerns about Nanotechnology, but exclusive from the process of political decision-making. According to the framework of ‘engagement motivations’ given by Wilsdon and Willis (2004), the anticipatory governance of Nanotechnology was driven by the intention of ‘doing something right’ (a normative reason) and of ‘using engagement as an instrument for other purposes’ (an instrumental reason), instead of ‘improving the quality of decision-making’ (a substantive reason) (ibid.: 39), which might largely limit the effects of engagement activities in practice. Even though, that was only one step beyond the prosperity of public engagement in Nanotechnology.

Only one year later, Barben et al. (2008) offered an in-depth analysis on the anticipatory governance of Nanotechnology, and identified it as a convergence of three capacities, namely foresight, engagement and integration (these will be explored in greater detail in the following subsections). For now, these three capacities refer to: the ability to anticipate the implications of Nanotechnology over the long-term (foresight); the application of ‘dialogue-led public engagement’ (engagement) (House of Lords, 2000, cited in Holliman and Jensen, 2009: 36); and the cooperation between natural and social scientists (integration). Since then, the idea of public engagement has been treated as the core ingredient of anticipatory governance which endeavours to obtain public acceptance (Guston, 2014) and permeates into two other capacities (foresight and integration) at the same time. For instance, in response to the ‘fundamentally uncertain’ future of Nanotechnology (2008: 979), Barben and his colleagues argued that an ensemble of new assessment systems that ‘require the engagement of a variety of potential users and stakeholders in the production of knowledge’ (ibid.) were guiding the development and research of Nanotechnology, and were believed to benefit from the improvement of ‘sociotechnical outcomes’ in the near future (ibid.). Here, engagement activity was employed in a set of social research projects in Nanotechnology as the ‘distinct approaches to the longer-term implications of nanotechnologies’. Public deliberation and consensus conference could be seen as two typical formats of public engagement in practice (Barben, 2008: 985).

2.1.3.1 Foresight

Generally speaking, foresight lays the foundation of ‘future-oriented’ anticipatory governance by anticipating the future effects of today’s decision-making.

[F]oresight is a methodologically pluralist approach to plausible futures with an emphasis on such methods as scenario development that provide a more diverse and normative vision compared with

other methods that seek to identify a single, most likely future
(Barben et al., 2008 cited in Guston, 2014: 9)

Although interpreting the term in a different way given his different field of study, Leon S. Fuerth, former national security advisor under the former U.S. vice president Al Gore, expresses his belief in the profound implications of foresight by describing foresight as a method to stay ahead of events to ‘identify new challenges’ so that a meaningful and prospective strategy can be determined in advance for reacting to potential problems in the future. Similar to Barben et al.’s understanding of foresight above, Fuerth (2009: 16) states that foresight can also be treated as a capacity ‘to anticipate alternative futures, based on sensitivity to weak signals, and an ability to visualize their consequence, in the form of multiple possible outcomes’ (2009: 16). As a systematical capacity, foresight accepts that any possible scenarios may occur in the future and any long-term implications and consequences for present actions. Taking such a wide range of factors into account, according to Fuerth’s analysis foresight involves ‘hindsight, insight, topsight and prescience’ (2009: 10). Simply expressed, foresight requires reflecting on previous lessons and experiences (hindsight), a clear comprehension of oneself at the level of both individual and society as a whole (insight), an overall viewpoint which pays close attention to the interplay between the actors in the system (topsight), and finally, an ability to predict different future outcomes (prescience).

Rather than the criticisms of anticipatory governance which propose that it ‘vastly overstates’ the ways in which foresight can shape the future (Fuerth, 2009), foresight capacity is cultivatable based on past experience. An implications analysis on today’s decisions and their corresponding contingency measures aids ‘anticipating’, which enables the government to ‘shape’ and prepare for the oncoming future instead of relying on crisis management after a crisis happens. Barben et al. have discussed several distinct approaches of cultivating foresight capacity, such as ‘forecasting, public deliberation, scenario development, foresight and vision assessment’ (2008:985-986).

However, their study lacks a conceptual summary and feasibility analysis, even though several examples follow their interpretations. Extending the idea of foresight to a wider scope of ‘policy process’, Fuerth and Faber (2013) embed foresight into policymaking mechanisms and propose that an effective integrated system of foresight and policy should be institutionalised in following ways: creating a foresight ‘fusion cell’ (I will shortly return to this concept), paying attention to the connection between foresight and policy, introducing hypothetical-based assessment, and training the government in cultivating foresight.

Here, the foresight fusion cell mainly refers to an outward expansion from the relatively limited and individual horizons of decision-makers to the wider public (Fuerth et al., 2013: 44). A broad absorption of foresight information from the wider public is a good option for informing the policy process, because, as Fuerth et al. have realised (ibid.), the producers of foresight ‘do not necessarily think’ or behave ‘like policy makers’ (ibid.). So what the government needs to do is following ‘the stream of foresight information [...] as part of the data flow to officials’ (ibid.). In this case, social media are able to meet this requirement perfectly by constructing an ideal platform for the free expression and sharing of information, in principle.

2.1.3.2 Engagement

The engagement strategy involved in anticipatory governance refers to the prevalent model of science communication between scientists, governments and the public. As argued before, PES has gradually taken the place of PUS and become the mainstream approach advocated by scholars (Wilsdon et al., 2002; Macnaghten et al., 2005; Wooden, 2006). According to Barben et al.’s perspective (2008), engagement simply ‘refers to encouraging the substantive exchange of ideas among lay publics and between them and those who traditionally frame and set the agenda for, as well as conduct, scientific research’ (cited in Guston, 2014: 9). In other words, policymakers who participate in public engagement are required to take care that the opinions of the public are highly

respected by ensuring that their voices are heard and all opinions are taken into consideration. Any neglect or irresponsible ‘cherry picking feedback based on decisions already made’ (Jensen, 2011a: 8) may lead to a negative public reaction (possibly emotional) which in public engagement systems would be avoided. In addition, an upstream shift also occurs in science communication, requesting an effective move forward to the process of policymaking at a very early stage when the applications of emerging science and technology have not been marketed yet.

However, the reality of anticipatory governance is not perfect as expected. Fuerth et al.’s interpretation does not give due consideration to the model of engagement in comparison with the original concept given by Guston. In Fuerth’s description, open-minded idea exchanges between the policymakers and wider stakeholders (including the lay public as tax-payers) have been replaced by a ‘feedback system’ (2013: 41) aiming to ‘monitor and adjust policy relative to initial expectations’, which, according to Fuerth’s explanation, is supposed to be established and implemented within the structure of government instead of opening the doors to the wider public. Fuerth et al. provided a reason for this limitation: that given the complicated interactions taking place among interwoven departments within the Federal Government of the U.S., the government’s ability to deepen the level of public engagement is largely limited (2013: 49). Although lacking a convincing explanation, the problem Fuerth et al. mentions does indeed exist in practice. Even though the model of public engagement is prevalent in science governance, the implementation of engagement, or the evolution of science communication, in reality is facing endless difficulties, especially at a national level. However, this information does not mean that opening the policymaking process to the public remains unlikely. For instance, bypassing the traditional system of policymaking a third-party platform will help overcome the problem of engaging with the public as part of internal procedures. A third-party platform is partially independent from government control and enables free idea exchange among all members of society. Here, social media provide a platform to connect scientists, government and the public.

2.1.3.3 Integration

Among the three components of anticipatory governance, integration is directly beneficial for real-time technology assessment (Guston and Sarewitz, 2002; Barben et al., 2008) and further specifies approaches within the context of policymaking to enhance cooperation between the natural and social sciences. In Barben et al.'s words, integration refers to 'sociotechnical integration' in that it creates opportunities 'for substantive interchange' between science research and social processes to reflect on the long-term capabilities of technology in order to direct policymaking decisions (2008). For integration to occur science and technology research needs to be open to the social arena, so as to take a large number of societal issues into consideration. To expand the horizon of natural science involves striving for public understanding, public support, and pursuing higher social and business values of emerging technologies, such as GM.

For this to be possible natural scientists have to engage with an intricate social network at the earliest stage of research to gather insights that may pave the way for future development. The voices of social scientists are crucial for natural science when interacting with the public. Referring to GM technology as an example, a letter was issued to the prime minister of the UK in 2013 by the Council for Science and Technology (CST), outlining a wide range of societal issues relevant to the future of GM technology, such as environmental implications, public health, economic value assessments and humanitarian aid to ease human suffering due to poverty and hunger (CST, 21st Nov 2013). As a consequence of this letter assessments were carried out to anticipate the future implications of GM technology in relation to policymakers and public concerns. In this case, a creative form of integration occurred that is compared to 'laboratory' by Barben et al. (2008: 988), in which the cooperation between social and natural scientists takes place in a thoughtful and critical manner. Although approaches to integration vary a lot in form, engagement is always the core methodology which suggests that a tolerant, open-minded, and organised network is essential during research when assessing the future implications of emerging

technologies.

At a general level of policymaking, the so-called “whole picture” is comprised of integration exercises between different disciplines and institutional cooperation. Fuerth and Faber describe integration exercises as ‘networked governance’ aiming to ‘support whole-of-government planning and execution’ (2013: 45). Different from a vertically integrated administration structure, networked governance advocates horizontal integration between governmental agencies with the intention of shaping and pursuing common aims instead of working independently. In terms of Fuerth et al.’s explanation, every single step of policymaking should be formulated with concern for the ‘whole picture’ to take into account any possible contradictions occurring within the system (ibid.).

Nevertheless, changing from a vertical model to a horizontal one is not less complicated than any other institutional revolution or reconstruction attempted at a national level. As mentioned in Grubmüller et al.’s research (2013), one of the key steps moving from the vertical to the horizontal model is to ‘refer to diversified information portfolios’ (2013: 1), feeding evidence-based policymaking. This step involves sifting through a massive amount of information. The deducing of public opinion is a difficult task for governments, who govern their states within a strict political system, which is unlikely to be easily altered. Therefore, the application of an external platform to realise the challenges of such integration work is an effective way to extend the vision of policymakers, theoretically. On this occasion, social media becomes an ideal option for understanding a diversification of opinion in the public sphere, and provides opportunity for possible integration within an environment free of governmental intervention.

2.1.4 Improvements and challenges facing anticipatory governance

Initially launched in the Nanotechnology industry, anticipatory governance turns out to

also be a successful model for science governance. Not only due to the advanced consciousness seeing ahead of the matters at hand presents, but also the wide range of technological areas that anticipatory governance could be applied to as an approach for facilitating the formulation of public policy. In other words, overstepping the boundary of Nanotechnology, and even exceeding a science and technology context, anticipatory governance has been identified as a practical plan (Fuerth, 2009), or at least a powerful alternative strategy, to deal with policymaking issues. Theoretical advancement is also visible. For example, alongside the concept of anticipatory governance is the idea of upstream engagement, which is embraced in the connotation of engagement capacity.

Returning to the lineage of public engagement, and echoing the criticism that public engagement is lagging after public relation risks happen (Joly et al., 2008: 4), the idea of ‘upstream engagement’ promises that ‘scientists, academics and political decision-makers are trying to find ways to engage the public meaningfully in very early stages of research and development’ (NCCPE, year unspecified). In Barben et al.’s argument, the engagement process of Nanotechnology takes place ‘when they (the public) have very little substantive knowledge of the issues’ (2008: 987). It seems that opening up a nano-debate to the public at inchoate ‘premarket stages’ (Barben et al., 2008: 983) has illustrated that engagement should be put into practice straight away at the ‘very early stages of research and development’. He reasoned against public relation actions which lagged passively behind delaing with public opinion risks, instead insisting that being transparent enables the public to have a say on futures/issues.

A range of reflections on the implementation and the performance of upstream engagement in Nanotechnology have closely followed. Reseachers are trying to figure out an exact answer to the question ‘are engagement processes enough’ (Wildson et al., 2004; Rogers-Hayden et al., 2007; Joly et al., 2008). Joly and Kaufmann’s assessment on conferring with the public about Nanotechnology is a good example of reflection. In their words, although few question the significance of upstream engagement to the whole enterprise of science and technology, engagement is hard to implement in reality.

After analysing a public conference in Grenoble, France, they deemed that participatory activities did not entirely breakaway from a ‘public education’ model, at least in the case they examined. The conference occurred under a framework of public engagement in the format of a consensus conference, despite this no initiatives or responses were observed by the lay public, in most instances, that indicated how their voices could be used for decision-making (2008: 17). According to Joly et al.’s survey, the main objecting voice to opening up decision-making procedures to the public came from local policymakers who insisted that ‘public participation should aim at educating laypeople and fostering acceptance of the Nanotechnology projects’. The local policymakers’ attitudes were criticised by Joly et al. in their work (2008: 15).

If we borrow Wilsdon and Willis’s framework of engagement motivation again to aid our analysis of the literature, it could be said that the problem of implementation may result in an insitutional misuse of upsteam engagement, which will degrade the process into a formalistic step that the policymakers tick when drawing up a new rule, but will in essence end up as a public education exercise rather than public engagement, and for this reason, make no difference to science’s communication model or the quality of decision-making owing to a lack of public engagement aimed at improving social outcomes in a deeper sense, which is essential to a dynamic upstream engagement process. In other words, a successful engagement activity highly depends on how much initiative is held by the lay public in the decision-making process, instead of a public debate that the final outcome is a vacuum environment which fails to engage (Wilsdon et al., 2004).

Nevertheless, such a blind spot in public engagement cannot entirely deny the contributions made by upstream engagement (Joly et al., 2008). It is high time for social scientists to consider how to integrate the ‘microcosm of engagement’ into wider, institutional interactions to maximise the influences of public engagement. After exploring the history of public engagement in Nanotechnology, I realise that there is an absence of media performance in the theoretical framework of anticipatory governance.

Neither mass media, defined as the primary source of scientific issues received by the public (Nelkin, 1987), nor the communication effects of them have been ever discussed within the context of anticipatory governance. In other words, the scholars of anticipatory governance (Barben et al., 2008; Guston, 2000, 2008) observing the interactions between the public, scientists and governments, mainly concentrate on the performance of political communication and neglect the powerful effects of social media in promoting PES, which leaves a blank area for this thesis to further investigate. Regarding Joly and Kaufmann's reflection, the initiative given to the lay public, which is lacking in traditional public engagement exercises, is likely to be composed of by social media. Generally, I argue that anticipatory governance, including specific sub-capacities, is likely to benefit from mass media involvement, especially Internet-based social media.

In addition to reflecting on the realities of public engagement, a doubt has arisen concerning the necessity of anticipation when researchers are faced with an unpredictable future. Since the beginning of the 21st century, responsible innovation has been introduced and praised as a positive reaction to the rapidly changing world of science and technology (Fuller, 2018). Regarding the notion of responsible innovation, creativity and opportunities are promoted to encourage the development of science and emerging innovations that 'are socially desirable and undertaken in the public interest' (EPSRC, 2018). Targeting the same purpose of responsible innovation, anticipatory governance has generally been regarded as a cornerstone strategy, which operates based on a precautionary principle which anticipates any possible consequences, and mitigates the negative ones at all costs—even including completely abandoning the innovation due to the potential harm it may cause (Fuller, 2018). Researchers, like Fuller (2018) and Nordmann (2014), reflect on this precautionary principle approach to risk, and discuss whether being 'risk-averse' is the only attitude that we can exploit, in response to an uncertain future (Fuller, 2018: 3).

Regarding anticipating an uncertain future, Nordmann (2014) raises a rather extreme

argument that the future could never, and need not, be predicted. He believes that anticipation could hardly prepare us for the future in a true sense because accidents can happen even if people can anticipate the future. While Fuller does not completely agree with Nordmann's view that the future is uncertain, he proposes 'precipitatory governance'—an alternative means of science governance regarding the attitude toward risk—and argues that rather than putting too much effort into anticipating what might happen, it is more effective to respond positively to inevitable risks by 'deriving the most good from it' (Fuller, 2018: 1). To derive the most "good" means that 'the prospect of major harm may itself provide an opportunity to develop innovations' (Fuller, 2013: 1). Digging out the potential benefit from apparent harm and then exploiting it is believed to be a significant component of precipitatory governance (Fuller, 2018: 3). In addition to that, Guston's opinion towards 'foresight capacity' (2014) is also challenged by Fuller (2018: 3), who asserts that a real foresight strategy should extend the responsibility range of innovation from the present into the long-term future. Fuller identifies precipitatory governance as a proactionary principle serving responsible innovation, and stresses that precipitatory and anticipatory governance have completely different attitudes towards risk.

In terms of Fuller's interpretation, precipitatory governance differs from anticipatory governance by assuming that a bad outcome will happen, and thinking in terms of what opportunities are opened up by it for innovation purposes (2008). It does not matter whether the risk happens. In contrast, anticipatory governance is so preoccupied with preventing bad outcomes that it may inhibit the innovation process altogether. No doubt, Fuller's reconsideration of the government's attitude towards an uncertain future, triggers the alarm that people are unlikely to completely take control of the risks. However, I argue that it is not appropriate to consider precipitatory governance in opposition to anticipatory governance as there is no absolutely opposite claim between these two notions. The proactive principle raised by Fuller represents an advance in our knowledge about future and uncertainty, which, however, is still established on the basis of grasping possible consequences through anticipation. In the social media landscape,

the diversity of opinions related to the future of emerging technologies, like GMOs, is still believed to provide benefits. Whether the government should respond to the results of anticipation proactively is then a core question that policymakers should concern themselves with after consulting the outputs of public engagement.

2.2 Science governance in the Digital Age

Built on the technical foundation of Web 2.0, social media refer to a diversity of Internet-based applications, technologies and platforms, enabling free interaction and creating online communities. As mentioned by Masthoff et al. (2012), social media are community-based, as the members of communities are allowed to build up and maintain relationships, share and exchange information, and express personal ideas by creating user-generated content. Within the context of social media, messages are spread through a network structure (many-to-many), which speeds up the diffusion of information and extends the range of information delivery. Soon after the establishment of a social media communication model, there was a prosperity of user-generated content in volume and diversity (Berkovsky et al., 2012:1), which makes social media a source of information, feeding the development needs of a high-speed information society. In addition to that, the remarkable growth of social media has been given extensive attention, whilst the potential of social media in ‘education, outreach and member recruitment’ in a broader range of social life has been clearly realised. As pointed out by Berkovsky et al. (2012), having ‘no foreseen limits to the growth and diversity of the content on social media’ (2012: 1), and after nearly 13 years of improvement since 2004 (Wirtz et al., 2010), the value of social media is not only a way of socialising but a supportive and analytical tool for exploring behavioural activities and social changes in modern society. For instance, Grubmüller et al.’s research (2013) highlights the political potential of social media as an instrument for E-government, enabling policymakers to deduce trends in public opinion and to foresee likely changes or potential risks in the future use of technology. Claussen et al.’s survey on the online engagement activities of the American Fisheries Society concludes that social media

have become the major site and channel of science communication under a mainstream climate of PES (2013). Therefore, with regard to anticipatory governance, social media should play a significant role in promoting engagement exercises, which, however, was not mentioned in previous researches.

2.2.1 Social media and science communication: A bridge between science and the public

If scientists could communicate more in their own voices—in a familiar tone, with a less specialized vocabulary—would a wide range of people understand them better? Would their work be better understood by the general public, policy makers, funders, and, even in some cases, other scientists? (Alan Alda, 2010: 10)

The words of Alan Alda indicate one of the core issues of science communication that scientists are confronted with: how and in what way can scientists effectively communicate scientific issues to the lay public, as well as to various stakeholders, without unnecessary obstacles of expression and understanding. Social media provide a way to break barriers to communication by connecting communicators to receivers in a context of equal dialogue. The metaphor of a bridge in the heading of this section has been frequently used to describe the significant function of mass media in science communication. According to Gregory et al.'s introduction (1998: 1), the popularisation of science and technology has become an inevitable trend for the scientific community due to a number of reasons, such as the need to seek funding support and influence political initiatives. Scientists thus required an effective actor to narrow the cognitive gap between scientists and the lay public or, alternatively, a mediator to establish a bridge of communication over the divide. Given the significant role of media as 'the public's primary sources of information about science and technology' (Dudo et al., 2011: 56), mass media platforms are committed to facilitating communication and promoting a 'public understanding of science and technology' (Nelkin, 1987: 2). As

Dudo et al. argue in their work (2011), the preeminent performance of mass media in portraying public issues and shaping public perception toward the world has been widely acknowledged. As a bridge between science and the public, mass media are able to uncover scientific issues as they are perceived by the public, and portray science with specialised techniques, such as setting an attribute agenda (McCombs et al., 1972) and framing ideas (Entman, 1993), so as to shape or reshape the public's opinion toward science and technology.

Inheriting most of the basic functions of mass media, such as transmitting cultural norms and influencing public opinion, social media have grown up to a vital site for promoting PES. With the widespread application of the Internet, social media—defined as ‘forms of electronic communication that allow users to form online communities to share information, ideas, personal messages and other content’ (Lewis, 2014: 89)—have gradually replaced traditional media as ‘the most popular source of science information’ (Horrigan, 20th Nov. 2006). The basic functions of social media, such as ‘absorbing information, sharing information and engaging with others’ (Lewis, 2014: 89), have fundamentally changed the ‘one-way’ flow of information into a public engagement model that incorporates two-way science communication. Within the context of social media, members of the public who have an interest in scientific issues are given access to scientists who were previously considered mysterious or distanced from the crowd. By creating user-generated content on social media, scientists are able to express, explain, and argue over scientific issues, which in their own words are much more accessible and trustworthy to the lay public (Stafford et al., 2012: 489; Masthoff et al., 2012).

In addition, communication between experts, either from the same or different disciplines, also takes place on social media, which happens to be another way of shortening the distance between scientific discussion and the lay public due to the open and collective environment of discussion forums that are created for people of all qualifications to participate in (Masthoff et al., 2012; Berkovsky et al., 2012). The high

volume and the remarkable diversity of information to be found on social media creates explanations on scientific issues at all levels—from profound theories to bullet-point news summaries (Stafford et al., 2012: 489-490). Information is accessible to the general public. According to Bik et al.’s interpretations (2013), the availability of social media speeds up the pace of science communication, ‘both within scientific communities and with the general public’ (Darling et al., 2013: 3). Social media-based ecosystems, such as microblogs (Twitter, Weibo) and professional networking sites (ResearchGate, LinkedIn), enable scholars to share their work (the primary sources of scientific literature) with the public and, in many cases, encourage dialogue-led engagement online. Thus, it is reasonable to argue that as a typical carrier of public engagement, social media are able to support anticipatory governance by providing a forum where interaction can occur, and by portraying the prospects of science and technology.

2.2.2 A digital divide: The limited representativeness of social media

However, before giving high hopes to social media, it is worth considering who science communication work should initiate their dialogue with. Although the theoretical arguments and reasoning suggest social media as an effective instrument of science communication, the reality of social media in science communication has never been as perfect as expected (Norris, 2002). Any behaviour, response, or opinions revealed on social media can only come from those who are engaged and are able to engage online; instead of being representative to the whole population online discussion creates a digital divide because of unequal access to Internet across the world (Jensen, 2015).

According to Norris’s research on worldwide disparities in Internet usage, a ‘digital divide’ is understood by what opportunities people have between different regional and social groups, and even what purposes the Internet is used for. Unsurprisingly these opportunities are unequal thereby causing a digital divide. More specifically, three categories of divisions are mentioned: global, social and democratic (2002: 4-14). First,

on a global scale, due to the disparities between equal Internet access in industrialised and developing countries, a regional division generates a widening gap between information-rich and information-poor countries. This gap strengthens the leading role of developed countries in information technology and leaves less-developed areas even further behind. Second, with respect to the internal structure of society, Internet access varies substantially across social groups. For instance, disparities of Internet use exist between high and low-income households, males and females, younger and older generations, urban and rural residents, and also among disadvantaged groups, such as groups with visual disorder problems (2002: 10). Third, regarding making use of the Internet as a political resource, Norris pointed out that a democratic divide is visible in the Digital Age because very few Internet users participate in political activities. In other words, although social media, or the Internet as a whole, are often used as a political resource to achieve ‘public support and to influence policy process’ (Norris, 2002: 13), inequality is generated between the minority who make use of Internet resources as a means of political engagement and the majority who do not.

Divisions of inequality are depicted in numerous research on Internet use (Norris, 2002; Min, 2010; Jensen, 2015) and affects public life in an information society, which is impossible to ignore. It is notable that the technological improvement of information receiving devices, such as smartphones and tablets, have widened people’s day-to-day access to the Internet and, to a lesser extent, may diminish disparity gaps in Internet use between different social groups (Part and Lee, 2015: 80). However, following the popularity of new devices a new divide is generated between device owners and non-device owners, so that although people may have alternative access to the Internet, like broadband, the divide may result from any innovative way of using Internet attached on new devices. Similarly, the use of social media generates inequality between the registered users and non-users, in regards to certain special privilege exclusive to registered users, such as the abolishment of word limit for registered Weibo users. Hence, the limited representativeness of social media resources becomes an essential point to bear in mind for policymakers or scientists wanting to engage the public.

2.2.3 The role of social media in anticipatory governance

As mentioned above, the significant role of social media in science communication has been widely realised. However, with respect to the analytical emphasis of previous studies, two directions are apparent: the strategies of science communication (Arias, 2004; Dudo, Dunwoody and Scheufele, 2011; Friedman and Egolf, 2011; Luzón, 2013) and the relationship between media (including media staff such as journalists) and scientists (Peters, 1995; Colson, 2011; Liang et al., 2014). Among these works, only a handful refer to the social media arena (Colson, 2011; Luzón, 2013; Liang et al., 2014), not to mention the evaluation of social media through the lens of anticipatory governance.

In science communication research on social media sites, in many cases, social media are regarded as an effort to complement traditional media practices, thus the potential of social media in individually promoting public engagement is not yet fully developed. For example, Vinciane Colson, a Belgian scholar, explores the performance of science blogs in disseminating science news (2011) and concludes that although science blogs have been identified as a competent channel for science communication, the relatively ‘less serious and rigorous’ (2011: 901) presentations given on science blogs may reduce the credibility of science information posted online, so the public prefers to rely on the news sources from traditional media instead of ‘informal’ ones. This audience bias towards traditional news sources is likely to impede social media from fully releasing the online potential of science communication. Considering science blogs, Luzón investigates ‘the strategies used by bloggers to communicate and recontextualize scientific discourses’ (2013: 429). Luzón’s research (2013) demonstrates that an increasing number of scientists apply new media techniques to communicate with both peers and the lay public, the effects brought by this new model of science communication are still left inexplicit. In summary, science communication research on social media sites is quite limited in both depth and width.

Regarding the field of anticipatory governance, as I have mentioned in Section 2.2, although countless communication theories and previous studies support the strong potential of social media as a facilitator between the public and those working in the fields of science and technology, not even one case of empirical research connects social media's performance to anticipatory governance. There is a noticeable absence of media-related views in interpretations of anticipatory governance, which illustrates the gap this thesis fills. On the basis of numerous existing research outcomes, the three capacities of anticipatory governance have been labelled with the features of the Digital Age: foresight, engagement and integration. Within the context of social media, 'foresight' refers to forward-looking and long-term implication-related content emerging on social media. 'Engagement' is a set of specific behaviours carrying out public participation activities on social media platform, responding to the advocacy of PES. 'Integration' involves discussants from all walks of life during a public debate which takes into account the remarkable diversity of opinions circulating on social media.

By interpreting the capacities of anticipatory governance in a social media environment, the present research explores social media practices, especially online engagement activities, for identifying the specific performance of social media in promoting GM related discussion and then contrasting this information to the original three concepts summarised in the paragraph above. Comparing the measurable performance of 'foresight' and 'integration' in digital environment, public engagement turns out to be a sophisticated concept encompassing numerous features and dimensions. As Sarah Davies mentioned in her research about the ways scientists adopted different science communication methods (2008), public engagement cannot be interpreted or examined using a single notion. Therefore, a theoretical framework of engagement, embracing various features of engagement practice, will be outlined in Section 2.3 for identifying engagement activities in a deeper sense.

2.2.4 Twitter and Sina Weibo: Supportive forums for anticipatory governance

Among the numerous social media services prevailing in the Digital Age, microblogging is a successful online service that enables registered users ‘to follow other users and/or broadcast their own character-limited posts (140 characters per message) called tweets’ (Berkovsky et al., 2012: 3). As one of the most popular world-wide microblog brands, Twitter has become a major free site for science relevant conversation to take place (ibid.). Across the Pacific Ocean, Sina Weibo (Weibo hereafter), the Chinese version of Twitter, which, however, has reached the same scale with only half of the time that Twitter spent (Xia, 2013: 3). Nowadays, Twitter has 328 million MAUs (monthly active users) around the world in terms of the earnings report of the 1st quarter 2017 (Twitter, 8th Feb 2018), while Weibo exceeded 300 million in 2012 thanks to the huge available market in China. These statistics clearly indicate Weibo’s strong potential to become an influential platform for public engagement in China.

Since the first launch of Twitter in 2006, an increasing number of research efforts have focused on the potential of microblogs for changing the ways in which people communicate in contemporary society. Unlike other social media services, such as Facebook and Renren (a Chinese Facebook-like service), which operate on the basis of a semi-closed social network where user-generated content is only visible to ‘followers’, who have certain existing social connections in the real world, microblogging networks are no longer formed by offline relationships (Xia, 2013: 7; Naaman et al., 2011). Instead, information on Twitter and Weibo is accessible to all registered users of the platform; following is free of permission on microblogs, which means that people can maintain offline relationships through interactive communication online and some new connections between strangers form, which could hardly be achieved in reality, such as directly interacting with celebrities, public figures, opinion leaders and scientists. In this way, Twitter and Weibo have become a functional aspect of maintaining and creating social connectivity (Xia, 2013) with the assistance of ‘two-way’

communication, at least for those that use and frequently engage with these social networks.

In Naaman et al.'s research on 'characterizing emerging trends of Twitter' (2011: 901), microblogging is described as an 'ever-updated live image of society', which to some extent reflects real situations happening outside of the digital world. Thanks to the creation of Internet-based networks and their interactive functions, a new dominant form of information dissemination called content sharing has arisen on microblogs (The New York Times, 13th June 2011; Choi, 2015). Different from the traditional mass media which put emphasis on creating content, the behaviour of sharing information, either original or forwarded, characterises the interactive communication model of microblogging (The New York Times, 13th June 2011).

In 2011, comprehensive research on the motivation of content sharing on social media was taken by The New York Times. The results showed that users contribute what they consider as valuable with the desire to improve the lives of people that they care about, and this motivation mainly drives the behaviour of content sharing on microblogs. The feeling of self-fulfilment achieved after forwarding perceived valuable information to someone users' care about is a motive for sharing. Additionally, the researchers found that a considerable proportion of respondents were motivated by curiosity about 'the causes of something they care about' (The New York Times, 13th June 2011: 6). Apart from the aforementioned intention of creating and maintaining social connection, another explanation for passionate context sharing is to shape or reshape personal identity (ibid.). Whatever the purpose of content sharing, the interactive communication model of microblogs has been shifting the manner in which people produce and consume information in the Digital Age (Naaman, 2011: 902; The New York Times, 13th June 2011).

With a gradually in-depth understanding of social media, the capacity of Twitter and Weibo in promoting science communication has been realised and given due attention;

not only by carrying out scientific discussion, but also in providing analytical tools to academic researchers for investigating human cognition and online behavior. Stafford and Bell's research shows that scientists are increasingly using social media, Twitter in particular, as a platform to engage with their colleagues and others (2012: 490). Through a visual analytic approach, Uren and Dadzie (2015: 350) concluded that Twitter is capable of affecting the dynamic of less popular science topics through framing work. Besides, the influence of Twitter on the scientific discussion is longitudinal, which leads to 'the development of the debates' (ibid.) taking place on social media. The developments of these debates are very important in my argument for policymakers using them as a resource of public voice.

Turning from single-platform analysis to a comparative approach, there has been apparent increasing research interest in the comparison between Twitter and Weibo regarding their multi-dimensional features recently (Chen et al., 2011; Titangos, 2013; Xia, 2013; Lin, 2016). Representing the most popular microblogging services in English and Chinese, Twitter and Weibo demonstrate high similarities in their mode of operation, including their basic functions, commercial model and means of income. However, existing comparative research has not yet taken the product value of social media into consideration. For example, comparing the political potential of Twitter and Weibo, which is supposed to make difference to decision-making issues, remains a brand-new topic for analysis. Against different social, cultural and political backdrops, the value of Weibo in a political dimension is likely to differ from Twitter. Additionally, as mentioned in Section 2.2, the idea of anticipatory governance remains an emerging belief in social media research field; while media-related analysis is not yet available within the framework of anticipatory governance.

In summary, the prominence of digital technology has provided an alternative route for science governance to take, in which social media have played a significant role. Building a connection between science issues and the lay public, social media, Twitter and Weibo in particular, are committed to facilitating science communication through

a ‘two-way’ dialogue model, which at the same time, is shifting the manner of producing and consuming information in contemporary society. On one hand, media-relevant research is still an undeveloped area in anticipatory governance theory, which does not mean that the role of social media is ignored. On the contrary, social media are crucial to the implementation of anticipatory governance, delivering outstanding performance in promoting public engagement. On the other hand, most of the comparative studies on Twitter and Weibo remain at a simple level instead of considering product value and social implication.

With respect to the present research, the role of Twitter and Weibo in science governance, which refers to the political and social potential of social media in contemporary society, will be explored. The comparison taking place between Twitter and Weibo is designed to give an insight into whether the roles of social media in supporting anticipatory governance differ from each other under two distinct social backgrounds. In my research, anticipatory governance is understood as a successful means of making full use of social science methods to benefit the natural sciences. The major capacities of anticipatory governance (foresight, engagement and integration) have been elaborated on in relation to the digital world. In doing so, foresight is supposed to characterise anticipatory governance as a ‘forward-looking’ and ‘self-governing’ capacity (Guston, 2009); while, engagement, the core idea of anticipatory governance, can be seen as an echo to the mainstream model of science communication that realized the importance of public opinion. Also, involving a wide range of discussants in conversations to share their diverse opinions indicates the ‘integration’ capacity of anticipatory governance on social media. Among these three capacities of anticipatory governance, engagement exercises taking place on social media will be given extra attention in the present research due to the theoretical match between the engagement needs of science governance and functions supporting engagement activities provided by social media, and also the significant role of social media in science communication as indicated in previous studies (Horrigan, 20th Nov. 2006; Masthoff et al., 2012; Berkovsky et al., 2012; Stafford et al., 2012; Lewis, 2014).

In the next section, I am going to embed the engagement capacity of anticipatory governance in the conceptual framework of PES, before proceeding to identify the role of social media in the process of public participation. This will clarify the vague association between anticipatory governance and social media performance. A series of sociological and communication theories, including ‘the third-order thinking in science communication’ (Irwin, 2014), the two-step flow of communication (Katz et al., 1955; Choi, 2016), public intellectuals (Jacoby, 1987; Boudieu, 1991; Posner, 2003) and sub-politics (Beck, 1992), will be applied to underpin the reasonability that social media contribute to anticipatory governance through public engagement activities and by other means of shaping future-related issues to the public. Following the theoretical framework (Section 2.3), the previous studies of GM issues in media context will be overviewed.

2.3 Interpreting ‘public engagement’: The theoretical framework

As an emerging theoretical concept of science governance, anticipatory governance has shown great potential and considerable political value in government decision-making during times of high uncertainty (Quay, 2010: 496). Described as a strategy for coping with the unknown risks and of an uncertain future, anticipatory governance is pursued through three approaches, namely foresight, engagement and integration, which are also believed to be the core components of anticipatory governance in practice. With respect to engagement, Barben et al. (2008) have mentioned several specific cases in Europe and the USA, and tried to make sense of this format of communication between scientists and the public. Further to Barben et al.’s outcomes, Guston (2014) interpreted engagement as ‘encouraging the substantive exchange of ideas among lay publics and between them and those who traditionally frame and set the agenda for, as well as conduct, scientific research’ (2014: 9). Guston’s definition, however, still focuses on the specific manifestations of engagement instead of conducting a rigorous conceptualisation. Guston provided several cases of engagement that occur in Europe

and the USA but didn't give a definition of engagement capacity involved in the framework of anticipatory governance.

According to the explanation given by Guston (2014), 'engagement capacity' involved in anticipatory governance refers to the notion of 'public engagement of science', which is highly praised as the mainstream model most used in contemporary science communication affairs. Within the context of social media, a structured framework embracing both engagement-relevant theories and up-to-date research outcomes works for gaining a better understanding of the opportunities and limitations of social media for supporting anticipatory governance. Before outlining the structure of the theoretical framework of this study, this section provides a detailed description of the major arguments of five, related, science communication theories.

2.3.1 Third-order thinking

'Third-order' thinking was a term put forward by Alan Irwin (2008: 199-212) to depict a host of science communication and risk management issues against the backdrop of PUS—public understanding of science was the dominant model of science communication at the time (Nelkin, 1987; Wynne, 1995; Hagendijk et al., 2005) and was transitioning to PES, in which 'two-way' dialogue between science and society is given greater emphasis (Wilsdon et al., 2004; Irwin, 2008). After briefly summarizing the public engagement methods taking place in Europe, Irwin established a theoretical framework by clarifying the features of three different modes, 'orders', of science communication and elaborating on the connections between orders within the context of science governance.

First-order-thinking suggests an initial awareness of the risks stemming from the development of socio-technology. Referring to the BSE scare in the UK as an example, Irwin (2008: 203) pointed out four characteristics apparent in the way the UK

government responded to the risk. These four characteristics reveal the problems of a ‘top-down’ model of communication. Known as ‘Britain’s biggest public health scandal’ (Ahmed et al., 29th Oct. 2000), when BSE was first diagnosed by scientific experts internal governmental advisors recommended a cautious approach. The government communicated the incident as a scientific issue, stressing, with a tone of certainty, that science is trustworthy and people should listen to the experts. (Irwin, 2008: 203). Scientists are highly valued in a first-order culture where a government is committed to making rational choices based heavily on scientists’ perspective (Davies, et al., 2016: 225; Irwin, 2008). In this instance, the government attempted to “protect” people but did not offer any chance of consulting or questioning (Irwin, 2008: 203). Science-centred claims given by the government became the dominant voice throughout the event. In contrast, opinions from a grass-roots level were rarely drawn on. Unsurprisingly, with the escalation of events, the credibility of the government, alongside the meat industry in the UK, was damaged when this news came out. A majority of the public then disagreed with the judgements made by the government concerning the nature of the risk and the way in which information was controlled. At this point, the first-order model of science communication became ‘deficit’ due to the over emphasis given to the deficit scientific knowledge of public (Irwin, 2008) and then proved to be unsuccessful (Wynne, 1995; Wooden, 2006; Irwin, 2008), which implies an urgent request of a new approach resolving the problems left behind by the first order model and creating a mutually favourable relationship between science and society.

Drawing lessons from the BSE scare, since then the UK government has advocated transparency as the mainstream approach for science communication (Irwin, 2008: 205). Meanwhile, the government began to acknowledge that the public should be given more trust and respect when risks and controversial issues arose. Thus, their one-way communication model transitioned into ‘two-way’ engagement. Public engagement was considered as a new form of democratic accountability, as it brought the scientific community and lay-people into equal dialogue with mutual trust and respect (Irwin,

2008; Davies, et al., 2016). Such accountability contributed to science-related risk governance, and also made policymakers change government practices.

The transition from the first-order model to the second-order model does not refer to a well-defined historical replacement in which the deficit model inevitably gave way to the new engagement approach. Although Irwin uses the term ‘order’ to describe the connection between models, first-order practices were not completely abandoned due to well-established theoretical and political biases (Irwin, 2008: 205). A co-existence of the two models is regarded as a normative strategy of science communication in Irwin’s theory. The choice about which model to follow depends on the complexity of the circumstance involved (ibid.). That is Irwin’s main argument about ‘third-order thinking’. Rather than creating a new form of scientific governance, or investigating the most suitable way to resolve problems of the first- and the second-order models, a third-order perspective critically reflects on socio-technical changes within a broader spectrum of sociological issues. Taking a full range of relevant societal dimensions into consideration, and also a clear awareness of the strength and weakness of the applied model, the third-order case of communication requires a flexible strategy, ‘multiply-framed, contextual and contended’ (Grand et al., 2010: 3), mixing two-way dialogue with a government’s guidance and accountability.

Irwin’s perspective about third-order thinking was understood by Grand et al. (2010) as an outstanding interpretation of the ‘upstream’ movement of public engagement (Stilgoe and Wilsdon, 2009), reflective of ‘the nature of the research process—dynamic, uncertain and tentative’ (2010: 3). Holliman et al. (2009) described upstream movement as an emerging ‘social contract’ enacted by socio-technology and the society (2009: 3). Holliman et al. (2009) argue that to apply a model of upstream PES all involved parties are required to ‘revise and/or extend their routine practices of science communication to meet the requirements of a more demanding agenda’ (Holliman et al., 2009: 3), which

was achievable through an in-depth explanation of the nature of the third-order thinking, including the corresponding model of science governance and the sociotechnical challenges of each order. With this in mind, based on Irwin's theory Wakeford (2009: 90) extends third-order thinking from the theoretical to the practical level by identifying and classifying the 'complex problems that science communication techniques are attempting to address'. Wakeford also refers to Robin Holt's analysis on the key factors of risk management. Scientific issues are complicated, climate change for example, 'D[ifferent] people see the problem from divergent perspectives. These people may then set up strategies based on different mental models' (Wakeford, 2009: 91). Even though there has been a proliferation 'two-way' dialogue on a theoretical level over the past ten years, numerous researchers attempt to measure and question how, and to which degree, the transformation from a 'deficit' to a 'dialogue' order has occurred (Sturgis et al., 2004; Lezaun et al., 2007; Davis, 2008; Chilvers, 2010; Jensen et al., 2016).

As early as 2004, when the first wave of public engagement had surged into the scientific communication landscape, some scholars, such as Sturgis and Allum (2004: 58), questioned the shifting emphasis of communication, which had transitioned from scientific one-way knowledge towards two-way dialogue (Jensen et al., 2016:19). Sturgis and Allum have acknowledged that the over-simplistic deficit model of communication is problematic. In their research, they reached the conclusion that the the significance of scientific knowledge could never be ignored by either governments or scientists, even though scientific knowledge does not have a straightforward linear effect (2004: 67). However, they also realised that a contextual perspective involving a wide range of knowledge and societal issues is required to facilitate communication between science and society (2004: 68). Unsurprisingly, Irwin's theory of third-order thinking has explained the confusion, caused by the contradiction that scientific knowledge has influence but not a straightforward linear one on the general public, raised by Sturgis and Allum.

Moving away from theoretical arguments to an empirical study on the practice of science engagement, Dr Jason Chilvers mapped out the ‘sustainability’ of public dialogue on science and technology (2010). In Chilvers’ work, the specific roles of different participants engaged in public dialogue—including researchers and experts, practitioners and policymakers, and the relations between them—are explored through a series of intensive interviews. The research gains an insight into the notion of public dialogue expertise, which has drawn ‘little scholarly and practical attention’ (2010: 26), and therefore is insufficiently exercised by practitioners, affecting the quality of public dialogue in practice (2010: 28).

Paying the same attention to the practice of public dialogue, Jensen and Holliman (2016) conducted analytical research on how Irwin’s perspective of third-order thinking was ‘translated into a real change in the guiding principles and practice of UK science engagement’ (2016: 1). They concluded that first-order values still dominate science communication, even though evidence of model shifting, from one-way to two-way dialogue, is witnessed. Hence, order transition remains at a very limited scale, where only a few participants have ever experienced the second or third model of engagement. Although the finding that the minority of practitioners are experiencing second-order engagement has illustrated that public engagement models have changed, comparing the situation to 10 years ago, there are obstacles towards adopting second- and third-order approaches in science engagement, such as insufficient economic input from governments and a lack of training sessions for scientists and policymakers focusing on the use of personal skills in engagement exercises (Jensen, 2016).

The dominant role of the first-order model is also witnessed by Davies (2008) in her work identifying the approaches applied by scientists and engineers participating in science communication. Through an in-depth interpretation of scientific talks taking place between experts and the public, Davies concluded that ‘there is not one

straightforward notion of what “public engagement” should involve, but rather diversity, flexibility, and disjunction’ (2008: 415), which also further suggests that the approach to examining the performance of public engagement is never simple and straightforward, while ‘diversity, flexibility, and disjunction’ are merely the tip of the science communication iceberg. Apart from an innovative interpretation on the revolution process of science communication (Irwin, 2008), further work is required on public engagement practices, to conceptualise the sub-categories involved and a more effective way of better understanding the nature of public engagement, as what has been done in Nabatchi and Leighninger’s work (2015).

2.3.2 Thick, thin and conventional public engagement

Switching from a longitudinal perspective (the historical development of public engagement theory) and instead tracing the transition of the science communication model to a horizontal angle, American scholars Nabatchi and Leighninger (2015) put forward a taxonomy of public engagement embracing three categories of participation practices, which are supposed to cover a full range of recognisable engagement exercises. In order to examine the ‘quality’ and the ‘potential’ of public engagement in contemporary society (2015: 13), Nabatchi and Leighninger first of all broaden the concept of public participation by describing it as an ‘umbrella term’ under which ‘the activities by which people’s concerns, needs, interests, and values are incorporated into decisions and actions on public matters and issues’ are organised or naturally occurring (2015:14). Therefore, a variety of forms of participation happening in different contexts are involved in the scope of research. After clarifying the range of the study, Nabatchi and Leighninger creatively classify the various forms of engagement into three categories, namely thick participation, thin participation and conventional participation, in terms of the features underlying engagement practices, which are also treated as the criteria for assessing the potential of engagement (2015: 14-23).

Specifically, in Nabatchi and Leighninger's perspective 'thick participation' refers to a well-organised form of public engagement that 'enables large numbers of people, working in small groups (usually five to fifteen per group), to learn, decide, and act' (2015: 14), like deliberation but with a simpler 'action planning' in practice (ibid.). It is clear that within the context of thick participation, sufficient space for 'two-way' dialogue about public issues is given to participants so as to guarantee the dynamic of participation (2015:16). The well-constructed flow of 'thick participation' activity clearly outlines the sub-theme of each section: pre-activity secures the involvement of multiple societal dimensions into the topic being deliberation (ibid.), while a post-activity report provides a response to all the participants as a reimbursement for their efforts concerning policymaking (2015). Although thick participation provides an intensive format to follow, and adheres to strict rules for gathering the outcomes of engagement, according to Nabatchi and Leighninger's analysis, the difficulty in organising activities and the fact that this is a time-consuming process make thick participation the least common practice among the three categories. What is more, in addition to well-designed activities, the quantity, the socio-demographic diversity, and the existing standpoints of each participant are contributing factors to the overall quality of engagement (2015: 15). For instance, a negative example of participant recruitment and quality, regarding the diversity of participants' existing opinions, would be the 'National GM' public debate which resulted in a bias of anti-GM opinions.

Moving away from physical group work to individual action occurring in a virtual environment, 'thin participation' extends the concept of public engagement to a wider range of engagement practices. Online engagement is central to thin participation (2015: 17). Taking place on all kinds of Internet-based platforms, including social media, web portals, and mobile instant messaging apps (MIMs), participants take part in activities by creating content about the focused issue at hand, and can also 'like' the cause, or spread the content (e.g. retweeting) out through the network(ibid.). In terms of Nabatchi and Leighninger's explanation, although thin participation is easily achieved through

individual's online behaviour, subject to personal purposes, the real social impact of thin participation relies heavily on the quantity of participants (2015: 17). In other words, when a considerable number of people assemble as a virtual community, based on a single standpoint or appeal, and get involved in thin participation, the opportunities and the content of participation are likely to rapidly spread through the existing social network (Nabatchi and Leighninger, 2015: 19). A wider range of participants are able to take part with a diversity of opinions, and generate vast, social and even political impact outside the traditional political system. It is noticeable when comparing thin with thick participation, that thin participation occurs on the basis of spontaneous actions by participants with loose organisation, which means that intensive and in-depth deliberation seems unlikely to take place. However, in terms of Nabatchi and Leighninger's interpretation (2015), whether engagement exercises secure social democracy depends on how participants make use of them. In other words, online participation could be as intensive and in-depth as thick participation if participants regarded it as a way of making a difference to public affairs, especially when the interactive functions of social media are powerful enough to meet all kinds of requirements for 'two-way' communication.

The strengths of thin participation are twofold. Firstly, the diversity of opinion involved in public engagement practice is more likely to be acquired by thin participation given already well-established social networks and the virtual communities on the Internet that provide better participant recruitment conditions than that of thick participation conditions involving group work with a limited number of individuals (Nabatchi and Leighninger, 2015: 19). Secondly, thin participation could be adopted as either a follow-up tool to extend the influence of thick participation, or as a pre-activity instrument for detecting a range of public opinions, or for properly recruiting participants for the purposes of organising thick participation activities (2015: 20-21). In this case, although identified as two distinct categories of public engagement, thick

and thin participation are able to be incorporated into each other to make up for the defects existing in an isolated participation model.

Apart from thick and thin participation, Nabatchi and Leighninger also identified ‘conventional participation’: a ‘one-way’ ‘top-down’ communication model (2015: 21). Instead of empowering people by providing chance to speak out, such as thin and thick participation are committed to achieve, conventional participation opens up a channel to participants to be informed of the pre-set agenda and examine the actions of governments (Nabatchi and Leighninger, 2015: 22). Citizen hearings and town hall meetings are the most common formats of conventional participation, in which participants are passively told about a topic and given limited opportunity and time to express their thoughts. Neither equal dialogue or group work techniques are provided to participants in conventional participation, not to mention the chance of making a difference to decision-making (Nabatchi and Leighninger, 2015: 31).

It is obvious that ‘conventional participation’ described in Nabatchi and Leighninger’s three-type classification matches the features of first-order thinking mentioned in Irwin’s framework, and also belongs to the public understanding model. Referring to the academic definition of public engagement mentioned in Section 2.1.1, conventional participation, which discourages public inputs into decision-making, could hardly be counted as public engagement at all! This understanding of engagement suggests a divergent, or at least a deviated, understanding concerning the concept of public engagement. Nabatchi and Leighninger’s research focused on an American social context. Rooted in different academic traditions, third-order thinking theory and the three-type classification of public participation are based on different perceptions of public participation. Actually, even in the same academic context, the divergence of a definition is likely. For example, the co-existence of contradictory concepts of public

engagement have been found by Jensen and Holliman in UK science engagement practices (2015).

Nevertheless, the above taxonomy work was based on the observation of public participation events that are widely adopted in contemporary USA, in which, according to the researchers' words (2015: 21), conventional participation remains the 'most common form' of participation even though its shortcomings have been clearly realised. Davies (2008), Jensen and Holliman (2016) also came up with a similar conclusion from their research, which, together with Nabatchi and Leighninger's outcome, reflects the difficulty in transitioning from a 'top-down' communication model to a model incorporating public engagement. Apart from that, Nabatchi and Leighninger's new way of classifying participation via event-organisation and participant recruitment form a new perspective of interpreting and analysing engagement practice within intricate social contexts. Targeting spontaneous discussion taking place on social media platforms, the present research applies Nabatchi and Leighninger's interpretation of thin participation as a theoretical guide for identifying online engagement actions, and then assesses the potential of social media as a supportive forum for carrying out anticipatory governance.

2.3.3 Public intellectuals: Powerful opinion leaders

Speaking of the online engagement taking place on social media, a variety of actors involved are remarkably influential concerning the development of engagement. In many cases, these individuals even affect the trends of targeted issues at large. Regarding a collective activity, such as GM discussions, with multi-party and multi-community integration, opinion leaders have played a significant role in steering public opinion toward controversy. Here, two-step flow of communication provides an initial explanation for the indirect delivery of information (Katz and Lazarsfeld, 1955). Put forward by Katz and Lazarsfeld in 1950s, when radio and printing were the dominant forms of mass media, the 'hypodermic needle model of communication', proposes that

an audience is believed to be defenceless and directly accept the message delivered by mass media. In contrast, the two-step flow of communication theory argues that the flow of mass communication is never direct (1955:18). Instead, information is first received and absorbed by opinion leaders, who 'tend to be more exposed and the more responsive group' (Katz and Lazarsfeld, 1955: 309). These leaders are likely 'to influence other persons in their immediate environment' (1955:3). Against an historical backdrop where information transmission remains limited and underdeveloped, via radio and newspaper, opinion leaders became another 'media' or mode of communication, taking their high level of exposure and experience of the mass media and conveying information to the people surrounding them by quoting and interpreting content. During the process of content interpretation, subjective factors, such as emotion and attitude, are attached to the raw information. In this way, the audience receives the processed message and is likely to be affected by such personal influence (Katz and Lazarsfeld, 1955).

With the rapid development of communication technology, the above two-step flow of communication has gradually lost academic attraction for researchers due to widespread immediate information transmission channels, which enable direct communication between media and the mass public. The arrival of Internet-based services has heavily revolutionised the media effectively arresting the dominant position of the traditional information channels (Bennett et al., 2006; Mutz et al., 2011; Choi, 2015). However, opinion leaders—influential individuals mobilising among the general public—have never lost their power.

In 2015, about sixty years after Katz and Lazarsfeld's first work on the two-step flow of communication, South Korean researcher Sujin Choi launched a study testing the effectiveness of the two-step flow of communication within the context of Twitter (2015). Targeting two 'discussion groups centered on political issues' that took place

on a Twitter-based public forum, Choi found that within an online, collective discussion about political issues, opinion leaders rising from the general public could be clearly identified and followed the principles of a two-step flow of communication through ‘having their messages spread by others’ (2015: 706) instead of being the creator of content. With the interactive function provided by Twitter, opinion leaders are able to maintain a high level of exposure to media by experiencing intensive interactions with other users and generating social influence through either delivering original content or forwarding something associated with their leadership (2015). Thanks to the well-structured network of social media, the personal influence of opinion leaders is widely and rapidly diffused to others (termed non-leaders). Among the opinion leaders demonstrating outstanding performance in steering public opinion, those with existing authority and prestige acquired from their own specialised fields are more likely to draw attention and make a greater impact. In this research, such individuals are identified as public intellectuals. In order to accurately identify the opinion leaders steering public debate over GM issues on social media, it is significant to bring the notion of a public intellectual into the theoretical framework. This notion further dissects the role and the contribution they are making to democratic movements occurring on social media.

Tracing the concept of a public intellectual back to Europe in the 18th Century, public intellectuals were actually a product of the Age of Enlightenment, which signified the awakening of modern social civilisation (Peter, 1996; Zafirovski, 2010). During the Enlightenment movement, a series of advanced thoughts and advocacies centred on ‘reason, individualism and skepticism’ (Zafirovski, 2010: 144) were put forward in opposition to ‘the scholastic obscurantism of decadent universities and academics’ (Bourdieu, 1991: 656-657). Obscurantism, basically means that scholars were not aiding the spread of knowledge, but the ideals of the Enlightenment opposed this way of thinking by placing an emphasis on science and education, which involved making ‘information available to the greatest number of people’ (Headrick, 2000: 15). Scientists, philosophers and literary artists, who publicly claimed liberty and autonomy

against religious traditions at that moment, were identified as public intellectuals (Cushman, 1999). The historical event of '*Affaire Dreyfus*' (The Dreyfus Affair) is frequently mentioned as a typical example, in which French officer Alfred Dreyfus was framed and convicted for communicating French military secrets to the Germans. Public intellectuals interfered and made a big difference to political decision-making with existing competences, and influence, acquired from their own intellectual fields. For example, the famous writer Émile Zola wrote an open letter to a Parisian newspaper protesting that Dreyfus had been framed (Bourdieu, 1991: 656; Jacoby, 2015).

To gain an insight into 'the genesis of the intellectual' (1991: 656-658), Pierre Bourdieu identified a public intellectual from two dimensions. That is, 'on the one hand, he must belong to an autonomous intellectual world... independent from religious, political and economic powers' and, on the other hand, 'invest the competence and authority they have acquired in the intellectual world in a political action' (1991: 656). Unlike a politician who fully engages in politics, public intellectuals overstep the boundary of their own disciplines to involve themselves in the political landscape with independent thought and intention. Such actions lead public intellectuals to intervene in political decisions in defence of their independent reasoning, which involves experience, knowledge, and presumably political and ideological values (Cushman, 1999: 330). The engagement of public intellectuals in political life contributes to democratic inputs, which is likely to go against political proposals that they disagree with through actions of resistance.

Based on Bourdieu's definition, Richard Posner (2003) made an effort to distinguish public intellectuals from the notion of intellectuals as 'knowledge workers' who write directly to general public about political and ideological concerns that they do know a lot about (2002: 19-20). Posner identified four distinct genres of public intellectual: (1) the 'self-popularizing' (Posner, 2003: 7), who translate academic work into

understandable language for the lay public; (2) the policy proposal makers, who focus on their own academic specialty or ‘social reform’ (ibid.) outside their usual intellectual fields; (3) ‘real-time commentators’(ibid.); and (4) those that provide expert testimonials in court. According to definitions of public intellectuals given by numerous scholars (Bourdieu, 1991; Cushman, 1999; Posner, 2003), a close connection to the general public, together with corresponding social responsibility, distinguish public intellectuals from the rest. Public engagement characterises public intellectuals, and is given emphasis in research on public intellectuals.

When considering the social role of public intellectuals, Russell Jacoby’s provocative work ‘The Last Intellectuals’ (1987) cannot be ignored as it argues that public intellectuals are disappearing from America. Jacoby proposes that the absence of younger intellectuals in the public view after World War II, reveals an ongoing migration of intellectual life from the public realm into professional life. In universities the intellect then focuses on highly specialised research and teaching work, thus remote from public debate. In terms of the investigation conducted by Jacoby (1987), he argues that a growing number of intellectuals, especially the younger generation, give up their social responsibility of ‘contributing to social betterment’ (1987: 16), choosing instead to hide under the shadow of university careers with a guaranteed salary, job security and a pension. Non-academic intellectuals, who master ‘a public idiom’ and passionately engage with and speak for the public, turn out to be an ‘endangered species’ (1987:7). Jacoby believes that the regaining of social responsibility represents the regression of public intellectuals, which enabled the role of intellectuals to be recast in America’s social and political life (1987: 198).

Since the publication of Jacoby’s book, the use of ‘public intellectuals’ as a research topic has taken off (Jacoby, 2015). However, Jacoby’s argument about ‘the missing generation’ has not been fully accepted by his peers. Edward Said (1996) believes that

living an intellectual life is about making choices about what is worth doing. On the one hand, university careers make a remarkable contribution to the improvement of society, especially in the work of ‘revising and developing ancient tradition and hallowed names’ (1996: 72). On the other hand, university careers are not composed of purely academic work any more. They are entangled with temptations, such as financial interest and the desire to be a person of renown. These factors challenge the professionalism of academics. Said argued that the public intellectual should be considered ‘as exile and marginal, as amateur, and as the author of language that tries to speak the truth to power’ (1996: xvi). His words encourage public intellectuals to maintain a connection to the material world whilst keeping a distance from the temptations of utilitarianism.

Entitling his research as ‘a study of decline’, Posner (2003) provided a different understanding about the decline of the public intellectual. An understanding based on the context of contemporary society, unlike Jacoby’s point about the absence of young intellectuals (1987), Posner noticed that the social impact of public intellectuals towards public issues has seen an apparent decline. In other words, the so called “public intellectuals”, who are supposed to ‘opine to an educated public on questions of or infected by a political or ideological concern’, are losing their social functions, as the result of the shifting focus from public discourse to specialised academic careers (Posner, 2003; Jacoby, 1987).

After finding evidence of a public intellectual decline, Posner went further to explore whether there was an effective way to rebuild the social accountability of public intellectuals. He then examined the feasibility of improving the performance of public intellectuals by ‘encouraging fuller disclosure of academics’, public-intellectual activities and earnings in order to make them accountable for their forays into the public arena’ (2003: 12). Posner (2003) concluded that public intellectuals ought to give due

attention to public discourse and dedicate time to the popularisation of academic outcomes for the general public, and requests an effective approach for intellectuals to fully engage with the general public—a strategy of public engagement.

Nowadays ‘Internet-driven venues and opportunities’ have the potential to create surges of interest, as in hot topics, and rapidly alter the way people think and live. Social media—as Internet-based interactive services—provide an approach for public intellectuals to sustain their intellectual life by confronting general opinion (Potter, 29th November, 2015). The traditional working model of public intellectuals, such as publishing papers, articles or books via print media, has been heavily challenged by spontaneous writing on social media (blogging). We now observe that there has been a gradual rise of the ‘opinionated blogger’ (Potter, November 29, 2015; King, 2012). The previously privileged life of intellectuals, encompassing a ‘café, little magazine, friendship and bohemian social life’ (King, 2012) remains but is gradually replaced by Facebook and Twitter. Correspondingly, the “battlefield” of the public intellectual is undergoing a transformation from traditional media to interactive-function based new media (Jacoby, 2009) thanks to the freedom and convenience offered by Internet services. In Jacoby’s updated argument about ‘The Last Intellectuals’ (2009), establishing personal blogs on the Internet is a trendy way for intellectuals to escape ‘censorious editors and referees’ (2009:40) and unlock their intellectual life to a wider audience.

As a key actor involved in public debates, public intellectuals are critically active on social media, which inherited the mission of literary critics. However, the quality of online participation is not guaranteed in an Internet context. Jacoby acknowledges that the public intellectual is limited by ‘one-stop thinking and instant commenting’ on social media (Jacoby, 2009: 40-41); while Danowski and Park state that ‘the online environment does not lead participants to substantive debate’ with meaningful

interaction between participants (Danowski and Park, 2009: 339). This claim has also been established by many scholars (White, 1997; Doheny-Farina, 1996; Davis, 1999; Weger and Aakhus, 2003) who argue that given people's Internet usage habits, such as quick browsing and instant communication, the quality and depth of online discussion is limited.

However, Danowski and Park's work (2009: 339) exploits a new way to consider the quality of online discussion other than the quality of argument. In their work the mentioning of relevant public intellectuals during an online discussion also serves as an indicator of the quality of substantive online political discussion. After comparing the presence of public intellectuals in traditional and new media, Danowski and Park believe that online political discussion is likely to be pushed forward surrounding social topics, or in other words, the 'sociomorphic quality' attached to public intellectuals who are associated with certain topics (2009: 342, 349). A person high in sociomorphism facilitates the emergence and maintenance of richer social network structures. Additionally, a concept is more sociomorphic to the extent that more extensive social networks emerge through the discussion of the concept (*ibid.*). Besides, 'social actors, message content and media have varying sociomorphic qualities' (Danowski and Park, 2009: 342). Considering the likelihood that public intellectuals engage in discussion and communicate with other participants, the interaction between public intellectuals and the rest should also be taken into consideration as an influential factor in online conversation (*ibid.*)—observable through substantive references to their names during discussion.

In summary, considering their great potential to advance political discussions taking place online public intellectuals are undoubtedly an influential actor involved in public engagement. They are likely to affect participation trends, and, sometimes, even substantially influence the direction of public thought. Within the context of a public

engagement exercise, the function of public intellectuals overlaps with opinion leaders. They can both popularise academic work through understandable language; speaking about and for the public on social and political issues and, most importantly, deepen online political or other relevant discussions, and steer public debate; all of which enhance the value of online resources as democratic inputs to contribute to the decision-making work of authorities. The engagement of public intellectuals on social media (Weibo mainly) is a typical case of online engagement related to GM technology. The outstanding performance of Chinese public intellectuals has mobilised millions of discussants and led a massive anti-GM movement on Weibo—a third-party platform bypassing the traditional political system. This engagement exercise is identified as ‘mid-politics’ later in the thesis.

2.3.4 Sub-politics: A reflection of democracy outside authority

At the beginning of the last decade of the 20th Century, German sociologist Ulrich Beck put forward the theoretical model of risk society. His timely work followed the Chernobyl disaster where radioactive material was accidentally released into the atmosphere. Risk, in Beck’s theoretical interpretation, is defined as ‘a systematic way of dealing with hazards and insecurities induced and introduced by modernization itself’ (1992: 19). It is true that social wealth, risks and hazards following the wide application of advanced socio-technologies are a consequence of modernisation, which ‘cannot be banned from modern life’ (Beck, 1997: 65). In industrial society, where technology enabled mass production, risks and hazards existed but were well-controlled. However, society has transitioned from an industrial society into a ‘postindustrial’ or ‘risk society’ which means having to face the ‘historically new phenomenon of the socially produced but unaccountable possibility of destroying all life’ (Beck, 1995: 85).

Concern over wealth distribution has been gradually eclipsed by the issues of risk management, given the destructive forces of risks involved that are likely to have a global impact and also affect future generations. Beck analysed (1992), modernisation

risks, such as environmental pollution, newly discovered illness and terrorism, that could bring about irreversible and invisible harm. Risk is unequally distributed on the principle of the 'boomerang effect' which is basically caused by unintended consequences. As a result, the basic calculation of risk, established 'by science and legal institutions' (Beck, 1992: 22), failed to operate. Beck stated that 'modernization is becoming reflexive' (1992: 19). Facing the undesired and uncontrollable risks of technology, people begin to criticise and attempt to find a way out of the dangers or legitimise the risks based upon current knowledge. Knowledge about risks and their corresponding causality gains increased significance as people become conscious of the negative side effects of social development.

Rather than establishing a mechanism of reflection, 'reflexive modernization', mentioned by Beck, refers to a process of 'self-confrontation' which makes it possible to generate 'creative (self-) destruction for an entire epoch: that of industrial society' (1994: 17). Related to risk, it is apparent that anticipatory governance is a representative theoretical innovation based on the theory of a risk society. The creation of anticipatory governance relies heavily on Beck's sociological theory of risk society, in which dynamic, reflexive modernisation requires a reflexive government strategy to anticipate an unknown future. For example, the foresight capacity of anticipatory governance considers risks that may arise in the uncertain future and, ideally, puts preventive measures in place. Apart from that, sub-politics—an emerging political culture bypassing the official political model which arose from the process of reflexive modernisation—is worth paying attention to because of its great potential as a new form of democratic input in a society at risk from its own technology (Holzer and Sørensen, 2003: 79).

Confronting the socially and politically problematic issues left by industrial modernity, citizens first of all turn to politics for assistance (1994: 17). Scientists and the public's

desire of having risks properly managed and legitimised makes them political concerns, so that governments or political parties are expected to take steps towards effective solutions and protection. However, the traditional system of politics is not able to act upon what citizens want all the time; especially when there is a divergence or a desynchronization ‘between scientific and social rationality in dealing with the hazardous potential of civilization’ (Beck, 1992: 30). To put it differently, for achieving other political, economic or social goals, even as the dangers grow, political organisations ‘are not politically reforged into a preventive risk management policy’ (1992: 48), so people’s hope that formal politics can manage the risk at hand is destroyed. Another path to survive potential risks arises at the grass-roots level. This is sub-politics.

Generated by a lower level of society and bypassing the official ecosphere of politics, sub-politics is a new political culture mobilised ‘outside the iron cage of bureaucratic politics’ (Holzer and Sørensen, 2003: 80), and ‘allowed to appear on the stage of social design’ through bottom-up social movement (Beck, 1994: 23). In other words, there is no longer a clear boundary between politics and non-politics (Beck 1997: 52). In addition to the official political system, comprised of parliamentary, governmental and party politics, sub-politics—which is comprised of considerable public opinion—has shifted the conventional ‘rule-directed’ system of bureaucratic politics towards a ‘rule-altered’ model. Sub-politics does this by affecting public attitude towards controversial issues related to the potential risks of technology, and by unleashing a massive influence on politics by affecting public support towards governments (Beck, 1997: 53). Aside from ‘the contestation of taken-for-granted assumptions of modernity by actors outside the system of formal politics’ bottom-up social movements are identified as ‘an active side of sub-politics’ by Holzer and Sørensen (2003: 82). Within a digital environment, the migration of social movement from offline to social media has also drawn attention from scholars, such as Amandha Rohr Lopes (2014) and Tan et al.

(2013), but few of them have ever connected the outcomes of their research to the development of sub-politics.

It can be seen from Beck's theoretical framework that sub-politics is an alternative political culture empowering grass-root practices which run parallel to formal politics. The political engagement of the general public through sub-politics becomes more accessible than conventional procedures based on the organisation of working groups. Regarding anticipatory governance, sub-political movement is a valuable source for public engagement outwith the official political ecology. It can be predicted that without a structured arrangement for engagement, the diversity of opinions embedded will be vast, while, at the same time, debate is obstructed by certain useless interference information.

Closely related to new types of conflicts and hazards emerging in a social environment, Beck's theory of risk society questioned the existing links between society and politics, and redefined the principles of political decision-making in modern society (Beck, 1997; Coaffee, 2009). During the 25 years following Beck's book 'Risk society: Towards a new modernity' (1992), risk society theory was frequently applied to various realms, varying from global terrorism to mental well-being, which continuously developed the theory. For example, British scholar Coaffee (2009) adopted the theoretical model of risk society for analysing the threat of global terrorism—an emerging large-scale risk occurring uncontrolledly around the world (2009: 65). Meanwhile, risk society theory has also supported the necessity of placing a research emphasis on individuals' mental health (McLaughlin, 2008).

However, criticisms towards Beck's theory have never ceased. Criticisms primarily challenged that theory for being too vague to applying to practical situations, and the

pessimism involved to predict the potential harm of risks (Adams, 1995: 181; Coaffee, 2009). Additionally, Beck's view that sub-politics co-exist with a government's formal, traditional system of politics was questioned by Holzer and Sørensen (2003), who believed that societal influence brought about by sub-politics should be largely independent from the 'political system' as a 'non-political character' to reflexive modernisation (2003: 95). In their work, it is highlighted that active sub-politicians refuse to be restricted to formal channels of communication provided by official politics (2003: 95), for example, a 'political consultation' in China and a council hearing in the USA. Instead, they attempted to explore alternative paths with the public to achieve political goals. Although much research has pushed the concept of sub-politics towards a deeper level of understanding, whether there is any space remaining between the formal political system and sub-politics in terms of public engagement is an unanswered question that will be considered in the present research.

2.3.5 E-government: Government defencelessness when using social media

Moving away from grass-root-generated social movement, the focus of this section shifts to the digital engagement practice of governmental agencies—the core actor of political decision-making. With the rapid enhancement of information and communication technology (ICT), E-governance has experienced rising prominence in the normative work of governmental agencies. An E-government is defined by Norris (2002) as the use of electronic communications devices, computers and the Internet to deliver public services. E-government was primarily expected to strengthen 'policy effectiveness, political accountability, and [...] public participation' (2002: 113). Since Norris's interpretation made at the beginning of the 21st Century, our understanding of E-government has been further updated by Jeong (2006), who believes that the services provided by E-government are no longer limited to the creation of an official website or to an email communication system. The reason being that E-government is an integrated communication service, comprised of multi-dimensional interactions, including system-internal interactions (e.g. between governments and other

governmental agencies) and outward interactions (e.g. between governments and citizens) (Jeong, 2006). Thus, social media, together with their abundant interactive functions, became ‘a central component of E-government’ (Jeong, 2006; Bertot et al., 2012: 31).

As introduced by Grubmüller et al. (2013), governments have realised the advantage of using social media for supporting policymaking, ‘as information sources and as instrument for gathering feedback and detecting further trends’ (2013: 19). The famous ‘Arab Spring’ is been frequently mentioned to illustrate the great potential of social media to accelerate social revolution, and to promote social democratization (ibid.). Since this incident, governments acknowledge social media as an efficient tool to access the raw voices of the public.

However, bearing in mind the outcomes of several research studies into social media use and governmental agencies (Chang, 2008; Noveck, 2008; Bertot et al., 2012; Grubmüller et al., 2013), governments appear unable to rid themselves of the antiquated model of one-way communication. For example, in Noveck’s Wiki-government (2008) ‘knowledge-sharing’ and the translation of raw data into references ‘useful to decision-makers’ are advocated as two improvements to enhance the efficiency of E-government. While Grubmüller et al. (2013) attempted to make use of the technique of ‘social media analytics’ to gather ‘user generated data’ for detecting the trends of public opinion (2013: 23). Neither, ‘knowledge-sharing’ or ‘trend detecting’ refers to the interactive functions provided by social media. This observation might imply that social media by governments rarely involves the application of two-way interaction. Thus, the deficit model of communication remains and such insufficient or unresponsive engagement is likely to result in a public crisis of trust towards governments. Numerous studies suggest that social media is distinct from traditional media in terms of democratisation

potential. This deduction raises an important question: ‘why do governments remain cautious about implementing the interactive functions of social media?’

In what follows, I will apply Bertot et al.’s research (2012) about ‘the impact of policies on government social media usage’ to answer the question above. Positioned at the core of social management, governments are faced with a series of rules or principles that are mandatorily complied with in terms of policies or law provisions. Unlike other scholars exploring the value or potential of social media usage in E-government, Bertot et al. focused on The U.S Federal Government’s use of social media to communicate with the general public. After analysing 20 nationwide policies applied in the USA, Bertot et al. defined three main principles that influence social media use: namely ‘access and social inclusion’; ‘privacy, security, accuracy and archiving’, and ‘governing and governance’ (2012: 30). Each principle restricts the use of third-party-sites (e.g. Twitter, Weibo and Facebook) in E-government.

To be specific, the first principle, ‘access and social inclusion’, requires governments to offer equal access to citizens, such as those ‘with limited English proficiency’ or with a disability, in order to ensure people’s rights to social inclusion and equality. The second principle covers the management of online information relevant to either governmental confidentiality or individuals’ privacy. In short, governmental services must protect citizen’s privacy, data security and information accuracy. In the highly dynamic environment of social media, especially a third-party platform (i.e. Twitter and Weibo) outside an official government website, there are information risks. Safety of information is a foremost concern for governments to solve before launching any activity on social media (Bertot et al., 2012: 32). Governments prefer to be conservative by tacitly endorsing and setting serious security control mechanisms. Because of the security measures required communication rarely takes place between government agencies and the public in a ‘digital open space like Twitter’ or Weibo (Bertot et al.,

2012: 33). A self-evaluation system concerns the third principle of social media use: 'governing and governance'. In this system, a number of details regulating the dissemination of information are established for communicating to all members of the public (ibid.). In light of Bertot et al.'s analysis (2012), it is apparent that direct two-way communication to provide a direct response to the public on social media, is problematic given the concerns about the safety, equality, privacy and sustainability of online information that exist prior to the pursuit of an efficient and effective communication.

With regard to of the distinctive context of China, in 2016 The Mercator Institute for China Studies (hereafter MERICS) launched an investigation into 'how the Chinese leadership utilizes social media' (Gierow et al., 2016). The final report points out that the arrival of a new media age has challenged the authority of the previously strict state-control of media in China. A severe crisis has arisen concerning the credibility of government practices; similar to what is happening in Western countries, an increasing number of citizens in China tend to believe information acquired from social media, which largely consists of user-generated content rather than state news channels (ibid.). This crisis prompts the Chinese government to use social media 'as a channel for political communication' in addition to 'strict controls and censorship' (ibid.: 3). Regarded as a matter of national security, communications on social media between the Chinese government and the public are carefully considered and monitored. Similar to the governments of Western countries, the Chinese government is not able to take full advantage of the strengths of social media, such as real-time conversation and direct response, due to information filtration and all kinds of rules securing information safety. As can be seen from content generated by official governmental agencies, the government cannot free itself from 'standard bureaucratic wording' in information dissemination (Gierow et al., 2016: 4); which generates a communication barrier and implies a top-down distribution of government information on social media rather than two-way dialogue.

However, these restrictions do not mean that governmental usage of social media in either China or Western countries follow an antiquated or non-effective way of communication. Differing from a normal social media user, in addition to information dissemination, more social responsibilities and accountabilities are undertaken by E-government. Although two-way engagement is advocated as an effective way of political communication, the pure application of public engagement in the daily work of E-government is unrealistic. As argued by Irwin in his framework of third-order thinking (2008), third order of communication requires a reflective and flexible strategy, echoing the specific situation that governments are confronting. PES is not the end point for science communication. Instead, PES results in a ‘demand for further engagement’ and the endless accusations of opacity, a lack of transparency (2014: 208).

Confronting the rather sensitive issues of scientific controversy, like GM crops, GM food and GM technology, governments tend to choose a conservative attitude in dealing with public communication on social media. First of all, to govern effectively governments have to maintain the stability and harmony of the social order and prevent the possibility of an escalation of controversy. Given that premise, governments should not commit to ‘more than what they can deliver’ (ibid.) in engagement exercises—‘alongside the unavoidable requirement for accountability and leadership’ (Irwin, 2014: 209). With respect to the probable consequences of public engagement, secondly, governments take passive measures, such as turning off the comment function on government official website, or clearly declaring that no response is available on social media. In general, Bertot et al.’s study (2012) about the influential factors of governmental usage of social media, Irwin’s perspective about third order communication and MERICS’s outcomes of an in-depth analysis on Chinese governmental usage of social media, have worked together to explain the engagement performance of governmental official accounts on Weibo and Twitter.

2.3.6 Concluding theoretical framework

After elaborating on the major arguments of five, related, science communication theories, the framework of this thesis gradually takes shape. As mentioned before, PES is a second-order model of science communication (Irwin, 2008), which involves ‘two-way’ dialogue and eliminates the ‘one-way’ deficit model of public understanding. Based on Irwin’s two-way dialogue model of communication, Nabatchi et al. (2015) innovatively brought online participation into the scope of public participation, and identified ‘thin participation’ which extended the concept of public engagement to a wider range of engagement practices advocating the potential to bringing about more engagement exercises through social media. In addition, under Katz and Lazarsfeld’s theory of ‘the two-step flow of communication’ the flow of mass communication is never direct, instead, information is first received and absorbed by opinion leaders. Furthermore, via the interactive function provided by sites, such as Twitter and Weibo, opinion leaders are able to maintain intensive interactions with other users, generating social influence through either delivering original content or forwarding something associated with their expertise (Choi, 2015).

Among ‘thin participation’ exercises taking place on social media, opinion leaders try to steer public opinion and spread their voice out through the social network. Correspondingly, their personal influence spreads through the network, so that the followers of opinion leaders are likely to assemble voluntarily and form an online community, which, on the one hand, expands the scale of public engagement on social media, and on the other hand, is a politically influential force on government decision-making. Public intellectuals with existing authority and prestige acquired from their own specialised fields (Bourdieu, 1991), turn out to be powerful opinion leaders; who hold strong personal influence and substantial involve themselves in political action to stamp their perspectives on public opinion.

The public attributes of public intellectuals have massively contributed to the democratic input of modern society (Posner, 2003; Jacoby, 1987). During controversial public debates, the active engagement of public intellectuals on social media is likely to trigger large-scale movement if their political claims oppose official ones, or once the public is irritated by the disparities between government attitude and public opinion. Protest movements led by public intellectuals were identified as a dimension of reflexive modernisation by Ulrich Beck (1992) as a means of preventing uncontrollable risks happening in near future. Although the global growth of social media use has seen a democratic divide emerge between those who make use of the political resources and opportunities on social media and those who do not (Norris, 2002), social media are functioning as an alternative way of mobilising people into politics; that is, generating a new political culture led by social activities that bypasses the formal political system, and creates new opportunities for citizens to engage in political activities. Gradually realising the potential risk of advanced technologies, the lay public search for alternative solutions when government trust is lost. Closely following these social media movements is a generation of sub-politics, a grass-roots-based new political culture, distinguishing itself from official politics and contributing to policy-making decisions (Beck, 1992, 1995). Linking social media to the theoretical framework of anticipatory governance, an emergence of sub-politics led by public intellectuals is capable of embodying the three capacities of foresight, engagement and integration at the same time, reflecting the power and vitality of an anticipatory governance strategy in the context of a risk society.

On social media, public opinion develops an influential voice through sub-politics with regard to decision-making matters. In 2002, when social media largely remained unknown, E-government committed itself to establish government websites. This process was used by industrialised countries to enhance the transparency of governmental information and maximise governmental accountability for its citizens (Norris, 2002: 128). Nowadays, ‘two-way’ communication on social media and the

remarkable diversity of opinions are attractive resources for governments. Grubmüller, Götsch and Krieger (2013) came across countless obstructions in the practice of online public engagement, such as the problematic results arising from the ‘GM Nation?’ public debate. Yet concluded public engagement was an essential tool for deducing public opinion (Grubmüller, Götsch and Krieger, 2013). Soon after the launch of Twitter and Sina Weibo, governmental departments set up official online accounts, which were accessible to all registered users but came across numerous security and privacy limitations regarding their implementation, such as securing the safety of confidential information and ethical issues, like protecting civil privacy (Bertot et al., 2012). While the research done by MERICS (Gierow et al., 2016: 4) provides an insight into the status quo of social media usage by China’s government, which experiences similar problems to Western countries in terms of the limited application of interactive functions provided by social media. Nevertheless, rising prominence is being given to social media as a resource of ‘publicly available user generated data’ that can benefit governments’ ‘evidence-based policy making’ (Grubmüller, Götsch and Krieger, 2013: 1). This reality makes social media a necessary instrument of E-government, generating essential evidence for policy design. At this point there are two main questions to consider related to how governments treat resources on social media: (1) how do online engagement exercises work, and (2) how are participants, including individuals and organisations, behaving and interacting among spontaneous discussions online? The answers to these questions will have an influence on the potential of social media as a supportive forum for anticipatory governance. These questions will be explored and analysed in the present research.

2.4 Previous studies of GM issues in the media

The controversy surrounding GM issues dating back to the 1990s results in the frequent mention of ‘GM’ vocabulary in sociological research. Academic work on the public’s reaction to GM issues has been continuously produced despite focusing on different subject areas relevant to GM issues. With regards to media studies on GM issues, the

government sponsored public debate ‘GM Nation?’ (2003) was a landmark event. Public and academic interests were intensively fixed on GM issues. A remarkable diversity of voices arose and were captured by media coverage which create a valuable source reflecting the social construction of GM issues.

Before 2003 when media research about GM issues remained placid, attitude surveys on GM or its public acceptance played a salient role in GM-related sociological research. Soon after the ‘GM Nation?’ debate, the research focus shifted to media coverage—attributable to the highly contested nature of the debate. At that moment, research paid attention to forms of traditional media, especially newspapers (Cook et al., 2006; Shineha et al., 2008; Augoustinos et al., 2010; Du and Rachul, 2012; Pollock et al., 2017), while the digital media environment was not introduced till recently (Munro et al., 2015; Clancy et al., 2016). Although studies of GM issues in a new media context remain few in quantity, their research outcomes (Munro et al., 2015; Clancy et al., 2016) have indicated the great potential of digital media, especially social media platforms, in forming, promoting, and steering the anti-GM social movement. Section 2.4 outlines the research focus of previous studies related to GM issues. Generally speaking, three stages can be observed in the research: attitude survey oriented studies before the ‘GM Nation?’ debate; research on media representations of GM during and after ‘GM Nation?’; and the introduction of the digital environment at a later stage.

2.4.1 Surveys on public attitudes toward GM

Before the ‘GM Nation?’ debate, sociological studies on GM issues, or referring to biotechnology pertaining to the genetic manipulation of microorganisms, concentrated on surveying the distribution of public attitudes toward GM as a frontier technology (Cook et al., 2006). For instance, scholars Davison, Barns and Schibeci (1997) critically reviewed existing public attitude surveys towards biotechnology. Their research questioned the validity of certain research designs, which were believed to be problematic as they affected the final results of surveys (Davison, 1997: 318). In the

late 1990s, public opinion surveys were treated as an effective instrument for governments and relevant agencies (in developed countries) to objectively detect ‘the level and nature of public interest in, and acceptance of, new technologies such as biotechnology’ (ibid.). In 1997, Biotechnology and the European Public Concerted Action Group (hereafter BEPCAG) launched a public opinion survey but shifted its purpose from public attitudes towards GM technology to gauging public trust in the ability and authority of government (BEPCAG, 1997). The results were negative in that they indicated that governments and other public authorities were facing a widespread crisis of trust in their capacity to effectively cope with public concerns about GM issues. Entering the 21st century, the social debate over GM technology has been continuously expanded by the purposes of a different industry. From the aspect of the food market, Burton et al. (2001) investigated customer attitudes to GM food in Britain, and attempted to measure ‘the extent to which these attitudes translate into willingness to pay or to avoid’ (2001: 480) GM products. Although the research object or the aim of survey varies from one to the other, an apparent negative attitude towards biotechnology or GM issues is the most outstanding similarity that all these researchers came up with, reflecting a tense atmosphere of aversive opinion toward GM technology amongst the public.

2.4.2 The representation of GM issues by traditional mass media

It is unsurprising that ‘GM Nation?’, the public debated sponsored by British Government in 2003, escalated the severity of GM matters and made ‘GM Nation?’ itself ‘the subject of some controversy, especially over questions of its representativeness’ (Reynolds and Szerszynski, June 2006). In the following one year after ‘GM Nation?’, media coverage, especially newspaper coverage, of either ‘GM Nation?’ or GM issues intensified negative public opinion on not only GM problems, but also the government’s ability to govern GM technology. GM commerce was described in the news as an ambitious and mercenary industry that exerted ‘considerable political pressure on the government and Britain more generally’

(Augoustinos et al., 2010: 110). Correspondingly, research interests grew towards monitoring and analysing the media representation of GM technology to get a grasp of this emerging controversial technology positioned within a complicated social environment in relation to public attitude. Cook et al. (2006)'s work serves as a typical example.

Concentrating on British press coverage of the GM food debate and public reactions following 'GM Nation?', Cook et al.'s research (2006) gave particular attention to the intensified statements of journalists and elusive public opinion trends in the first half of 2003, when the controversy over GM increased dramatically. Unlike the majority of researchers, to gauge public attitude toward GM issues Cook et al. creatively combined applied linguistics with sociological discourse analysis to analyse GM-related news reports published by four mainstream newspapers in Britain: the Daily Mail, the Times, the Guardian and the Sun, given the views held by different newspapers the GM issue was framed within distinct contexts. Subsequent researchers (i.e. Shineha et al., 2008; Du and Rachul, 2012; Pollock et al., 2017) expanded this discourse analysis approach to investigate public reaction to GM technology, including the views held by stakeholders of the GM industry and feedback provided by the lay public from all walks of life. This enabled researchers to draw conclusions about how the GM debate presented by the press media 'is communicated to the public and assessed by them' (Cook et al., 2006: 6).

After analysing the recurring linguistic patterns of news reports, researchers saw a full range of framing skills employed in the coverage of GM controversy. For example, pro-GM news stories tended to 'focus on the scientific fact of GM safety' utilising scientific narratives (Cook et al., 2006:11), and attributed GM controversy to a lack of public understanding (ibid.). Anti-GM news stories preferred to invoke a broader context which encompassed society, politics and economics, and talked about the long-term

and potential risks of GM (ibid.). Numerous rhetorical skills, such as emotional epithets (2006: 13) and metaphors (2006:14), were adopted in news stories so that attitudes and standpoints were reaffirmed and emphasised. In addition, a special connection between GM issues and ‘other political events of the time’ such as ‘the war in Iraq’ (2006: 5) was observed by researchers studying news reports as a rhetoric strategy: ‘a rich source of metaphor, allusion and comparison for commentators’ (Cook et al., 2006: 6; Augoustinos et al., 2010: 109).

While people’s reactions to GM-related coverage varied, there was a clear divergence between stakeholders and the ordinary participants. Stakeholders had a clear consciousness of how the GM debate was going, while “ordinary” participants did not (Cook et al., 2006: 25). The broader understanding of GM debate was ambiguous in ordinary participants’ minds, while the identity of an author or the source of news stories was found to be the dominating framing device affecting the formation of a person’s views toward GM technology (Cook et al., 2006: 28).

Highly inspired by Cook et al.’s research, in 2010, Augoustinos and colleagues examined how the GM controversy was represented in British newsprint media ‘as a battleground of competing interests’ (2010: 98). This perspective further developed Cook et al.’s research outcomes acquired in 2003, and extended the work by ‘measuring stakeholders’ reactions’ (Cook et al., 2006) to explore how major stakeholders—‘the British public, the British government, the science of GM, and the biotechnology companies’ (Augoustinos et al., 2010: 98)—were constructed by the media coverage of the GM controversy. Critical discourse analysis was adopted by Augoustinos et al. to investigate ‘the linguistic patterns which function to construct specific versions or accounts of this highly contested issue’ (2010: 99). Augoustinos et al.’s findings concluded that the negative construction of the GM issue overwhelmed the positive one in quantity from 12th January 2004 to 11th April 2004 (Augoustinos et al., 2010: 100).

Positive representations ‘were nonetheless in evidence’ (2010: 103), for instance one familiar argument is that GM technology is in favour of ‘the alleviation of hunger in the Third World’ (ibid.). Regarding the role of major stakeholders, first, Augoustinos et al. found that the public and the government were positioned in an ‘oppositional struggle over GM’ (2010: 106). Second, scientific communities were frequently challenged and questioned by the public because they were believed to have concurrent interests with governments (2010: 109).

In addition to the above findings, the association between GM issues and other political events, discovered by Cook et al. in previous research (2006), was again dug up by Augoustinos et al.’s research. The link has been applied to other scientific controversies by comparison, such as the BSE scare and climate change (Augoustinos et al., 2010: 109), illustrating the powerful function of analogy as a rhetorical device in issue framing. After analysing the ways in which major stakeholders were presented in newspaper coverage, Augoustinos et al.’s study outlined the social construction of GM debate. The study provides a rich resource for the evaluation or the anticipation of developing trends in public engagement and deliberation processes that are proposed in the ‘battleground’ of GM policymaking (Augoustinos et al., 2010: 112).

The media representation and social construction of GM technology presented by traditional media, could be seen as a lens through which to observe acts of science communication undertaken in the pre-digital-age. This lens provides a valuable reference for more recent researches. For instance, Augoustins et al.’s investigation (2010) on the construction of the major stakeholders of GM technology is an effective pathway to deeply analyse how highly contested an issue is within a complicated social environment, and also to forecast developing controversial trends in the near future. Gauging the reactions of experts and the non-experts respectively (Cook et al., 2006) has inspired me to measure the interactions between major stakeholders on the Internet

where direct communication has become possible. The oppositional struggle over GM issues (Augoustins et al, 2010) undertaken by the government and the public hints that contradictory views might be the result of numerous aspects and the struggle over GM issues is likely to deteriorate the relationship between government and the public, unless appropriate measures are taken.

2.4.3 GM issues in digital media

In 2002, when newspaper and television remained the main source of science information for the public, Richard Holliman states that ‘attempting to consider the wide range of issues covered by the media with respect to GMOs would have been unrealistic exercise’ (2002:1). However, since then the advanced technology of search engines supported by online Internet databases makes the same research exercise achievable in the Digital Age. Clancy et al. (2016) took a step from traditional media into the new media arena to analyse the visual rhetoric technique often exploited in science communication to frame the anti-GM movement on an international scale. Abandoning the tradition of employing linguistic or discourse analysis methods, Clancy et al. adopted a semiotic-memetic approach to analyse more than one thousand visual depictions of online anti-GM images: this method detected the political discourses embedded in an image constructed reality (Clancy et al., 2016: 283).

According to Clancy et al.’s analysis, anti-GMO imagery presented by new media was composed of powerful critiques surrounding three dominant GM issues: (1) the manufacturing process of GM, which goes against natural food ideologies; (2) GM products, and (3) the dangerous and out-of-control implications of GM products (2016: 285). This research enabled the main notions of GM resistance to be clarified, and some critical political discourses of GM refined from the massive online debate. A semiotic-analysis method offers more targeted research compared to a broad analysis of the social construction of GM issues; for instance, a semiotic-analysis of the anti-GM movement offers a valuable resource to policymakers on a global scale. Clancy et al.

(2016: 279) argued that the ‘dominance of the visual in mediated political discourse may privilege non-rational political decision-making’. In other words, the blurring of national boundaries on the Internet and image-based argumentation (that can transcend cultural and language boundaries) enables the construction of embedded political discourses that are profoundly influential to decision-making on a global scale, especially regarding worldwide controversial issues such as the anti-GM movement (2016: 287-288). It is noteworthy that the potential of new media in framing, disseminating and steering the GM controversy could be exploited by governments as a means to achieve their political goals in the Digital Age while at the same time giving impetus to the enhancement of science democracy.

By analysing the global construction of the public’s resistance to GMO (Clancy et al., 2016) has undoubtedly given the study of the media representation of GM technology new life by introducing the new media environment and its corresponding characteristics into research. However, it should be noticed that many design flaws remain unsolved in the research, which limit its depth of analysis. For example, there are clarification issues. Digital media refers to a wide range of new media categories—using the ‘Internet as a network that connects all types of communication from one-to-one to many-to-many into a wider ‘space’ of communication’ (Couldry, 2012: 2)—such as web portals, forums, blogs, social media, live stream platforms and numerous smartphone APPs. The characteristics of digital media vary from one to the other given the distinctive operating models, so although the research placed greater emphasis on the rapid and world-wide dissemination of information through digital media, which contributes to the image-based mobilisation of the anti-GM movement, the vague definition given to digital media limits the possibility of studying its other specific characteristics. For instance, the interactive function—a most significant feature of social media—is neglected in the research, instead the communication taken into consideration in Clancy et al.’s research follows a one-way top-down communication model. The analysis on the construction of the anti-GMO movement therefore stops at

the level of single-direction information delivery, such as visual rhetoric and content interpretation, rather than progressing to explore the association and the interactions among the major actors, such as governments, NGOs, commerce and the public. In addition to that, the statement that ‘the centrality of the image within contemporary political debates contributes to a broader shift away from rational, political decision-making’ (Clancy et al., 2016: 288) is overstated. Although transcending cultural, language and national boundaries through digital media, the visual mechanism of the anti-GM movement is not the only factor contributing to the “success” of the anti-GM protest, or even to the political impact. As a large scale collective protest, the emergence and development of the anti-GM social movement should be attributed to a diffuse set of factors, which are part of a complex and interwoven social network.

Some of the limitations of the research design were improved upon in Munro et al.’s study (2015), which investigated through the GMO debate ‘how individuals interact with each other to form online connections’ (2015: 38). Focusing on Twitter, where discussion about GM technology takes place spontaneously among individuals, the researchers followed a quantitative approach under the assistance of ‘Netlytic’—‘a cloud-based social media and networks analyzer’ (2015: 38). Netlytic enabled the researchers to collect and analyse the thematic distribution of GM issues and track the real-time interaction between individuals. Through capturing and calculating the frequency of Twitter’s interactive functions, such as replying, retweeting and mentioning, the researchers built up a database to objectively record the strength of the interactions taking place among the individuals. The software allowed a comparison between specific themes relevant to GM technology (2015: 47). It is apparent that Munro et al.’s research left the realm of thematic analysis to measure the establishment of interpersonal connections in a virtual environment, which provides a valuable reference for my research.

Nevertheless, two problems in the research design are worth noting. First, although the statistics provided by ‘Netytic’ software are likely to indicate the behavioural trends of individuals as they occur on Twitter, the subjective feeling and sentiment, expressed through linguistic rhetoric and the social constructions of the GM issue are hard to measure accurately with a quantitative research method. Considering the nature of interpersonal interactions, which contain subjective elements, such as feelings, emotion and attitude, a qualitative research method which can include these elements makes more sense as a tool for analysis. Second, even though the interactions examined by the researchers could be understood as the answer to how interpersonal interaction occurs on Twitter, the result is not persuasive enough to provide answers about how individuals interact with each other over GM issues. Regarding the highly contested issue of GM, which involves multiple stakeholders and numerous sets of associated interest groups, it is meaningful to identify the discussants involved, and then classify their interactions in terms of the identity of participants before setting out to analyse any interactive behaviours between participants.

Inspired by the unresolved problems of Clancy et al.’s (2016) and Munro et al.’s research (2015), I carefully considered the objective of the study, which is designed, on the one hand, to fill the gaps left in the research field and, on the other hand, to produce practical reference value for policymakers committed to strategies that facilitate science governance and science communication in contemporary society. Moving away from vague concepts of digital media, this research will focus on specific social media platforms, which have not yet been referred to in previous studies of GM technology in a media context—Twitter and Sina Weibo. Considering the different cultural, language and political environments that these social media platforms are rooted in, a comparative analytic study mechanism will be introduced to compare the role, or potential, of these two microblogging services for implementing anticipatory governance. Unlike previous studies (Cook et al., 2006; Augoustinos et al., 2010; Munro et al., 2015; Clancy et al., 2016), this research will give extra attention to the

interactive function and the engagement exercise of social media, not only because the two-way communication enabled by social media serves as the most significant characteristic distinguishing social media from traditional media, but also because the engagement requirement of anticipatory governance illuminates the prospect of social media as supportive forums for anticipatory governance in the Digital Age. Spontaneous discussion surrounding GM future-related issues taking place on Twitter and Weibo is regarded as the object of the research. The theoretical framework of this research, described in the sections above, suggest that the public intellectual-led anti-GM social movement on Weibo is a useful way of framing the “ecosystem” of Chinese science governance.

2.5 Chapter conclusion

Chapter 2 started from delineating an overall context of anticipatory governance (Section 2.1), in which a historical revolution of science governance, transforming from PUS to PES, took place and catalysed the generation of anticipatory governance. In response to the inevitable risks and uncertainties brought by emerging technologies in the post-industrial society, the forward-looking, engagement-oriented and result-seeking strategy of anticipatory governance has gradually grown to be an advanced model of science governance, which saw an initial success in nanotechnology and is now widely applied to many technological issues (i.e. climate change, genetical modification and synthetic biology). However, doubts and challenges also arose from the academia, concentrating on the over-cautious attitude towards risks and the unsatisfactory implementation of anticipatory governance, the practice of engagement in particular, which, in my research, is argued to be supplemented by social media.

After an interpretation on the three core ingredients of anticipatory governance (foresight, engagement and integration), a theoretical connection between social media and anticipatory governance has been built up (Section 2.2), arguing that social media,

Twitter and Weibo in particular, is playing a role of supportive forum for anticipatory governance through either meeting the requirements or making up the defects occurring during the implementation. Besides, a comprehensive theoretical framework interpreting the phenomenon of public engagement on Twitter and Weibo from multiple dimensions was also established (Section 2.3), again, backing up social media's potential in supplementing the normative practice of anticipatory governance. Six significant theories and academic works, namely Irwin's third-order thinking theory (2014), Nabatchi et al.'s three-type classification of participation (2015), Choi's two-flow communication theory in Internet environment (2015), Jacoby's public intellectual theory (2009), Beck's sub-politics theory (1992) and Bertot et al.'s academic work on E-government (2012), were involved in the theoretical framework and will assist the analytical work subsequently.

This chapter ended up with an overview of the previous studies on the media representation of GM issues. Although there were apparently quite a few researches regarding the context of social media (Munro et al., 2015; Clancy et al., 2016), the potential of social media in forming, steering and promoting anti-GM social movement has been figured out and further strengthened social media's role as a supportive forum for anticipatory governance. Based on this, I will move on to look into the practice of social media in performing anticipatory governance and then compare the practice with the theoretically derived performance of social media generated from literature review. The next chapter will elaborate on the methodological consideration, research design and operation process in detail. Additionally, a series of quality assurance techniques will be introduced for improving the academic rigor of the present research.

Chapter Three. Methodology

After interpreting the connotation of anticipatory governance in the literature review, the present research is dedicated to evaluating the potential of social media to facilitate the implementation of anticipatory governance. In addition to that, I focus particular attention on whether anticipatory governance can be adopted with the assistance of social media in a Chinese context. To this end, textual data generated from spontaneous discussions about GM future-related issues on Twitter and Weibo over two consecutive years (1st January 2015 to 1st January 2017) was scrutinised drawing inspiration from two distinctive approaches of qualitative content analysis: conventional content analysis and directed content analysis (Hsieh et al., 2005: 1279-1282). By analysing the textual content surrounding highly contested GM issues, the research assesses the capacity of social media to practice two components of anticipatory governance: foresight and engagement. A third component of anticipatory governance called ‘integration’ was also identified in this research but because of the limited operability of the present research in tracing the routines of policymaking this component was not examined in depth. Two main questions have been addressed in the present research, namely ‘How is an alternative GM future projected on Twitter and Weibo?’ and ‘How are the major stakeholders of GM technology interacting on Twitter and Weibo regarding the prospects of GM technology?’.

First, to investigate the construction of GM future-related issues on social media, conventional content analysis was applied to obtain a descriptive understanding about future predictions for GM. In addition, these findings were compared to the theoretical concept of anticipatory governance, the definition of ‘foresight’ in particular, to see whether the performance of Twitter and Weibo matched the requirements of foresight capacity. Second, an examination of the interactions amongst GM stakeholders was addressed via direct content analysis. To interpret the interactions and social phenomenon occurring on social media during the test period, a comprehensive analytical framework, as explained in the literature review, Section 2.3, Chapter 2, was applied to the diversified representation of engagement that appears on Twitter and Weibo. This framework was based on existing theories and academic works (e.g. Katz

et al., 1955; Jacoby, 1987; Beck, 1992; Alan Irwin, 2008; Bertot et al., 2012; Choi, 2015; Nabatchi et al., 2015) to assess the potential of Twitter and Weibo as a supportive forum for anticipatory governance. Furthermore, considering the different cultural, language and political environments that Twitter and Weibo are respectively rooted in, a comparative analytic study mechanism was introduced to compare the role of two microblogging services in implementing, or their potential for implementing, anticipatory governance.

3.1 Sampling methods: User generated content on Twitter and Weibo

The unit of sampling involved the textual content of GM future-related discussion on Twitter and Weibo. These were gathered regardless of the identity of the author. (Hereafter, the mention of ‘social media’ in the thesis refers to Twitter and Weibo in the present research.) ‘Discussion’ involved three behaviours of social media usage, namely composing, replying and forwarding (retweeting on Twitter). A ‘group of discussion’ refers to all the information following an initial tweet or Weibo, including: all the replies, reply responses, the comments made while forwarding, and the amount of ‘likes’. Instead of extensively collecting a mass of data at the start of sampling, the research commenced with a small number of discussion groups that demonstrated a high level of engagement (a high volume of replies, retweets, and likes). Data collection was then extended to all eligible user-generated content (UGC). To this end, exclusive devices of microblogs were employed as tools for aggregating data according to topics of discussion, such as the hashtag which is ‘a phrase beginning with a hash/pound sign (e.g., #longreads is used when linking back to lengthy online articles)’ (Bik et al., 2013: 3) and also internally installed search engines on both social media platforms. On Twitter, a search phrase index, including expressions like ‘GM food in the future’, ‘genetic modification policy’, ‘GM label’, ‘GMO labelling policy’, ‘new GMO rule’, ‘GMO future’ and ‘the future of GMO’, were designed before sampling began. Another key word index exclusive to Weibo was enacted, incorporating basic phrases, like ‘*zhuanjiyin*’ (GM and GMO) and ‘*zhuanjiyin biaoshi*’ (GM labelling), highly contested

topics, such as '*fan zhuanjijin*' or '*fanzhuan*' (anti-GM) and '*wuhan zhuanjiyin dami*' (GM rice in Wuhan city). To ensure samples with a high degree of engagement were selected, the first turn of sample screening took place. The eligible discussions had to have a conversation with at least five replies in English and seven in Chinese. Here, the amount of replies serves as a parameter indicating the activity of conversation. Setting up different criteria for two platforms was subject to the actual status of the data collected from the first turn of sampling—five replies on Twitter and seven replies on Weibo were the average amount of replies. Thus, the conversations containing less replies than those two parameters were screened out. After that, the eligible conversations were identified and screened again for relevance. For example, a spontaneous discussion surrounding General Motors, as well on Twitter, was screened out as irrelevant content in this study.

Starting from 1st January 2015 to the 1st January 2017, 381 groups of spontaneous discussions (Twitter 117; Weibo 264) containing 3,194 pieces of UGC (Twitter 824; Weibo 2,370 in Chinese) were gathered as eligible data for this study. All textual data was kept as an 'internal source' in computer-aided, qualitative data analysis software QSR NVivo for further analysis.

3.2 Analytical methods: Content analysis

The present research applied qualitative content analysis for analysing the textual data and to explore contextual information. Initially developed by Berelson (1952), content analysis refers to a family of analytic techniques that systematically examine textual data in either a qualitative or quantitative way (Berelson, 1952; Rosengren, 1981; Hsieh et al., 2005: 1277). Even though initially quantitative approaches to content analysis were majorly adopted, criticisms concerning the neglect of 'latency of content' (Kracauer, 1952: 634) led content analysis down a qualitative path, thereby broadening the research scope of this method. The tradition of quantitative content analysis relies on statistical accounts, alternatively a qualitative application of content analysis

provides ‘subjective interpretation on the content of textual data through the systematic classification process of coding and identifying themes or patterns’ (Hsieh et al., 2005: 1278), which is supposed to ‘preserve the advantages of quantitative content analysis for a more qualitative text interpretation’ (Mayring, 2000: 2).

Qualitative content analysis was selected as an analytic instrument in this research to create a systematic scheme for coding and category development (Mayring, 2000). Researchers employing qualitative content analysis pay attention to the themes and core ideas revealed in the content, but they also pay attention to latent information, such as the ‘situation of text production’ and ‘the socio-cultural background’ (Mayring, 2000: 3; Hsieh et al., 2005: 1278). With respect to the present study, the content of spontaneous discussion on social media is incomplete as an idea or expression is limited to a strict number of characters (140 characters, which was extended to 280 on Twitter in September 2017). Content is also full of subjective and obscure expressions, similar to the data collected from interviews, which means that the content alone, without context, is unlikely to result in a unified understanding of the subject at hand. Besides figuring out the latent issues behind the construction of a GM-related future and examining interactions amongst major stakeholders, an analytical technique was used to explore the meanings or patterns behind content.

Hsieh and Shannon’s work (2005) refined three specific approaches to qualitative content analysis (conventional, directed and summative) which has inspired the coding and analytical route taken in the present research. An enacted coding scheme influenced by conventional and directed approaches was drawn up. In terms of Hsieh et al.’s words: ‘conventional’ content analysis is employed for dealing with data collected through ‘open-ended’ questions or from participants’ spontaneous statements and comments (Hsieh et al., 2005: 1279), this generates an open-coding scheme where coding categories are derived from the text material itself. While a ‘directed’ approach is guided by a structured theoretical framework constituted by existing theories and research outcomes to ‘validate or extend’ the theoretical construction conceptually

(Hsieh et al., 2005: 1281).

With respect to the present research, although the original conceptual structure of anticipatory governance has been established, studies assessing the potential of, or interpreting the components of, anticipatory governance remain incomplete and limited in quantity, which would benefit from a directed approach of content analysis. The data of this study was retrieved from spontaneous discussion taking place without any objective interference from the examiner so that an open-coding scheme was more effective to retain findings close to the facts arising from the data. Based on these concerns, the present study adopted a semi-open coding scheme, in which the data is mainly open-coded as some pre-determined categories were set for discerning participant identity to examine the interactions taking place between major stakeholders. The main body of the analytical work followed a directed approach through the theoretical framework established in Chapter 2 (see Section 2.3) as an instrument for analysing what was occurring in GM future-related spontaneous discussion on Twitter and Weibo.

3.3 Analytical methods continued: Coding

As an analytical procedure that identifies patterns in textual data, qualitative content analysis relies heavily on coding technique (Jensen et al., 2016: 250). In order to establish a firm grounding in the data, and obtain a general direction in which the data could be analysed, all the textual data was looked through before coding. After which, Kelle's six-step coding procedure was introduced to guide the process of coding in computer-aided qualitative data analysis software QSR NVivo. The six steps are 'format textual data; open coding of data; memo writing; compare text segments that have assigned the same code; integrate codes, and attach memos to codes and develop a main theme' (Jensen et al., 2016: 252).

The raw data collected from Twitter and Weibo was initially processed before coding

with QSR NVivo, including unifying the format and translation of text from the raw data. The translation work for Weibo data, from Chinese to English, was conducted by two independent translators. Although the work done by two translators reached a relatively high level of consistency in meaning expression, a third translator still got involved and made informed judgements on which expression was better, especially when translation discrepancies emerged. The divergences mainly arose from the translation of proper noun and requested certain support of background knowledge, such as the choice between ‘right to know’ (see page 164) and ‘right of knowing’. I have to admit that the work of data translation came across numerous challenges, especially when translating terminologies or the name of academic works. For example, in the data Weibo user ‘*Wangxiaojian*’ referred to Rachel Carson’s famous work *Silent Spring*, which, however, was mis-translated to ‘*The Lonely Spring*’ (see page 128) without timely correction.

For addressing two research questions, the thematic distribution of GM future related discussions and the online interactions taking place among the major stakeholders were investigated. After unifying the format of the text and holding it as an ‘internal source’ in QSR NVivo, the data was analysed and categorised into three sets of codes, namely ‘theme’, ‘identity’ and ‘communication model’. In general, a semi-open coding scheme, rather than the ‘open coding of data’ mentioned by Kelle (Jensen et al., 2016), was employed at this stage subject to the two selected approaches of qualitative content analysis (conventional and directed). Specifically, the data was coded thrice in terms of the themes, the identities of participants and the communication models respectively. After repeatedly reading the original data, the initial thematic codes were completely derived from the text using NVivo software to capture the key issues discussed by the participants. The codes were then sorted into categories based on how different codes are related and linked (see Appendix 1), to see how the perspectives were distributed and associated to each other, which helped produce a description of each category in the following analysis.

Predetermined codes were set up for coding the identities of participants and identifying the communication models that the samples follow. As can be seen in Appendix 1, the predetermined code framework of 'communication model' is composed of Irwin's 'First-order', 'Second-order' and 'Third-order'. While the framework of identity was originally constructed by 'Experts', 'Non-experts', 'Opinion leaders' and 'Governments', inspired by Augoustino et al.'s classification (2010). During the process of coding, any sample involving certain stakeholder (stakeholders) was coded with the corresponding identity (identities). The text that could not be organized with the initial identity coding scheme has been identified with new codes in terms of the routine of directed content analysis (Hsieh et al., 2005). 'Public intellectuals' and 'NGOs' were therefore included and made up the final coding framework together with the predetermined codes. Correspondingly, all the theories and academic literature identifying or giving an explanation to either the behaviors of participants, both predetermined or newly identified, or the models of communication were picked out and formed a theoretical framework as has been elaborated on in Section 2.3. Key thoughts and ideas relevant to the categorised codes were written down and saved as 'memos', to record 'interesting connections' between codes, 'links to theory' or any ideas that need to be highlighted for the next stage of analysis (Jensen et al., 2016: 252). Till then, the coding scheme of the present research was built up.

After finishing the initial coding work, all the codes were organised and regrouped into new meaningful clusters ('nodes') to depict the relevance and relationship between codes/themes. At the meantime, a hierarchical 'structure of node' was established (Kaefer et al., 2015). The memo attached to each code was merged and then a new cycle of analysis began; to compare and figure out the connections between different aspects of the textual segments involved in each node. The whole coding process underwent a continuous 'back and forth' interplay (Jensen et al., 2016) with the data to ensure the accuracy and consistency until the categories could no longer be integrated any further. Then, definitions for each final category were developed. At this point, the coding procedure of the present study was complete. The memo materials written down during

the coding process played a significant role in the following analytical work.

3.4 QSR NVivo: Computer-aided qualitative data analysis software (CAQDAS)

Applying QSR NVivo CAQDAS as a tool for data management in the present research is attributed to the outstanding ability of the software package to handle a high volume of data fast and efficiently (Kaefer et al., 2015: 3), followed by the ease of transferring the raw material into a usable resource for report writing (Jensen et al., 2016: 256). The additional annotating function enables researchers to record emerging ideas into memos and systematically re-organise these, originally scattered, memos into the coding structure along with the integration of codes (ibid.), which generates an initial resource for analysis and speeds up the analytical work from the beginning.

Even though the obvious advantages of applying NVivo have made it a widely used tool for qualitative research, limitations while using a software application are still inevitable because, as Kaefer said, researchers remain the person in charge of the analytical work instead of the computer (2015: 11). Criticisms towards CAQDAS argue that ‘the use of software for qualitative data analysis could hinder in-depth, interpretative analysis by distancing the researchers from the data’ (Kaefer, 2015: 11), and over-emphasising coding (Jensen et al., 2016), while at the same time other researchers who over immerse themselves in their data may lose ‘sight of [the] large[er] picture’ (Kaefer, 2015: 12). The coding work in this research was done by two independent coders. An evaluation on inter-coder reliability organised after the coding procedure inspected the extent to which the researchers coped with coding integration to ensure the methods were robust. In addition to that, making use of multiple coder strategy in this research has produced multiple sources of data of a social phenomenon, enabling researchers to have the findings cross-checked (Bryman, 2012:717). This manner of data validation through cross verification from multiple sources is argued to reflect the criteria of triangulation (Denzin, 1970; Bryman, 2012)—a significant

indicator of academic rigor, which will be elaborated on in Section 3.7.1.

Generally speaking, in most cases the coding work done by two coders reached consistency (see Appendix 2) while the major disparity of coding concentrated on the identification of public intellectuals in Chinese context (with 73.6% agreement). At that moment, the third coder jumped in and launched a supportive background investigation on the potential public intellectuals whose identity was under pending. Judgements were made in terms of the outcome of investigation —only four influential opinion leaders in my research were qualified as public intellectuals, who, however, have got involved in nearly 11% of discussions on Weibo during the test period (see Appendix 3).

3.5 Data Analysis

The systematic coding work described in Sections 3.3 and 3.4 transferred the raw textual material of this study into usable and analysable data; recording both the social construction of GM-future-related topics discussed on social media and stakeholder interaction. In doing so, the potential connection between data and existing social theories, including anticipatory governance, became increasingly clear. Moving into data analysis stage, I attempted to clarify this connection via a purposeful search among existing theories and academic work for relevant concepts that were able to provide an explanation for the corresponding data. After that, a theoretical framework (see Section 2.3 in Chapter 2) was established based on an in-depth understanding of the connotations of each concept and the relationships between them. Armed with the knowledge of important theoretical concepts I returned to data analysis to examine the level of relevance between these concepts and the data. By introducing existing theoretical concepts into the data analysis procedure as an analytical tool, the details of spontaneous discussions surrounding GM-future-related topics on Twitter and Weibo were connected to a broader range of sociological concerns, and thus a greater number of social dimensions. This ‘theoretically-oriented’ (Jensen, 2012b) approach was

integrated with the techniques of qualitative content analysis.

Regarding textual corpus as a representation of the “real” world, content analysis is a technique that reconstructs and interprets ‘in two dimensions: the syntactical and the semantic’ (Mallery, 1990; Bauer, 2000: 134). The qualitative application of content analysis selected for this study mainly focuses on semantical reconstruction, which concentrates on ‘the relation between signs and their common-sense meaning — denotational and connotational meaning in a text’ (ibid.). As mentioned previously, the ‘situation of text production’ and ‘the socio-cultural background’ (Mayring, 2000: 3; Hsieh et al., 2005: 1278) were significant dimension of analysis in qualitative research. Regarding the present research, exploring the social construction of GM-future-related topics on social media was achieved through semantical reconstruction in addition to basic statistics about the thematic distribution of GM future issues. Measurements concerning the interactions amongst major stakeholders benefited from an analysis on the latent information of content, supported by the theoretical framework through a series of theories and claims from the literature—literature which suggested explanations for how the participants interacted with each other on Twitter and Weibo. The whole process of data analysis underwent a ‘back and forth’ process in which ‘a fresh interrogation of the original data’ was conducted ‘whenever relevant’ (Jensen, 2007: 60).

All the processed data were fully read through, together with the attached memo scripts. To address the first research question about how the alternative future of GM is projected on Twitter and Weibo, I drew support from the structure of the main nodes, established during the process of QSR NVivo coding (Section 3.4), to dissect the construction of these hot topics. For example, with respect to ‘research and scientific issues of GM’—the most frequently discussed issue on Twitter and Weibo, there arose four prominent sub-topics: ‘existing and up-to-date research outcomes and application’; ‘scientific principles’; ‘scientists’ statements’; and ‘evidence about GM consequences’. These outline a picture of GM research as discussed by social media users.

The memo attached to each specific topic was carefully examined for any meaningful phenomenon that characterised GM future-related spontaneous discussion that took place on social media. Following the description of memos, I returned to the data and selected the most representative samples for in-depth interpretation. Intensive discussion following scientists' statements about the future prospects of GM retrieved from Weibo could be regarded as an example, illustrating that scientists' statements drew attention but did not persuade the public. The analysis on these representative phenomena was further linked back to the core concept of anticipatory governance, searching for a potential connection at a deeper level. For instance, widespread negative emotions discovered in spontaneous discussions are associated with free expression which is a useful engagement component for anticipatory governance to understand how people feel about GM issues.

The results at this stage address the second research question which moves away from observable thematic distribution to the interactions occurring between major stakeholders. Thus, the second research question investigates the nature of online engagement activity on a deeper level. Different from the strategy applied for the first research question, the analytical work at this stage was guided by two more detailed questions, which narrowed the second research question down to two specific aspects; namely, 'who participated in the discussion?' (participant identity) and 'what is the interaction like?' ('one-way' or 'two-way'). According to initial observations of the present data, as well as on identity information provided by Twitter and Weibo about individuals, all the discussants could be identified as 'expert', 'lay public', 'government' and 'non-government organisation'. Reviewing the present data, three types of interaction were found particularly noteworthy on Twitter and Weibo: the discussions between experts and non-experts; amongst the grass-roots-oriented anti-GM movement; and the interactions taking place between governments and the public. Representative cases were picked out to examine further. A new phase of analytical work commenced on representative cases selected to address the first and second research question of the study.

First, all the cases were analysed through a communication model lens. In other words, each selected conversation was identified in terms of its pattern of communication. Irwin's third-order thinking of science communication (2008) and Nabatchi et al.'s three-type classification of public participation (2015) were utilised at this point as a basic standard of evaluation to identify the model of communication that each spontaneous discussion was following.

Second, regarding the large-scale anti-GM movement expressed on Twitter and Weibo, the dynamic performance of a few social media users inspired me to refer to the theory of two-step flow communication (Katz et al., 1955; Choi, 2016). This theory provides an explanation for the role that public opinion leaders play in the context of online engagement. Public opinion leaders, who were actively mobilised on Weibo, were famous public intellectuals in China; which brings the theory of the public intellectual (Jacoby, 1987; Bourdieu, 1991; Posner, 2003) into the research along with its associated political implications. Let me explain, adopting the concept of the public intellectual as an analytical tool the present research identified the massive anti-GM movement on Weibo as a grass-roots-oriented social movement led by public intellectuals, which inspired me to introduce Beck's sub-politics theory (1992) to analyse the potential implications of the anti-GM movement for Chinese democratic politics.

Lastly, this research paid attention to the interactions between the government and the public on Twitter and Weibo, which was found to be underdeveloped. In addition to an analytical communication model lens, Bertot et al.'s work about the dilemmas of social media usage faced by governments (2012) was drawn upon for explaining the smaller amount of government participation on social media when compared to other major stakeholders. All the theories and academic work applied to data analysis construct the theoretical framework of this research. An analysis that involved a 'back and forth' process between theories and data analysis took place whenever new theories or research outcomes were needed to explain phenomena arising from the data.

3.6 Epistemological considerations

The epistemological stance of qualitative content analysis played a significant role in determining the data analysis strategy of this study. Considering the relationship between knowledge and “truth” from a philosophical perspective, the epistemological position addresses whether the social world could and should be studied in the same way as natural science research (Bryman, 2012: 27). Based on this concern, two contrasting paradigms of epistemological consideration were considered, namely positivism and interpretivism (Somekh et al., 2011; Bryman, 2012).

The application of qualitative content analysis is believed to be closely associated with the assumptions of interpretivism (Bauer et al., 2000; Mayring, 2014). Inheriting the intellectual traditions of *Verstehen* (Weber, 1947), hermeneutic-phenomenology (Bogdan et al., 1975) and symbolic interactionism (Blumer, 1962), interpretivists purposefully deviate from the natural science research model, as studying the social world requires unique logic to reflect on ‘the distinctiveness of human as against the natural order’ (Bryman, 2012: 28). Therefore a division is drawn between the nature of humans and objects. Rather than accepting a casual explanation of human behaviour, interpretivist research seeks to understand human action through the interpretation of a diverse number of subjective meanings of “social reality”, because, interpretivists believe (Henn et al., 2005), that there is not one “truth” or “true” social reality, because human behaviours and experiences are determined by subjective factors, such as ‘conscious intentions, motives and purposes’ (Henn et al., 2005: 15), instead of an external ‘force that are deemed to act on it [behaviour]’ (Bryman, 2012: 28). Based on the nature of interpretivism, qualitative research is the major means of practicing the epistemological stance of the interpretivist (ibid.). That is, interpretivists apply themselves to obtain an understanding of certain social action through investigating the interpretations participants place on their actions (Bryman, 2012: 380).

Thus, the epistemological implication of the present research is very clear: under the

epistemological guidance of interpretivism, qualitative content analysis was adopted as an analytic instrument in this study to explore the potential of social media use for carrying out anticipatory governance, during which the behaviours of social media users were intensively analysed.

3.7 Quality in qualitative research

Quantitative content analysis has, to some extent, been described as ‘superficial analysis’ (Mayring, 2000: 2) and yet an over-reliance on quantification by quantitative methods may reduce the accuracy of analysis by neglecting a deeper qualitative approach (Kracauer, 1952: 631). However, doubts on the subjectivity and the opacity of qualitative analysis are inevitable when we consider the challenges of adopting a qualitative approach (Thorne, 1997: 117). Not merely qualitative research, the whole realm of social science research is undergoing a critical self-reflection concerning research quality (Bauer et al., 2000; Bryman, 2012: 389). For quantitative researchers, reliability, validity and objectivity are three essential criteria for maintaining and assessing the quality of ‘concept measurement’ (Bryman, 2012: 170; Bauer et al., 2000: 342). While in qualitative research, the concern rests on whether the criteria being used are justifiable. Justifying the validity and plausibility of qualitative research has aroused much discussion in the methodological literature.

Some researchers, like Mason (1996) and Silverman (2000), assimilated reliability and validity into qualitative research by altering the definition of these two terms. Other methodologists, such as Thorne (1997), Bauer and Gaskell (2000), disagreed with this approach by saying that the classical criteria of objectivity, validity and reliability applied to assess quantitative research are not appropriate for qualitative research, given qualitative researchers’ completely different epistemological stance from that of quantitative research. An alternative set of criteria, which assess the quality of qualitative research, is therefore established in the methodological literature and supposed to have an equivalent function as that of quantitative research (Thorne, 1997:

120-121; Bauer et al., 2000: 342; Bryman, 2012: 390). Inheriting Thorne's claims about quality evaluation (1997), Bauer and Gaskell's criteria, including triangulation, reflexivity, thick description, transparency and procedural clarity (2000: 342-347), have been introduced in this study for building up a reflexive mechanism to demonstrate the quality of research. Furthermore, Jensen and Laure's suggestion of involving 'deviant-case analysis' as a criterion to secure the quality of the research was also introduced. I will now elaborate on these five criteria, connecting to the present research in relation to quality assurance.

3.7.1 Triangulation

Triangulation was defined by Denzin as 'the combination of methodologies in the study of the same phenomenon' (1970: 310), which is believed by Bryman as a somewhat broad way of employing this criteria in qualitative research (2012: 392). Bryman also viewed triangulation as 'the use of more than one method or sources of data in the study of a social phenomenon so that findings may be cross-checked' (2012: 717). A 'more than one method' and a multiple 'sources of data' approach have been adopted in the present study. As introduced before, a multiple coder strategy was employed in the present research so that data was coded by two independent coders and at least two sources of data were emerged. The proportion of agreement reached by coders as shown in Appendix 2 has to some extent supported the reliability of this coding strategy, and meanwhile reflected a high standard of triangulation. All the collected data in this research were categorised according to themes, after which the descriptive data analysis technique (provided by NVivo), and which is frequently used in quantitative research, was employed to measure the thematic distribution of GM future-related spontaneous discussions. The content analysis method in this research was mainly applied qualitatively, however, statistical function used by a quantitative approach was also adopted as a supportive tool (see Appendix 3), providing data evidence for the subsequent in-depth interpretation of the data (in Chapter 4). On the one hand, the findings of this research were supported by more than one source of evidence; on the

other hand, the theoretical concept of public engagement—one of the three components of anticipatory governance—was interpreted alongside five other existing theories from multiple analytic angles, by which a comprehensive structure of theory that is capable of analysing complicated social phenomena was established.

3.7.2 Reflexivity

Reflexivity in qualitative research refers to a procedure that ‘value[s] the researcher’s own contribution to the understanding and to trace how the researcher’s original sense of the topic changes over the course of the research’ (Angen, 2000: 383; Bergum, 1991), which can also be understood as an act of self-reflection on the changing construction of researcher’s knowledge throughout the course of their research study (Jensen, 2007: 64). Reflexivity is basically about situating researchers in their own research with a clear awareness of the ‘*a priori* normative position’ (ibid.). As argued by Jensen (2007: 64), the acknowledgement of the inevitable bias brought to the research by researchers is encouraged by the reflexivity method; a disclosure of the normative position that identifies researchers’ motives and interests in studying their topics facilitates reflexive work in empirical research.

Two existing beliefs constitute my normative position. Firstly, although my attitude to GM technology is not discussed in the analysis chapters, I believe that there are supportable reasons why governments’ made a decision to not completely ban the application of GMOs. I have faith in the social value of GMOs, which balances their potential risks. My assumption about GMO’s safety is summarised well by the following statement made by WHO: ‘no effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved’ (May 2014). Secondly, I have to admit that I came into this research with a sceptical attitude towards the massive anti-GM movement taking place in both the physical and virtual environment. I believe that the intensive emotional and provocative speech that the anti-GM movement spreads among the public is powerful

in steering public opinion without relying on scientific evidence, which obstructs independent thinking.

Based on my belief in the social value of GM technology, I set out to study anticipatory governance as a way of managing contested emerging technologies, such as GMOs. With regard to the gigantic wave of GM-related discussion on social media, I intentionally gave equal attention to both anti-GM and pro-GM voices to see how and with what arguments the entire debate is structured. Being sceptical about the motives of the anti-GM movement, I probed further to interpret the behaviours of anti-GM activists, who were later identified as public intellectuals, and tried to understand the social phenomenon of their struggle in a deeper sense. Additionally, I attempted to see whether social media as a public engagement resource is capable of aiding the implementation of anticipatory governance; despite GM-related spontaneous discussions which, sometimes, do not support making use of GM technology, therefore, seemingly creating a noise which obstructs the management of new technology.

3.7.3 Thick description

The criterion of thick description refers to an ‘extensive use of verbatim reporting of sources’, outlining ‘the color, the language and the life world of social actors’ (Bauer and Gaskell, 2000: 347). According to Lincoln and Guba’s view (1985), thick description enables readers to form their own judgements about the likelihood of transferring the findings or conclusions of a study into other social milieus. In other words, the verbatim extracts of original sources create rich, contextual information which empowers readers to consider the validity and application of the empirical results. Jensen and Laure elaborated on the best ways of using thick description on a practical level (2016: 279), saying that ‘longer segments of text rather than brief, isolated quotations’ are necessary. Regarding the present research, verbatim analysis completed at the beginning of the coding procedure, and the establishment of memos recording a wide range of ideas that extended through the data (see Section 3.3), illustrate that thick

description has been adopted in the present study. The following chapters will display the consequence of this quality assurance method.

3.7.4 Transparency and procedural clarity

The transparency and the clarity of data processing work are essential to the quality assurance of qualitative research (Bauer and Gaskell, 2000: 346). According to Bauer and Gaskell's perspective, transparency is demonstrated by providing a detailed description of the original data, the coding frame used, and reasons for the selection of the analysis method; and clarity can be observed from the descriptions of data collection and analysis (*ibid.*). According to the research procedures described in the chapter above, the flow of data coding and analysis has been clearly outlined. The choice of methods and the reasons supporting the selection have also been indicated. A detailed description of the data and the coding frame used for content analysis will be mentioned in Chapter 4.

In addition to Bauer and Gaskell's perspective about transparency and procedural clarity, Jensen and Laure put forward another mechanism of measurement called 'audit trail' (2016: 279)—under the assistance of CAQDAS. In this research, NVivo software helped to establish an audit trail system by recording nearly every data processing step carried out with the software. For example, every data source kept in NVivo as 'internal' or 'external' sources were labelled with information concerning their time of creation and recent modifications, which enables me to trace the development of ideas. The creation of a new node came with a detailed description about what the node referred to and what sources it was linked to. The observed 'relationship' between nodes outlines the structure of nodes and leads researchers to all the relevant sources. The location of sources in the raw data is also capable of being highlighted with NVivo, so that contextual information is much easier to obtain. The creation of memos is able to record and explain the structure or the pattern of nodes. Therefore, it can be said that with the technical support of NVivo, the present study has made an effort in securing the

transparency and procedural clarity.

3.7.5 Deviant-case analysis

The present study involved deviant-case analysis. In Bauer and Gaskell's criteria framework (2000), the technique of 'deviant-case analysis' pays special attention to cases in the data which 'point in the opposite direction' to 'initial findings' (Jensen and Laure, 2016: 281). Deviant-case analysis was not taken into proper consideration until 2012 when Jensen (2012b) applied this measurement to improve 'the quality and accountability' of analysis (Jensen and Laure, 2016: 281).

By discerning 'low frequency examples' (ibid.) in the data that oppose the main conclusion, this method of analysis provides an opportunity to question the initial findings by seeking a reasonable explanation to justify these cases in relation to the entire data set. In other words, an involvement of deviant-case analysis is an external challenge introduced by researchers, a method that forces themselves to improve and refine their initial analysis which includes acknowledging 'diversity in the data' (ibid.). Failing to provide a reasonable explanation for opposing examples leads to a fresh evaluation of the initial coding categories to cover the full range of phenomena revealed by the raw data (Jensen and Laure, 2016: 282). In this thesis, space was given to deviant-case analysis after the main data analysis stage, thereby critically improving the analytic work of this research.

In Chapter 4, the results of the analytic work described in Chapter 3 will be presented surrounding two core research questions: how the alternative future of GM was projected by members of the public, and how GM stakeholders interacted on social media. Rather than addressing these research questions with an analysis on high-frequency phenomenon only, this research will go one step further to target low-frequency deviant cases arising from the raw data to evaluate the validity of the conclusions.

Chapter Four. Results: The alternative future of GM framed on Twitter and Weibo

4.1 The thematic distribution of GM future-related issues

In most cases, previous studies on the comparison between Twitter and Weibo tend to follow a quantitative research approach (e.g., Ma et al., 2016; Yu et al., 2017; Huang et al., 2017) to calculate the distribution, coverage or frequency of certain topics discussed on the two platforms. However, this method bypasses the substantial content of posts, which should be regarded as a direct element which distinguishes one social media platform from another. In addition, the content of posts provides a means to reflect on the role of social media to understand how public opinion is generated in completely different social environments. Therefore, the present research follows a qualitative approach and delves into the details of topic framing to observe how GM-related futures are projected on Twitter and Weibo.

Investigating the thematic distribution of these GM-related futures is a means of mapping out future-related topics discussed on social media from an observable perspective. The outcome of this investigation will help obtain an overall picture of how an alternative GM future is framed by social media users. In general, the future of GM technology is constructed by a variety of dimensions that range from economic concerns to science management issues. There exists a high level of overlap in the data regarding the distribution of thematic frames between Weibo and Twitter, and regarding the ranking of these themes in terms of the frequency of topics being discussed. This information indicates that regardless of the language, social, cultural and political background of participants, people basically have the same concerns about the future implications for GM technology. Yet, the specific subdivided issues of each frame discussed on Twitter and Weibo differ from one another, demonstrating distinct social and cultural features of the two, different language environments. In general, covering diverse GM issues, thematic framing on social media causes people to perceive and conceive an alternative GM-related future, which also affects the direction of public opinion on such a controversial technology. Moreover, the three-fold capacity of anticipatory governance can be clearly identified from spontaneous discussion about

the prospects of GM on social media, suggesting that social media have the potential to support the anticipatory governance of GM issues.

The following section will engage with the results of qualitative content analysis concerning the framing of different GM-related futures. After qualitatively analysing the patterns of user-generated content on Twitter, a framework constituted of the five hottest themes that produced a high volume of online discussion is refined from a large amount of information from online conversation (824 tweets, a total of 7,563 words). The five thematic frames include: research and scientific issues, governmental management and intervention, attitudes toward GM, safety issues, and implications for the use of GM technology. Considering Weibo, the future-related frames of GM tend to be unequally distributed among five heated themes which show a high similarity to Twitter: research and scientific issues, GM governance, GM labelling policy, public attitudes towards GM and GM safety issues. Referring to nearly fourfold the quantity of the raw data collected from Twitter (2,370 pieces of Weibo content with 30,190 Chinese words) the user-generated content on Weibo covers a wider range of attributes and a more diverse range of propositions raised in discussion than Twitter, discussions which have been embedded with Chinese features.

Section 4.2 then proceeds to interpret conversations on social media in more detail with the assistance of theoretical concepts—the three ingredients of anticipatory governance—to gain an insight to the conceived futures of GM.

4.1.1 Research and Scientific issues

On Weibo and Twitter, the theme 'research and scientific issues' covers a couple of research-related issues, including: the latest, and previous, outcomes of GMO research; the scientific principles and practical application of GMOs; the supportive evidence for the consequence of GM technology, and the issues relating to properties of GM research, such as funding sources and ownership. These conversations occupy the highest

percentage of eligible content (16% on Weibo, 18% on Twitter), thus research and scientific issues can be ranked in first place in terms of GM-related discussions. With respect to the Chinese context, aside from these conventional issues some topics also discuss the prospects of Chinese agriculture attributed to GM technology, such as a newly invented Chinese App for monitoring the growth of GM crops. Overall, ‘research and scientific issues’ has been regarded as one of the central issues when people discuss alternative futures concerning GM.

4.1.2 Governance and government

Closely following the issue of GM research, the governance and government-related topic gave rise to countless discussions, which made it another must-talked about and controversial theme on social media. Different from the high consistency of GM research issues in Chinese and English, there exists an obvious distinction on Twitter and Weibo. Specifically, Twitter users tend to be more interested in ‘governmental management and intervention’, which encompasses the actions taken by governments, such as policymaking, regulating and supervising. Topics about policymakers, politician and political officials are also included under this label. While in contrast, the same theme on Weibo is named ‘GM governance’ and the focus of discussion diverts from government actions to a series of public governing behaviours targeting GM technology, such as appealing for legislation, improving the policy system, protecting individual’s civil rights and shaping the government’s image, which, of course, covers governmental management and intervention and extends to a broader range of social actions, such as the public intellectual-led anti-GM movement on Weibo.

Discussions about GM governance accounted for 13% of Weibo’s coverage while government behaviours occupied 9% on Twitter, both of which rank second place following ‘GM research issues’. It is also noteworthy that on both social media platforms, disputes over GM labelling policy has been a heated topic and attracted high participation. With respect to the outstandingly high coverage of GM labelling on

Weibo and Twitter, in this research GM labelling policy will be treated as a very specific and representative issue (see Section 4.2), to reflect how discussants envisaged such a hot and controversial topic on social media.

4.1.3 Attitudes toward GM

Regardless of the environment of language, social media serves as a public forum where people are able to express personal ideas, attitudes and preferences freely (Grubmüller, Götsch and Krieger, 2013: 20). The present data shows that attitudes towards GMOs are widely expressed on Weibo and Twitter, however, with different focuses. Regarding user-spontaneous discussion about possible GM futures on Twitter, the composition of attitudes toward GM within discussions is much more complicated than expected. Generally, rather than being able to simplistically divide the debates into supporting and opposing options, the attitudes can be classified into six specific dimensions, namely support, suspicion, anti-GM, object to anti-GM, trust and unsureness. Participants' detailed moods, tones, values and beliefs behind their words contributes to the classification. Attitudes conveyed on Weibo show complicated dimensions, and also deviates in terms of the different attributes of GM technology. In other words, Weibo users tend to express attitudes toward certain specific attributes of GM, the management of GM for example, instead of commenting on the issue of GMOs as a whole.

Similar to any other discussion or debate, subjective factors such as personal values, beliefs, and attitudes permeate into and are delivered, either directly or indirectly, in communication with others. Regardless of the purpose of declaring personal attitudes, expressions with clear attitudes has an effect on steering the direction of public opinion on a target topic. GM issues are not an exception, which will be further analysed in Section 4.3 and 4.4. To summarise, occupying 8% of the eligible content on Twitter and 6% on Weibo, attitude-related tweets rank third place amongst the top most popular themes framing the future of GM technology.

4.1.4 Safety issues

Issues about the safety of GM technology draw extensive attention from the public when people are conceiving what the possible future of GM technology may look like. Regardless of the language context, safety issue of GM technology referred to any possible influence that GM brings with it concerning the safety of individuals, communities, societies and the natural environment. In most cases, the main safety issue of GM concerns forecasts about the implications of GM, either positive or negative. This thematic topic illustrates the capacity of foresight expounded in anticipatory governance, which will be fully discussed and analysed in Section 4.4. As can be seen from the present data, the safety issue of GM technology is a key factor affecting the attitudes of many people towards GM technology, who then tend to be cautious about the prospect of GM technology and believe that people will have to pay for the consequences of misapplying GM technology in the future. Therefore, this conceived association discusses the relationship between safety and attitudes toward GM will be further interpreted (in Section 4.3). Generally, regarding the present data, 5% of the content refers to the safety concerns about GMOs on Twitter and 6% on Weibo, ranking safety issues in fourth place amongst the top most popular themes of discussion.

4.2 GM Labelling: A rational and forward-looking action confronting future uncertainties

As discussed before, GM future is a rather broad topic covering a diverse range of specific themes, including GM-related policymaking. GM labelling is an appeal for clearly identifying GM ingredients in products by using a unified and standard label (Food Standards Agency, 2013). The practice of GM labelling has been implemented in the EU since 2003 (Regulation (EC) No. 1829/2003 of the European Parliament and of the Council on genetically modified food and feed, 2003). However, as a forthcoming policy in China and the USA, the GM labelling issue has ignited intensive discussion on both social media platforms. During the debate, a wide range of possible

consequences, either instant or long-term, as a result of a GM labelling policy would have been anticipated in an informal manner, by which I mean discussants demonstrate personal attitudes toward the formulation of policy. Regarding the notion of foresight, applying a methodologically pluralist approach to develop as many future scenarios as possible is what foresight capacity aims to achieve. In order to exert influence on the determinative work of governance, people following a foresight approach try to make use of variable methods to explore the most likely future, and limit the uncertainties of emerging technology (Barben et al., 2008). Anticipating the long-term societal implications of technology such as GM serves as a primary means of limiting uncertainties in the future; thus, affecting decision-making in the future could be seen as the final purpose of foresight. In this research for example, consequence-oriented discussions of GM labelling generated from social media engagement can benefit scenario development for government purposes. This example reflects the foresight capacity that spontaneous discussion on social media is equipped with and that governments could, and should, make more use of.

GM labelling supports consumer rights by providing them with information to make choice between GMOs and other conventional products (Food Standards Agency, 2014). GM labelling regulation was first introduced in 2003 and was implemented within the EU afterwards (Department for Environment Food and Rural Affairs, UK, 8th May 2015), despite regulations being in place a GM food labelling policy has not yet been applied to the full range of foods available (ibid.). Amended provisions of the GM labelling regulation are still under discussion for strengthening the consistency and efficiency of implementation (Food Standards Agency, 2014). GM labelling is inherently a forward-looking issue, so spontaneous discussions about GM labelling tend to concern the long-term implications of this emerging policy. The present data shows that GM labelling accounts for a high coverage of the eligible content collected from Weibo (10%) and Twitter (7%). A series of topics derived from GM labelling have drawn great attention from the public and extensive discussion is visible on social media. What is more, surrounding the implications and possible consequences that GM

labelling brings with it, spontaneous discussion on social media has fully exemplified the foresight of anticipatory governance.

In the subsequent section, the theoretical concept of foresight will be applied to analyse spontaneous discussion concerning GM labelling. This analysis enables us to see how alternative futures of GM are framed by forward-looking action.

4.2.1 Long-term implications embedded in spontaneous discussion

Scenario development—the major objective of foresight—could be achieved through anticipating the long-term implications of GM technology; anticipation also helps to acquire basic knowledge about what the future may look like. In terms of the present data, foresight capacity manifests itself, prominently, in intensive debates on the long-term implications of GM labelling. Discussants on social media conveyed personal attitudes toward GM labelling with supportive evidence retrieved from scientific articles, news stories or personal experience. During the process of making an argument, discussants consciously or unconsciously described an alternative hypothetical future as a consequence of the long-term implications of the use of GM technology. Even though the implications run in diverse directions, varying from civil rights to price fluctuations, and from commercial interests to livelihood issues, the spontaneous discussion surrounding the possible societal implications of GM technology demonstrates an attempt to look ahead and prepare for the most likely future.

The first and also the most popular contention about GM labelling on social media is whether GM products should be labelled. Viewpoints vary a lot from person to person, while two outstanding voices dominate the discussion: for and against (which I will refer to as support and opposition). According to the distribution of attitudes in the data on Twitter, people who support GM labelling seem to be neck and neck with those who oppose GM labelling. The opponents of GM labelling, such as ‘**Cosmic Hominid**’, state that labelling methods are only necessary when an ‘actual’, proven drawback to

human health has been demonstrated by GM technology. Otherwise, any deliberate action pointing out GM-related information is just ‘superfluous’.

Cosmic Hominid Mar 17, 2014

@beachvetlbc If the food presents actual health risk, then it might be appropriate to label. In the case of GMOs, it doesn't, so it's superfluous to do that.

Some opponents of compulsory labelling believe that the ‘demand for GM labeling’ ignores scientific evidence. However, this viewpoint has been completely refuted by the supporters of GM labelling.

Brian Urbancic @SciGroupie Mar 17, 2016

@SetthemF @mamaliciousdc @HillaryClinton I'm curious if you are a science denier in general, or just for GMOs.

setthem free @SetthemF Mar 17, 2016

@SciFan66 @SetthemF @mamaliciousdc @HillaryClinton I'm curious as to how you equate a demand for GMO labeling with a denial of science? Geez.

On Weibo, debate over the necessity of labelling GM also takes place between supporters and opponents who are equally distributed in the data. To the supporter of GM labelling, securing basic civil rights provided by GM labelling serves as a convincing reason to make them stand their ground. As can be seen from content on Weibo, phrases like ‘right to know’ and ‘right to make choice’ are frequently mentioned.

Southern Metropolis Daily Dec 21, 2015

[Food security policy draft of Shenzhen city: GM label must be attached clearly] From now on, it's likely to constitute an offense if GM food is not clearly labelled. Recently, the local government of Shenzhen has publicly solicited opinion from the masses about drawing up 'The food security regulations of Shenzhen special economic zone (draft)'. It is required in

the draft that a GM label should be attached on a salient part of the package with the characters 'Zhuan Ji Yin' (GMO) which shouldn't be shorter than 1.8mm. What do you think?

BubbleCandy Dec 21, 2015

Shenzhen, well done! This is the case. If you are not afraid, please go ahead. People who are afraid have the right to reject. Customers have a right to choose whether to eat GM food. Nobody can impose their own opinion on others.

Yanzixiaowo Dec 21, 2015

*Replying to@ **BubbleCandy** Good job! We at least have the right to know whether it is GMO so that we won't be helpless if there happens to be something negative in the future.*

BubbleCandy Dec 21, 2015

*Replying to@ **Yanzixiaowo** True. I'm not fighting against GMO. I just think people should be given the right of not buying.*

Here, a very typical case of discussion about civil rights resulted from a piece of news posted by Southern Metropolis Daily's official account—a well-known newspaper in China. In terms of the original content post, by Southern Metropolis Daily, a new draft of regional policy had been put on trial in Shenzhen city about food security; clearly regulating the size (no less than 1.8mm) and the indicating position (salient region on the package) for GM labels. This new rule was directed against the lack of consistency and clarity for GM labels that widely exists across the country. Similar to the example shared above, most of the discussants expressed a supportive attitude to the new policy, saying that people have a right to know what they are buying so that they can make a choice and be responsible for themselves instead of taking any risks without being informed. As argued by 'Yanzixiaowo', making the identity of GM products transparent provides people with the ability to resist these products, while a lack of transparency does not allow people to freely make their own choice regarding the

unknown dangers or risks of GM food. Labelling is essential to secure this basic right for the public.

It is clear that the protection of civil rights is a possible societal implication of GM labelling that some discussants were expecting. Although it is still too early to affirm that civil rights are able to be secured through the GM labelling movement, discussants have shown an intention of thinking ahead which informs government decision-making by illustrating future concerns linked to possible implications attributed to the policy of GM labelling. Even though spontaneous discussion might suggest a lack of organised debate—unlike public deliberation (Barben et al., 2008: 986)—issues relevant to the future, and the conceived implications of GM labelling raised during discussion arise just as often as those involved in any formal activity.

Xiatianderejifeng Nov 16, 2015

We're not opposed to GMO, but we go against illegal over-planting and the absence of a GM label. We take a stand against the behavior of imposing one's opinion on others in the name of science. We have the right of deciding what and how to eat.

Tengxundepiaopiaohebianliu Nov 16, 2015

Replying to @Xiatianderejifeng Here is my opinion of GMO: I support scientific research on GMO and the legal action of popularizing GM technology. I reject illegal or private planting. I don't agree with the idea of holding a GM product tasting events nor the mandatory label of GM, even though I believe a GM label makes sense. That's it.

OJO880 Nov 16, 2015

Replying to @Xiatianderejifeng The mandatory label is designed for securing your right of saying no to a GM product when you don't want to eat it. People will lose their right to make a choice without GM labels because they won't be able to even identify the food. GM labelling is also a means of facilitating the governance of GMO! Imagine if people discover that GMO is harmful one day, all the GM products with labels could be clearly identified

and removed immediately. Otherwise, people will take the risks of having GM food without realizing that they do.

Xiatianderejifeng Nov 16, 2015

*Replying to@ **OJO880** Indeed! And the factual situation must be more complicated than this assumption. For example, how can we make sure that the ingredients of food materials used by the food industry are transparent to the public?*

Apart from the discussions on ‘right to know’, the ‘right to make choice’ serves as another critical point that discussants were concerned about regarding GM labelling. Users, like ‘**OJO880**’, deemed that labelling GM products was essential for government to supervise the production and the selling of GM products. He/she even thought about what would happen if it was necessary to remove GM products from the shelf, should the worst happen and GM was identified as being harmful to human-beings. It would be easier to identify and remove the harmful product once clearly labelled. Meanwhile, the discussants, including ‘**Xiatianderejifeng**’, held the belief that distinguishing GM products from normal foods provides a chance for the public to make their own choice and be responsible for their own preference.

Scientists haven’t discovered any harmful effect brought by GM to human-beings or the environment (WHO, May 2014), which, however, has failed to persuade people to accept GM technology. Many people, such as ‘**Tengxundepiaopiaohedianliu**’, recounted that not discovering any harm is not equal to completely safe. They worry about the potential risks of GM that may be found in the future, with implications for people’s health, potentially, as in the case of the BSE scare, deadly. In this case, an alternative has been provided by social media discussion that present the Chinese government with a feasible way out of the dilemma. A solution that enables people to make their own decision and correspondingly bear the price of their own choice.

Similar to ‘right to know’, people regarded the freedom of making a choice as a primary

benefit brought by GM labelling policy, which contributes to the protection of civil rights. Without an absolute assurance on the consequences of GM technology, people preferred to be prudent when discussing GM technology instead of ruling out the possibility of risk. For example, user ‘**OJO880**’ outlined a possible scenario of not labelling (‘without GM labels’) and came up with a potential future where GM brings danger to mankind (‘Imagine if people discover that GMO is harmful one day’), an example ‘**OJO880**’ used to argue for the necessity of labelling. Although the conceived scene made up in the discussion is hypothetical, it did help to develop the debate about the necessity of compulsory labelling due to the possibility of a lagging reaction to the risk of GM technology without GM labelling.

Taking this example further, through a specific scene discussants anticipated a diverse range of probable situations that they might encounter in the future as a consequence of GM labelling. In terms of Barben et al.’s interpretation of foresight capacity, approaches to anticipating the long-term implications have no necessity to contain ‘accurate predictions and allegiance to technological determinism’ (2008: 985) but focus on ‘limiting uncertainty’ (2008: 986). In this case, although the spontaneous discussion on the long-term implications of GM labelling is loosely structured and lacks convincing evidence, when comparing the participants’ conversation about food labelling with the restricted requirements of scenario development, in terms of looking-forward and outlining likely futures, their discussions are similar to anticipatory governance which envisages an alternative future to act upon.

Referring to the same topic with a different emphasis on the implications, the users on Twitter believed that GM labelling policy has never overlooked or denied the existing outcomes of GM research that ‘no effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved’ (WHO, May 2014). On the contrary, the GM labelling movement is seen by those Twitter users as a rational and forward-looking action that takes a step further forward than the existing scientific research for preventing potential risks.

Specifically, in terms of the data selected from Twitter, numerous people, such as ‘guayzimi’, recount that it is irresponsible to equate an area with unknown adverse impact to a completely and permanently safe matter.

guayzimi Mar 28, 2015

@turpin4prez @azta110790 Is it reasonable to want to avoid GMOs as a class b/c you think they might be harmful, or they are harmful to the [missing text in original tweet]

Starman Spiff Mar 28, 2015

@turpin4prez @guayzimi Someone just needs to explain to the people that GMO's are not bad for them at present.

guayzimi Mar 28, 2015

@azta110790 How could you equal[equate] ‘GMOs are not bad for them at present’ to permanent safety? And how would you expect[bracketed word in original tweet]

guayzimi Mar 28, 2015

@azta110790 that people will be persuaded by that?

The huge undiscovered space of GM technology indicates countless uncertainties, including potential risks.

sesameki Jul 17, 2016

@mamaliciousdc@HillaryClinton Labeling GM at least makes them aware of the ingredients and potential risks.

Mamaliciousdc Jul 17, 2016

@sesameki @HillaryClinton Exactly. Labeling is forward looking while there’s uncertain risk.

As ‘seasameki’ argued, what the mandatory label of GM brings is supposed to be a caution of GM ingredients and their associated ‘potential risks’. As the present data indicates, discussants, such as ‘Mamaliciousdc’, treated GM labelling as a specific strategy looking ahead to consider a point where people might face an ‘uncertain risk’. Therefore, apart from anticipating and debating the possible long-term implications of GM labelling, spontaneous discussion on GM labelling itself is analytically attuned to foresight.

4.2.2 The pluralism of views enables critical thinking and builds up reflexivity

According to Barben et al.’s interpretation, the major approach of foresight to affect decision-making work is ‘encouraging and developing reflexivity’ (2008: 986). In other words, scenario development is supposed to, in principle, benefit the establishment of reflexivity mechanisms to guide decision-making. Regarding the format of spontaneous discussion on social media, pluralistic views enables social media users to critically think about the values surrounding GM labelling policy instead of being blinded by a one-sided argument. Meanwhile, reflexivity is likely to be built up through discussion, creating a resource for decision-makers; that is, when the information available to reference is abundant, comprehensive and critical enough as seen in the present data.

Although the proposal of labelling GM is widely upheld on social media, the supportive voice did not overwhelm the opposing one. People worrying about the probable negative consequence of labelling behaviour expressed their concern in heated debate. Throughout the discussion on the potential negative implications of GM labelling, a number of key features of foresight capacity as mentioned by Barben et al. (2008) and Guston (2010) are clearly indicated. Some of them even share the same function of the conventional approach of anticipation, such as forecasting and scenario development (Barben et al., 2008: 9).

Woyufengkuang09691 Apr 14, 2016

*Replying to **Haishikevinsuanle** I don't oppose GM actually because I have no idea about its long-term implications. I prefer not to eat but won't stop others eating nor planting. However, why don't the supporters of GM label GM products? Do you wanna strip my right of choosing? If GMO is as good as they believe, does their insistence of not labelling strip people's right of knowing and choosing?*

Haishikevinsuanle Apr 14, 2016

*Replying to **Woyufengkuang09691** Then may I ask why wasn't hybrid rice labelled when it was first issued? Could we choose not to eat? Can we afford GM food once labelled?*

Woyufengkuan09691 Apr 14, 2016

*Replying to **Haishikevinsuanle** Did anyone object to hybrid rice before? If so, I agree with the idea of GM labelling. If no conclusion can be drawn out, then I think we can label both GM and non-GM and leave the right of choosing with people. Dare GM [supporters] do like this? Now do you want to mention the issue of cost?*

Luobishanxiadediaoxiang Apr 15, 2016

*Replying to @ **Yuyanguanshi** @**Haishikevinsuanle**: Go and have a look in the supermarket then you will know how much more expensive the non-GMO oil is than that with no label. Don't take it for granted.*

In terms of the data, two issues have been raised that take two opposite attitudes toward GM labelling. On one hand, as mentioned before, people, like '**Woyufengkuang09691**', believed that GM labelling was key to a consumer's right to make a choice and know what choice they are taking. On the other hand, discussants with scruples about the labelling movement such as '**Haishikevinsuanle**' speculated that the price of non-GM food and the volume of GM product consumption would be heavily affected as a result of GM labelling. Here, either protecting civil rights or affecting the price of the food market are societal implications, despite running towards different directions.

Talking about the possible influence of GM food on the price of natural food, Weibo user ‘Yuyanguanshi’ and ‘Luobishanxiadexiaoxiang’ even went beyond predictable implications to discuss a wider range of possibilities through a series of logical reasoning, which not only exemplifies anticipating long-term implications, but suggests multiple futures commonly seen in the conventional method of forecasting (Barben et al., 2008: 986). It is clear that whatever implications spontaneous discussion involves, discussion greatly enriches perspective and at least offers a chance for the discussants to critically think about the value of GM labelling, rather than being blinded by one-sided speech.

Yuyanguanshi Mar 28, 2016

They are clear that once GM products are strictly labelled, customers and merchants will reject GMO, which leads to the end of GMO.

Luobishanxiadediaoxiang Mar 28, 2016

Replying to @ Yuyanguanshi Go and have a look in the supermarket then you will know how much more expensive the non-GMO oil is than that with no label. Don’t take it for granted.

Yuyanguanshi Mar 28, 2016

Replying to @ Luobishanxiadediaoxiang Doesn’t it exactly indicate the intensive purchase intention of customers? Not willing to label GMO products by reason of not willing to bear the cost of governance is actually a behavior of fooling customers regardless of what they are concerned about. Whatever, the right of choosing should not be deprived. Honestly, I’m neutral to the debate about whether GMO is harmful. However, since customers are worrying about this issue, GMO products ought to be labelled for securing the right of knowing.

Luobishanxiadediaoxiang Mar 28, 2016

Replying to @ Yuyanguanshi Have you ever think about the situation that the labelled non-

GM food will result in an inevitable increase of the price of natural food, that's a nationwide livelihood issue. The increasing cost of daily expenditure reads to further social conflict. What should the government do then?

Discussant **'Luobishanxiadexiaoxiang'** and **'Yuyanguanshi'** raise an issue: can everyone afford to have a preference? They have referred to four possible consequences that the GM labelling movement might utilise: consuming preference diverting to non-GM products, the increasing price of non-GM products, the growth of basic living expenditure for some people and further social conflict. In addition to that, they also provided a logical reasoning connecting those four possible consequences. Their reasoning serves as another typical case boosting the diversity of opinions and reflecting the foresight capacity of using social media for anticipatory governance. First of all, **'Yuyanguanshi'** considered the sharp decline in the sale of GM products as an initial consequence. In his/her words, due to the cautious attitude toward GM widely spread across the country, people, or at least some of them, 'will reject GMO' and divert to non-GM or organic products. Correspondingly, the merchants running natural or organic food businesses will seize this opportunity to further regard 'natural food without processing' as the sell point, and then increase their prices under the act of market competition. Hence, consumers who prefer to stick with natural food will have to bear increasing daily expense due to the growing price of food, which will be a prelude to the increasing living cost for the public. In the light of **'Luobishanxiadexiaoxiang'**'s reasoning, the large-scale rise of food prices nationwide will turn out to be a problematic livelihood issue within the scope of the whole population, which is likely to contribute to social conflict that is much more serious than normal, even though the government is still able to accurately predict how and with what effect the social conflict will happen.

To summarise so far, apart from the positive implications that GM labelling is likely to have, potential risks and negative consequences are also taken into consideration by the discussants, suggesting that the implications mentioned among spontaneous discussion

on social media vary a lot, covering not only the benefits of new policy, but potential problems that need to be addressed. Taking a step forward to explore the probable risks hiding behind the upcoming policy could be seen as a typical looking-forward move to describe an alternative future where the negative consequence of GM labelling is likely to take place. Encompassing a diversity of societal implications for GM labelling, spontaneous discussion is pluralistic in connotation and in the expression of ideas, which serves as a valuable resource for decision-makers who attempt to track public opinion toward GM labelling. Connected to policymaking, the discussion of GM labelling introduces a number of reflexive points for policymakers to reflect on the causal relationship between the decision they have made, or will make, and the potential reactions of the public. Although reflexivity here is not easy to organise compared to what could be done through scenario development, it still provides a method of self-reference for the decision-maker to ‘determine viable options’ (Barben et al., 2008: 986).

On policymaking related issues, another controversial topic connected to labelling GM or non-GM products has shown a clear intention to influence the specific provision of public policy. Based on logical reasoning about the probable influences of GM labelling on price fluctuations, discussant ‘**Luobishanxiadexiaoxiang**’ continued to develop the topic and raised a point about ‘what to label? GM or non-GM’? As can be seen from his/her words, there is a common phenomenon in the Chinese edible oil market where merchants label non-GM oil as a means of promotion and increase the selling price. In other words, some merchants in China are advertising pure, natural and raw edible oil to make profits from it, which is likely to widen the price gap between GM and non-GM products. Therefore, who will pay for the increasing price of natural food became a controversial issue, which is significant for policy-makers to think about.

Luobishanxiadediaoxiang Sept 17, 2016

*Replying to @ **Yuyanguanshi** Go and have a look in supermarket then you will know how much more expensive the non-GMO oil is than that with no label. Don’t take it for granted.*

Yuyanguanshi Sept 17, 2016

Replying to @Luobishanxiadediaoxiang Doesn't it exactly indicate the intensive purchase intention of customers? Willing not to label GMO product by reason of willing not to bear the cost of governance is actually a behavior of fooling customers regardless of what they are concerning about. Whatever, the right of choosing should not be deprived. Honestly, I'm neutral to the debate about whether GMO is harmful. However, since customers are worrying about this issue, GMO product ought to be labelled for securing the right of knowing.

Xibokeladimentu Sept 17, 2016

It's actually very simple: the people asking for right to know should pay for the price, which increases because of the clear label. Policy should be formulated like this. For example, the supporters of anti-GM requesting a right to know should pay for the increasing price of the labelled non-GM product. Another example concerns Muslims.

If Muslims request the right to know about halal food, the halal food they love should be labelled and they need to pay for the price of that.

Yuyanguanshi Sept 17, 2016

Replying to @Xibokeladimentu From the perspective of manufacturers, a problem arises. A producer of traditional non-GM food has never been requested to pass the verification of non-GMO ingredients, which has been no problem. It is unfair to ask these traditional food producers to be verified just because GM food producers want to enter market, bring all manufacturers into a competition and attempt to exempt them [traditional producers] from the verification of GM ingredients.

Kafeishouxiewuxiao Sept 17, 2016

Replying to @Xibokeladimentu The problem is that if people, in reality, show suspicion to 'GMO products', then a 'GMO product' is unlikely to pass the examination or verification. Currently, your assumption is only built up on the basis of food security. The opinion of experts could never replace the voice of public, which should have been the basis of

legislation, shouldn't it be?

In terms of the understanding of discussant ‘**Xibokeladimentu**’, people who appeal for a right to know should pay for the increasing price of a natural product. He/she believed that it would be better to label non-GM products instead of GM ones because people who support securing the right to know should be responsible for the consequences, such as the increasing price of non-GM products. He/she also referred to halal food as an analogy. Unsurprisingly, ‘**Xibokeladimentu**’’s argument is challenged by ‘**Yuyanguanshi**’, who observes the problem from another perspective—the authentication process before labelling. He/she thought that it was unreasonable to authenticate non-GM products and label them because of the existence of a GM product being introduced into the market. Apart from the huge investment authentication requires for a non-GM product, it does not make sense to test the quality of a normal product due to the controversy of a competitor instead of the problem of itself. By saying ‘policy should be formulated like this’, discussant ‘**Xibokeladimentu**’ has shown a clear attempt of affecting policymaking through providing personal suggestions, even in such an informal form.

In spite of illustrating the above argument in fragments, the substantial details of spontaneous discussion on GM labelling have exemplified the practice of foresight, including long-term implications, the means of making hypothetical scenes, the potential of building reflexivity and the attempt of affecting policymaking.

4.3 Expressing negative attitudes: The manifestation of public engagement

Apart from the heated discussion of the GM labelling issue discussed on Weibo and Twitter, the present data indicates an obvious negative attitude towards GM technology spreading across social media. Different from public engagement practices in a

traditional sense (e.g. group workshops), the public engagement of science that occurs on social media is formed by spontaneous discussion which is less-organised and unstructured but enables the manifestation of people's emotional expression and/or the revealing of personal attitudes. Although engagement takes place on third-party social media platforms, there are no routines or processes guiding engagement. Discussants participate personally and spontaneously so their personal or even emotional viewpoints that may exceed objective judgement is inevitable and, in turn, can be seen as a manifestation of public engagement. Observing these subjective statements, especially their negative side, is a meaningful way to understand the potential risks of GM as perceived by lay-people, and compare attitudes revealed by discussants on Twitter and Weibo. These subjective statements are a mirror reflecting the truest and the most direct response of the discussants. Being able to get a sense of the overall climate of public opinion towards a GM-related future in two social environments is a useful resource for governments on a global scale to inform policymaking in relation to emerging technologies.

In the data I categorised “negative” attitudes as statements conveyed during discussion that included unsatisfied and uneasy expression of feelings, moods of panic and anxiety, and opposition, objection, distrust and suspicion. All those manifestations of negative attitude were presented and delivered during spontaneous discussion where people freely expressed their personal perspectives and perceptions. During such moments, social media play a critical role by establishing an interactive forum that enables the free exchange of personal ideas which contribute to the steering of public opinion. A steering of public opinion through social media demonstrates the function of public engagement as described by the theoretical concept of anticipatory governance. In other words, the present data suggests that the widely spread negative attitude on social media is a direct consequence of public engagement, which created a chance for the collision of different views. Negative attitude spreading over social media can potentially bring all kinds of problematic issues to light surrounding emerging technology, such as the trust crisis in governments and dissatisfaction caused by insufficient governance on GM

issues discovered in the data. Investigating negative attitudes concerning GM issues is a good opportunity for the government to build a reflexivity mechanism which makes use of the high volume of information available on social media to aid decision-making work.

Within the theoretical framework of anticipatory governance, public engagement refers to an emerging model of ‘communicating science and technology issues to the public’ (Barben et al. 2008: 987), specifically following a two-way interactive communication approach to involve the public in the governance of emerging technologies, and so that the public can develop their own perceptions through structured discussion (Nature, 2004: 883). Shifting from a top-down communication model to the ‘new mood for dialogue’ (House of Lords, 23rd May 2000), public engagement has given non-specialists a right to speak for themselves through public dialogue about developments, instead of scientists telling the public what to think without the possibility of discussion. As discussed in more detail in Section 2.3.1, this particular two-way emphasis on science communication was interpreted by Alan Irwin as a ‘second-order approach’ in his theoretical framework of third-order thinking (2008).

Public engagement is substantially enhanced by making the voice of the public matter in early stages of decision-making concerning research and development. Regarding the concept of engagement in the context of anticipatory governance, Barben et al. (2008) provided several specific cases of public engagement methods applied in different countries to demonstrate the diversity of public engagement in practice: public debates organised by the Science Museum of London, as well as public debates organised in France, and a consensus conference held in the U.S, are a few examples. As an interactive Internet-based application open to the wider public, social media has created possibilities for public engagement, even though there is still a lack of formal organisation or institutional control to create procedures for engagement events and some people will not be able to be reached this way due to restricted internet access (see Section 2.2.2). The use of spontaneous discussion comes into fruition through the

ability of participants to post and forward user-generated content within a virtual community created on social media. This means that using the technical functions of social media including the composition of ideas, forwarded content or even ‘liking’ a cause, is a way to assess public engagement.

Regarding controversial issues, such as GM technology, spontaneous discussion on social media, especially the free expression of emotions, attitudes and perspectives, can be seen as a manifestation of public engagement effort, which in turn, is likely to demonstrate the potential and the limitation of social media as a forum to support anticipatory governance.

4.3.1 Fear of the unknown: Panic

The word ‘panic’ is one of the most frequently used words appearing in discussions on Weibo, suggesting that panic as an emotional response to GM technology widely exists and should not be ignored by policy-makers. As many users have realised, stemming from the inherent uncertainty of GM technology and people’s limited understanding of it, the emotion, panic, creates opposition to using the technology.

Wangxiaojian ouger Aug 23, 2014

My supervisor recommended a book called ‘The Lonely Spring’, which shocked me. We should be very careful about harmful things, such as pesticides and GMOs, which are damaging human-beings. Otherwise, we’ll regret.

Ouyaogaoya Aug 23, 2014

GM is neutral actually, as an advanced technology. What makes it good or harmful is the way it is used, like how iron is used for making a plow or forging a sword. If people have no right to decide the way to use, it will be better for them to reject it. It makes sense to encourage scientific experimentation of GM technology with the support of governments rather than promoting the application of GMOs broadly. People cannot be too cautious to

the problems relevant to subsistence.

Chenludexiaowu Aug 23, 2014

Replying to @Quyaogaoya I always tell the truth. It is completely a good thing if the public response is panic to GMOs. On the one hand, the panic emotion induces governments to strictly carry out the procedure of examination. On the other hand, the absence of GM labelling will also be widely challenged under the pressures of panicked emotion among the public, which benefits from the assurance of food safety.

HaidelixiDoing H Aug 24, 2014

Replying to Quyaogaoya: I actually have some ideas about what the opponents are opposing. Different opposing voices target different objectives. Some are afraid that GMO food does harm to their own genes (which is bullshit), others are afraid of poisoning due to the accumulation of harmful ingredients which some believe might be discovered in the future. In this case, I'm more curious about why people feel panic than what they are opposing.

Hytwml Aug 24, 2014

Why do people have little interest in this issue which is relevant to everybody and the future generations? How could entertainment news be so hot while GMOs—this biochemical weapon destroying the Chinese race—attract no attention? Is this nation blinded by the authorities to its glass-roots? Why can't we unite and work together to resist toxic GMO food?

Here, panic was clearly indicated by the phrases the discussants used to describe GM technology, such as 'biochemical weapon destroying the Chinese race' and 'damaging to human-beings'. The panic expressed by user '**Wangxiaojian_ouger**' can be seen from the phrase he/she used to describe GM technology. In his words, GM is 'damaging to human-beings' and should be treated carefully. Otherwise people will have regrets in the future due to the irreparable consequences of GMOs. '**Quyaogaoya**' compared

the relationship between GMO and GM food to different uses for iron. He/she believed that, similar to the multiple ways humans make use of iron, such as building a plow for agricultural production or casting a sword for killing, GM is an emerging technology with no benefit or harm attached, originally. What makes GMOs controversial are the way humans make use of the technology. In his/her view, if people haven't found out the best way of using GMOs at the moment, it would be better to remain cautious, which looks like panic. **'Chenludexiaowu'** deemed that people's panic in response to GM technology might be an effective way of forcing the government to pay attention to the governance of GM technology, basically to improve the efficiency of supervising work, which 'is a good thing' for food security in China (see the comment of **'Chenludexiaowu'** on page 129). Discussant **'HaidelixiDoing_H'** was trying to explain the causes of panic, which is believed by **'Hytwml'** as reasonable and acceptable given unknown future risks. **'Hytwml'** even described GM as a 'biochemical weapon' that may destroy the whole 'Chinese race' and tried to raise more support for anti-GM actions.

Nearly all the people expressing panic are opponents of GM technology. Discussants directly expressed panic through their user-generated content. As described above, all kinds of reasons make people uneasy, which also demonstrated their varying cognitions and judgements about GMOs. With respect to conversation cited above, panic originates from uncertainties concerning GM technology in the future, or to be more specific, the potential risk of GMOs. This fear of the unknown illustrates one of the main controversial issues concerning the public. Faced with uncertainties and misinformation about GM technology, people engaged in discussion on Weibo shared their own thoughts and worries in response to any comment or challenge from other participants. The emotion of panic could be seen as a specific manifestation of public engagement that takes place on social media.

4.3.2 Too pale a word: Suspicion

Referring to future-related content on Twitter, an attitude of suspicion is often shown during discussions. With respect to controversial issues, like GM technology, people prefer to be sceptical towards GMOs because of the huge potential of it to affect everyone's daily life.

Isaac Biggerstaff Jun 29, 2016

@JoelAchenbach Because there is no evidence currently to suggest GMO crops are dangerous, just as there wasn't about asbestos. Toooooooooo many unknown things...can't trust GMO.

By saying 'Toooooooooo many unknown things...can't trust GMO', '**Isaac Biggerstaff**' expressed his/her anxiety on GMOs resulting from the uncertain future of GM Crops. Faced with numerous uncertainties, people tend to treat the implications of GMOs with a pessimistic and suspicious attitude, just in case any irreversible consequence happens as a consequence of neglecting the possible risks. In this case, the discussant compared GMOs to asbestos alluding to the potential risk of GMOs. Referring to the issue of asbestos, '**Isaac Biggerstaff**' warned the other discussants taking part in the debate that people can only be protected from any potential future risks by being careful the implications of GMOs that were not prevented with asbestos. Whatever participants' specific purposes are for engaging in spontaneous discussion, they first try to express their own feelings and thoughts, which is enabled by social media.

Apart from the uncertain implications of a GM-related future as mentioned before, the attitude of suspicion also exists in some problematic issues, such as insufficient economic impact assessment, the political intention behind introducing GM technology, and the credibility of scientific research outcomes. The following tweets extracted from online discussion demonstrate scepticism which stems from three reasons (as discussed

below).

Riddle Like Aug 9, 2015

@pickwick I don't support a ban FWIW [for what it's worth]. But the lack of a decent economic impact assessment gives me pause on that.

James Mackenzie Aug 9, 2015

@pickwick @3pSteve @endless_psych The arguments for "feeding everyone" with it are largely emotive spin from the government I'm afraid

Protect Nature Aug 9, 2015

@CosmicHominid @beachvetlbc there you go, GMOs are not scientific. They just pretend because they get paid.

A lack of economic impact assessment made ‘**Riddle Like**’ change his/her mind of supporting to doubt. ‘**James Mackenzie**’ accounted that the ““feeding everyone”” slogan to promote GMO is just a governmental ‘emotive spin’ for gaining public support, which is unnecessary if they do have confidence in this technology. The discussant named ‘**Protect Nature**’ doubted the credibility of scientific outcomes because he/she believed that researchers get economic support and thus benefit the sponsors for grants with their project outcomes. Thus, in terms of the conversation cited above, scepticism comes from a lack of assessment, damage to governmental credibility, and the ambitious intentions of scientists. As can be seen from the data, a number of concerns hiding behind discussants’ attitudes and emotions are likely to be dug out through engaging with the public. Although spontaneous discussion on social media might be short of a rigorous argument process, and the language and wording are presented casually, the emergence of various opinions among discussants could be seen as an abundant resource with high analytical value.

Suspicion towards scientists is visible in discussion, especially when people talk about

the safety issues of GMOs. In **‘Protect Nature’**’s words, the ‘they’, who get paid, refers to scientists. While suspecting the reliability of research outcomes, **‘Protect Nature’** also doubted the professional ethics of scientists. Moreover, **‘Dr. Ena Valikov’** also revealed a suspicious attitude to scientists by saying that:

Dr. Ena Valikov Apr 7, 2015

@NOtoGMOs If GMOs had ANY merit scientists would proudly brand them instead of being ashamed and coercing people to buy them.

The scepticism towards scientists, or in other words, is a result of the estrangement between scientists and the public, which was mentioned in discussion. People, like **‘Dr. Ena Valikov’**, have an interest in exploring why this distrust exists. A fragment of a conversation between **‘Cultural Cognition’** and **‘Ramez Naam’** provides wording relating to public literacy and GMO.

Cultural Cognition Jan 30, 2015

@amy_harmon @ramez @SavorTooth they don't "disagree" w/ scientists; they don't know what the survey question means. So don't pretend they do.

Ramez Naam Jan 31, 2015

@cult_cognition @SavorTooth @amy_harmon I'm coming into this late but couple thoughts. 1. Agree that public doesn't understand GMOs.

Ramez Naam Jan 31, 2015

@cult_cognition @SavorTooth @amy_harmon 2. That said, Pew survey captures that ~half of public's vague perception is of health risks

According to this conversation, the ‘public doesn’t understand GMO’ demonstrates that **‘Ramez Naam’** thinks that there is a lack of public scientific literacy about GMOs. From **‘Ramez Naam’**’s perspective, the ‘perception’ of GMO in people’s minds is

‘vague’ and confined the ‘health risks’, and thus to very few dimensions of a much wider issue. Considering the whole data set, some participants believed that the worries and scepticism the public held about GMOs stem from an insufficient understanding.

In addition to attitudes that are directly expressed, suspicions towards GMOs are also held by some supporters of GM; as can be seen from the following conversation:

Ramez Naam Jan 29, 2015

@clayforsberg US National Academies of Science report finds that GMOs a clear environmental win. I link to it here: <http://rameznaam.com/2013/04/28/the-evidence-on-gmo-safety/>

Clay Forsberg Jan 29, 2015

@ramez I can see that. Especially compared to 'produced conventionally.' I stand corrected. But I suppose less is better than the norm.

‘Clay Forsberg’ agreed with ‘Ramez Naam’'s view about GMOs and expressed a supportive attitude, he/she insisted that ‘less is better than the norm’, by which ‘Clay Forsberg’ means a smaller amount of GMOs in farming is better than the normal quantity used. From this example, some misgivings appear to remain for the supporter when talking about the application of GM technology: throughout the data of this study suspicion exists not only in the voice opposing GM, but in the consideration held by GM supporters.

As can be seen from the data, although the common emotion shown in the cases above could be identified as ‘suspicion’, it is too pale a word to describe the diverse perspectives that Twitter users convey during discussion. An attitude of suspicion results from all kind of reasons according to the data, including: the inherent uncertainties of GM technology; insufficient governance work done by the authorities; the ambiguous standpoint of the scientific community, and weak public literacy about

advanced technology. Whatever the cause of their suspicions, discussants expressed concern and took the initiative in replying to others to express these concerns, which formed spontaneous discussion on the issues of GM technology and put public engagement into practice. It is noteworthy that the reasons that cause negative attitudes to be expressed in spontaneous discussion matter a lot to the engagement practice of anticipatory governance, because negative attitudes towards governmental actions, including management, supervision, and policymaking about GM technology, have, partially at least, served as a key indicator of the risks or the problematic issues that the authority is or will, potentially, face in the future. For example, nationwide massive discussion held on Weibo about unlabelled GM rice spreading across the Chinese food market clearly illustrates a severe trust crisis existing in China.

4.4 Negative emotion and the trust crisis in China

With respect to China, the GM food debate was intensive after the broadcast of the television programme shown on CCTV13 in the summer of 2014, ‘*Xin Wen Diao Cha—Zhui Cha Zhuan Ji Yin Da Mi*’ (News Investigation: Tracing Genetically Modified Rice) (CCTV13, 26th July, 2014). The show exposed the wide distribution of genetically modified rice in the Chinese food market. Based on rough calculations there has been around 1 billion GM-related tweets on Weibo so far (Weibo, July 2017), which were all launched after 26th July 2014. Triggered by this event, a series of discussions on the management and the legislation of GM labelling took place on Weibo, causing a big dispute on the governance of GM technology.

As analysed in Section 4.2, GM labelling is neither an emerging topic nor a problem without a legal basis in China. Tracing the starting point of GM labelling legislation takes us back to the ‘Regulations on the Safety Management of Agricultural Genetically Modified Organisms’ Provisions issued by the Chinese government in 2011 (State Council of the People’s Republic of China, 2011). Mainly regarding agricultural research and the production of GMOs, the provision required the transparency of GMOs

information, which had a bearing on the risk assessment and security management of GM technology (Ministry of Agriculture of the People's Republic of China, 2017). Another provision, the 'Regulation on the Implementation of the Food Safety Law of the People's Republic of China' (State Council of the People's Republic of China, 2017), was adopted in 2009 and revised in 2017. In terms of provision the regulation clearly indicated that the producers and operators of GM products should properly label them as containing GM. Additionally, consequences were stated for violating regulations that clarified the laws surrounding GM food security management (Ministry of Agriculture of the People's Republic of China, 2017). Therefore, as can be seen from the existing system of law and regulations about GM labelling, the right to know about GMOs in food production in China has been legally protected.

@Weiyanyiaoli: Don't strip the right to know from the public by reason of science!
//@ruirumamaqian: even though legislated, insufficient power of implementation is still a big problem. // @wudaogouyoujinongchangzhu: the local people congresses who have legislative power should take action//@wudaogouyoujinongchangzhu Govern and Regulate GMO!

Although a legal system concerning GM has been established, the high volume of calls for the legislation of GM labelling on Weibo, some of which were cited above, suggests a weakness existing in implementation practices. As '**Ruirumamaqian**' said, 'implementation is still a big problem'. Before the issue of new regional GM policy labelling in Shenzhen, there were no detailed rules about how to properly label GM products, such as the label position, size, standard format and the specific message to be included. With respect to the provision formulated by the 'Regulation on the Implementation of the Food Safety Law of the People's Republic of China' (State Council of the People's Republic of China, 2017), labelling should be implemented legally according to 'requirements' (ibid.), however, certain requirements were not clarified in terms of the provision. Therefore, the call for legally requiring manufacturers to label their products 'according to law' did not calm down over time.

With respect to the legislation and governance of GMOs, Weibo users have expressed straightforward negative attitudes and shared their expectations about forthcoming policy relating to GM technology.

Tengxundepiaopiaohebianliu Aug 11, 2015

Replying to @Xiatianderejifeng Here is my view on GMO: I support scientific research on GMO and the legal action of popularizing GM technology. I reject illegal or private planting. I don't agree with the idea of holding GM product tasting events nor the mandatory label of GM even though I believe a GM label makes sense. That's it.

Xiexizhe Aug 11, 2015

I don't oppose the scientific research of GMO, but I will fight for any action of illegal promotion. The judicial authorities should also fight against GM criminals

HanjiangdudiaoosuoliwengV Aug 11, 2015

Replying to @Tengxundepiaopiaohebianliu: As a project of scientific research, I don't object to GM. But the planting of GM crops should be restricted to specific areas and given special management. Don't force people to accept GMO. In short, management remains the major problem of GM!

Zuqiuxiaojiang Aug 11, 2015

It's absolutely irrational to convert the mistrust toward governments to the mistrust of science. While this irrationality originates from the science ignorant. The lack of trust is the sadness of a society, while the lack of knowledge is the sadness of an individual.

I used the word 'straightforward' above because participants were frank with their negative opinions. For instance, user '**Tengxundepiaopiaohebianliu**' stated his/her views on GM research, the legal promotion of GM technology, illegal/private planting, tasting sessions and GM labelling with succinct words such as 'support' or 'reject'.

He/she explicitly expressed a supportive attitude towards the scientific research of GM technology, which was also applied to agricultural growing by legal means.

Any illegal behaviour that involves planting or promoting GM crops is not tolerated by discussants, including **‘Tengxundepiaopiaohedianliu’**, **‘Xiexizhe’** and **‘HanjiangdudiaosuoliwengV’**, who have realised the necessity of digging out the potential of GM technology and called for the strong supervision from legal system. Discussant **‘Zuqiuxiaojiang’** brought the issue of ‘trust’ to light, mentioning that it is not rational to transfer a distrust of the government to that of science. It is obvious that the discussants above have segregated the scientific research of GM technology from other GM-related issues and given full support to the development of GM technology by backing the progress of this emerging technology.

Regarding the management of GM, Weibo users, such as **‘HanjiangdudiaosuoliwengV’** and **‘Xiexizhe’**, delivered concerns or negative attitudes during discussion. For example, **‘Xiexizhe’** was opposed to governmental ‘illegal promotion of GM’ and requested a stronger ‘judicial power’ for punishing illegal behaviours. While as **‘HanjiangdudiaosuoliwengV’** directly pointed out, taken from this continued conversation, that, ‘the main problem of GM came from the governing work’. Besides, he/she provided a suggestion to policymaking, saying that ‘the planting of GM crops should be restricted to specific areas and given special management’.

With respect to the data cited above from Weibo, it can clearly be seen that GM technology upsets the public due to an issue of governance, including the management and the implementation of laws and regulations, even though future uncertainties may cause uneasy emotions among public issues do not arise from GM technology itself in a Chinese context. To governments, the main executor of GM governing, the trust crisis that they are facing up may serve as one of many thorny problems awaiting a solution. However, the expression of negative attitude and the suggestions presented informally

on social media are valuable for the final work of decision-making (building a reflexivity on) because user-generated content directly indicated people's feelings, views and attitudes toward GM technology, which is necessary to take into consideration when formulating relevant policies. In this case, social media provides the possibility of freely exchanging information, and could be seen as a lens through which governments are able to uncover problematic aspects through observing spontaneous discussion and reflecting on the limitations or problems existing in governmental behaviours. Then a specific plan can be put forward to effectively resolve the problems.

Another reason supporting the reference value of spontaneous discussion on social media is that objective analysis and independent thinking are also available. In other words, aside from emotional expression, rational reasoning and analysis also take place and attempt to influence the direction of public opinion.

Xiaoxiangtiantian Sept 12, 2014

Why do you always argue about the growing of GMO, which seems like you have strong evidence. If you do have, show me!!!Otherwise just shut up!

Jingetiema11111 Sept 12, 2014

Replying to @Xiaoxiangtiantian Could you give an explanation for the case where the EU returned exported rice to China because it contained GMO ingredients when tested?

Xiaoxiangtiantian Sept 12, 2014

Replying to @Jingetiema11111 What's the reference of export? Quantity? The percentage of GM rice? How could you accuse with no credible evidence? How long has Yongyuan Cui accused? He asserted that he had reliable evidence, then what's the result?

Jingetiema11111 Sept 12, 2014

Replying to @Xiaoxiangtiantian Where is the GM rice that was tested out by EU from? Is

it approved to be grown commercially? If not, is it illegal?

Xiaoxiangtiantian Sept 13, 2014

Replying to @Jingetiema11111 What's illegal growing? How could it be identified as illegal because of being tested? Do you know the technique of GM testing is very keen?

Jingetiema11111 Sept 13, 2014

Replying to @Xiaoxiangtiantian Isn't it illegal? It has been tested! Or where is it from? Groundless!

Xiaoxiangtiantian Sept 13, 2014

Replying to @Jingetiema11111: I've never mentioned the phenomenon of private planting. Many people requested the original report of sampling and testing after CCTV exposed unlabelled GM rice spreading across the Wuhan food market but the investigator dare not to provide it. Why? A scientific method of sampling is definitely not buying several bags of rice from a supermarket. Many supporters of anti-GM believe in natural food. However, is natural food able to completely get rid of the safety problem? Ironically!

The case above was selected from numerous conversations as a typical one debating the social investigation conducted in the summer of 2014. Different from common comments condemning the illegal commercial growing of GM crops in China, the discussant ‘**Xiaoxiangtiantian**’ critically considered the rationale and reliability of sampling methods applied in the investigation. First of all, he/she reasoned that there was lack of precise actual evidence identifying the batch of GM rice that was tested in the investigation broadcasted on TV programme. No detailed information, such as the percentage of GM rice that was tested and the rice’s source, was made available. Second, a complete investigation report containing details of the original figures and information should have been given or published as evidence after the exposure of these problematic events. No follow-up report had been given by CCTV until now when more than three years have passed. Third, ‘**Xiaoxiangtiantian**’ doubted the rationale of the

sampling methods employed in the investigation as discussed with **‘Jingetiema11111’**. The results of the investigation were in doubt when **‘Xiaoxiangtiantian’** said that it was not a reasonable sampling method to go to one supermarket and buy a couple bags of rice. The lack of an extensive collection of samples is a research design mistake. To put it in other words, he/she believed the sampling method applied by journalists for the TV programme did not meet the requirements of reliable social research methods. So, as the results of the investigation could hardly indicate that illegal commercial growing occurred in the Chinese crop market, what CCTV concluded in the programme was misleading.

Apart from the criticisms of the insufficient supervisory work of the Chinese government, which dominated the direction of public opinion in the case of unlabelled GM rice in the Chinese food market from 2014 to 2016, the public voice doubted the reliability of the social investigation done by CCTV. Similar to what **‘Xiaoxiangtiantian’** and **‘Jingetiema11111’** discussed other conversations in the data set also evidence that people did not completely believe the results that the TV programme came up with, shown by raising concerns about whether a ‘scientific method of sampling’ was or was not used, suggesting that people engaging in online discussion were able to independently and critically think about the casual relationships involved.

In general, the high volume of information conveyed on social media and the frequent exchange of opinions taking place are attributed to the interactive function of social media. Spontaneous discussion, which is regarded as the manifestation of public engagement on social media, has provided an abundant resource of public opinion to governments, which is valuable for building reflexivity in governing exercises and decision-making work.

4.5 Chapter Conclusion

The data have shown that Weibo and Twitter support anticipatory governance by providing the public's understanding of GM issues and alternative futures, and in this way social media enables engagement events to include the wider public. Evidence selected from spontaneous discussion on Twitter and Weibo back this conclusion. First of all, GM-related futures have drawn extensive attention from users on social media. With respect to the amount of coverage involved, future-related issues are a leading hot topic in GM technology debates on both Twitter and Weibo, including forthcoming public policies, cognition and attitudes towards possible GM-related futures, and the long-term implications of GM technology. In addition, the high similarity of thematic distribution between Twitter and Weibo has illustrated a universal controversy surrounding GM issues, a controversy which even exceeds the boundaries of two different language environments (Chinese and English). To put another way, GM controversy is a global issue, the dispute over GMOs stems from a number of factors, such as insufficient public understanding, the inherent uncertainties of the use of GM technology and dissatisfaction towards governance. These are factors which appear in both China's and western countries' social media environment.

Secondly, the long-term implications of GM, predictable or unpredictable, and the corresponding strategies formulated by governments to address these concerns, are a critical issue to the discussants, regardless of the language environment. The debate over the long-term implications of GM technology has manifested itself in the foresight capacity of anticipatory governance. In terms of the present data, discussions on GM labelling policy serve as a typical case of seeing ahead and imagining a likely future for GM technology, and then preparing for any uncertain consequences that might happen in the future. The high volume of discussion surrounding the GM labelling policy has given due consideration to the long-term implications of GMOs regarding multiple dimensions of social life and drawn attention to the governance work required for GM products. It is apparent from the data that critical and independent thinking generated

from the multiple expression of the same ideas in online discussion, is likely to enhance the reference value of online spontaneous discussion as a resource for policymaking.

Thirdly, alternative futures of GM technology are conceived and openly expressed in personal language on social media. Negative attitudes spread over Twitter and Weibo particularly reflect the effect of PES on social media. As can be seen from the data, alongside the clear expression of attitudes or emotions discussants state the reasons or concerns that explain their negative opinions. For instance, although the majorly negative emotion (suspicion) spread across Twitter is different from the largest negative emotion expressed on Weibo (panic) the expression of those two negative emotions stems from a similar reason—the uncertainty of the impacts of GMOs in the future. In addition, negative attitudes towards the authorities due to unsatisfactory management work to address people's concerns has steered public opinion. The trust crisis faced by the Chinese government after the exposure of unlabelled GM rice in the Chinese food market serves as a typical case of public issue driven by the force of public opinion. It is unsurprising that, a high volume of denouncement and dispute generated on social media within a short time has placed pressure on the functional department of the Chinese government to act. Spontaneous public dialogue concentrating on the existing or potential problems on an issue of government interest should be given full consideration from the perspective of decision-makers because such dialogues contain abundant information which map out public preferences and concerns and can provide appropriate suggestions to them for policymaking.

**Chapter Five. Results: Making use of the
interactive functions of social media. The
role of experts, public intellectuals, and
governments in future-related GM
discussion**

As an interactive Internet-based platform open to the general public, social media creates and maintains social networks by assembling individuals as a virtual community, in which information, such as textual user-generated content, pictures, and video resources, is able to be created, exchanged and widely spread. Theoretically, a social media audience fails to represent the ‘general public’ in its entirety because only a portion of the public has access to the Internet are able to access social media—with the technical support of web-based devices, such as smartphones, desktop computers, laptops and tablets. As well as accessibility issues, the social media community is further divided into sub-groups according to members’ identities in the real world, even though there is no explicit boundary cutting across groups in terms of permission difference (Grubmüller, Götsch and Krieger, 2013). In the context of this thesis permission difference refers to a person's access to a social media platform and the permissions they have granted to the social media platform in order to use its interactive functions provided by social media.

Regarding scientific issues such as GM technology experts are an influential group whose perspectives have great effect on public opinion because of their authoritative and professional views when verifying and explaining scientific problems that are relatively unfamiliar for the lay public. Here, the ‘expert’ not only refers to the members of a scientific community, but also to the professional specialised in research on the social and political implications of science and technology. In addition, speaking about GM future issues on social media, public opinion leaders—who might not have a science education background but speak for the public as an authoritative outsider (Jennings and Kemp-Welch, 2013: 1)—are also involved and given special attention in this research. Apart from the key roles played by scientists and opinion leaders in science communication, the governments’ trends and performance are also worth noting given the crucial influence of the government in ‘fostering and facilitating science engagement in its policy-making’ (House of Commons, Science and Technology Committee, 2017: 3). With the widespread adoption of social media in recent decades (Bertot, Jaeger and Hansen, 2011: 31), governments have employed social media as ‘a

central component of e-government’ for extending government services and for ‘redefining government-community connections and interactions’ (ibid.). Therefore, at the end of this chapter, government behaviour regarding GM issues on social media will be discussed as a significant indicator of the appropriate usage of social media across government agencies.

Although experts make use of social media in the same way as other users, experts’ pronouncements on social media are more likely to cause complicated consequences for public opinion related to scientific issues. On the one hand, the perspectives of scientists and experts are sometimes regarded as the one of the major channels of obtaining scientific information online (Wilsdon and Willis, 2004), through their news feeds people keep updated on the latest research outcomes or the up-to-date perspectives of the development of emerging technology. On the other hand, as contemporary society moves towards a model of ‘knowledge society’, in which the growth of the economy increasingly relies on the achievement of science and technology (Wilsdon and Willis, 2004:16), experts’ purposes and intentions are frequently doubted and mistrusted due to hidden interests associated with science, profit, and the critical impact of policymaking on the development of technologies (Stilgoe, Irwin and Jones, 2006). The connection between scientists, the lay public and governments is one of the core issues facing contemporary science communication (ibid.). Thus related to research question two, addressing ‘How do experts and the lay public interact in future-oriented discussion on Twitter and Weibo?’ will gain an understanding of how the expert’s voice affects public opinion, and will also provide a clue to decision-makers about how to make use of these resources as an effective reference for policymaking.

This chapter is comprised of three sections, creating an insight into three pairs of relationships among spontaneous discussion surrounding a GM-related future, namely the interaction between experts and non-experts, opinion leaders and the anti-GM movement, and government to public interaction. The interaction between experts and

non-experts on Twitter and Weibo are both dynamic and intensive surrounding the long-term implications and the future prospects of GM technology. Opinion leaders, either in the form of NGOs (on Twitter) or individuals (on Weibo), play a critical role in promoting the social movement of anti-GM perspectives on social media. In a Chinese context, it is demonstrated through the data that public intellectuals are much more powerful in leading, mobilising, and impacting the lay public, which resulted in the emergence of ‘mid-politics’ a new political culture existing outside the traditional, official political system. Concerning the regulation on governmental usage of social media, the interactive functions of social media were rarely involved, and the communication between government and public was thereby limited to a one-way, top-down communication model, which is likely to be understood as meaningful to Irwin’s third-order thinking model of science communication (see Section 5.4).

5.1 Raising concern but hardly persuasive: The interaction between experts and non-experts

Following trends of ‘opening up the world of research’ in a social science context (Wilsdon and Willis, 2004: 12), scientists are increasingly encouraged to leave their ivory tower and engage with the lay public to communicate their scientific outputs. As the carrier of public engagement events, social media enables a two-way dialogue between scientists and the public, with interactive functions which can support the engagement capacity of anticipatory governance if fully utilised. Besides this function, providing information to the wider public who have Internet access, I have found that discussions on social media are theoretically diverse regarding the views and standpoints involved in debate, which lays the foundation for integration exercises to accomplish anticipatory governance. However, factual findings arising from the data differ from the theoretical assumption that scientists are actively engaging in PES on social media. Scientists’ voices released on social media get attention from the public, however, they fail to persuade people to accept emerging technology, at least immediately.

Pengpai News Apr 1, 2015

[Exclusive interview with Daru Lu: The statement of Yongyuan Cui is a lack of scientific basis] There were two things giving way to fear in the Qing Dynasty: the construction of the railway, which was believed to destroy the 'fengshui' of China, and the camera, which was said to steal the soul of human-beings. However, those were advanced technologies at that moment. The arrival of an emerging technology is always accompanied with doubting or even the panic emotion because of insufficient understanding. Our attitude towards GMO is: on the one hand, we have to give emphasis to the research of GM technology. On the other hand, the transparency and management of GM application should be stressed as well. We can't emphasize the necessity of GM legislation too much.

Dalishuanglangguzhen Apr 1, 2015

Science is different from profit. Promoting GM technology in reason is different from stealing the right of choosing from people in the name of science. In this case, widely promoting GM technology before obtaining conclusive evidence guaranteeing the safety of GM is actually the pursuit of profit. There are so many anti-GM movements in the U.S., don't those make sense?

Zibaowang Apr 1, 2015

Replying to @Dalishuanglangguzhen The safety of GM has been confirmed by the EU. Besides, over ten species of GM crops were allowed to enter the mass market; The European Food Safety Authority is responsible for the risk assessment of food and food safety in the EU. The report provided by this institution has confirmed that GM crops, which have been approved to be planted commercially, won't bring a higher risk to either human-beings or the natural environment, compared with natural crops.

Zibaowang Apr 1, 2015

Replying to @Dalishuanglangguzhen The Ministry of Health, Labor and Welfare of Japan is the exclusive institution responsible for Japanese food safety and health management,

they conducted a GMO food safety review at the beginning of September 2013. In total, 280 species of GM crops have been approved.

Dalishuanglangguzhen Apr 1, 2015

So what? The purpose of scientific research should have been serving the masses. No matter what other countries are doing, Chinese scientists could hardly get rid of the suspicion of being driven by profit.

As a famous scientist specializing in DNA testing and GM research in China, ‘**Ludaru**’ gave his opinion on the future of GM on Weibo through the ‘**Pengpai News**’ Channel. On the one hand, he emphasised the significance of supporting scientific research on GMOs. On the other hand, he stated that he believed the application of GM technology in practice should be in strict accordance with the laws and regulations of food security. With regards to the scientific research of GMOs, although a number of discussants on Twitter and Weibo have expressed a supportive attitude, there remain some sceptics, such as ‘**Dalishuanglangguzhen**’, who expressed doubt about the purpose of scientific research and then challenged the expert’s argument. In his/her words, what scientists endeavour to do is to pursue more profit in the name of scientific research. ‘**Dalishuanglangguzhen**’’s argument was refuted by user ‘**Zibaowang**’, who quoted factual evidence of GM-related public policy in EU and Japan to respond to ‘**Dalishuanglangguzhen**’’s statement about ‘many people in Western countries, like the USA, don’t have GM food’. ‘**Zibaowang**’ then supported the initial argument of ‘**Ludaru**’, while ‘**Dalishuanglangguzhen**’ reasserted his/her scepticism on the interests of GM scientists in China.

Similar to the case cited above, scientists’ ideas raised concerns among the public but hardly persuaded the public to agree with their arguments alone. As can be seen from the data, the interaction between scientists and the lay public in future-oriented discussion is a process of challenging, in which scientists put forward a view and are challenged without further explanation or argument. Here, I will discuss two

phenomena indicated by the present data before proceeding to further analysis.

First, interactive actions, such as replying to comments, are rare on scientists' social media accounts even though they pronounce ideas on social media. The same situation could also be seen on Twitter despite the fact that social media is an interactive platform that supports two-way communication.

Professor Tim Lang Jan 16, 2017

Is UK heading for a US Brexit? GM & US food? Feedlot Britain? Intensive, energy guzzling, obesogenic diet? Is this 'taking back control'?

Pascal Jacquemain Jan 16, 2017

@Dr_RJByrne how about driving on the right side to make it easier for US car manufacturers to export?

Dr Dick Byrne Jan 16, 2017

@jacquep could be very bad news for UK farmers and consumers will be faced with hormones GMOs and lower animal welfare

david wilson @VoltaireOK Jan 17, 2017

losing backside control perhaps

Illtud Llyr Dunsford @CharcutierLtd Jan 16, 2017

Pretty much. The increase in convenience foods and decline in independent grocery is a dark prospect to a business like ours.

Moira Gilbertson @MoiraEwesfulone Jan 16, 2017

@thefoodrules We have that already!

JT @lesdrus71 Jan 16, 2017

god I hope not

mike hamblett @HamblettMike Jan 16, 2017

this will happen - Tories rushing to embrace high-tech, low quality food + of course US style profiteering healthcare

The case cited above serves as a representative case of the communication between scientists and the lay public that can be found on Twitter. **‘Professor Tim Lang’** (@ProfTimLang), who is self-introduced as an expert in food policy by the City University of London, raised an issue about probable changes on GM and US food policy following Brexit. His comment was retweeted 65 times and received 13 replies indicating the interest that Twitter users have on this topic. However, those replies were not representative of a two-way interactive communication. **‘Professor Tim Lang’** does not respond or retweet, which illustrates that this case of communication remained a one-way top-down model.

Second, compared with the personal accounts of scientists and experts, the quotes of scientists’ words posted by mass media accounts are followed by a larger number of users. Mass media accounts, such as **‘BBC Science’** and **‘Pengpai News’**, have drawn a higher level of attention and triggered more intensive discussion than the accounts of scientists and experts. Regarding **‘Ludaru’**’s comment as an example, the quantity of replies following the original Weibo posted by **‘Ludaru’** is only one tenth of those following quotes posted by **‘Pengpai News’**.

Pengpai News Apr 12, 2016

[Exclusive interview with the former director of national institute of Biotechnology: GM is safe and the mainstream trend of development] Dafang Huang, the former director of The National Institute of Biotechnology states that there is an agreement in academia that GMO products coming with the approval issued by the authorities is safe. Regarding the future of GM technology, Dafang Huang believes that it is an inevitable historical trend of

agricultural development to make use of GM technology.

Maerhunzi Apr 12, 2016

Let's skip the debate about the safety of GM firstly. I'm actually a provider of agricultural food. I can tell you that at the moment all the meat that you can get from the food market is from animals fed by GM fodder. You've been eating it for ages. The cost of natural fodder is 60rmb for a pound of pork and more than 40rmb for a pound of chicken. In this case, how much will the retail price be? Can you afford it?

Geshimojian Apr 12, 2016

*Replying to @**Maerhunzi** First of all, I'm not quite sure whether GM is safe so I tend to believe the authorities; Second, trust given to the authorities is being lost now because the authority is losing credibility. And they should be responsible for this consequence themselves; Third, it is not necessary to completely ban GMO but what we need is labelling. The absence of labelling will result in panic emotion among the public once they discover GM ingredients, which is inevitably followed by a decrease of credibility for the government. It is actually a vicious circle caused by the lack of labelling, a decrease of credibility and the losing of trust.*

In the case above, the statement made by Prof. Dafang Huang, the previous director of The Biotechnology Institution of The Chinese Academy of Agricultural Sciences, received 43 replies, forming a couple of conversations. In Prof. Huang's words, the whole scientific community has reached a consensus that once GM crops have been 'approved' by 'authoritative departments', the safety of GM products has been guaranteed. Besides, Prof. Huang also believed that GM technology will become an irresistible direction for agricultural development in China due to an 'inevitable historical trend'.

Neither supporting nor objecting to Prof. Huang's argument, discussant '**Maerhunzi**', who claimed to be a practitioner of agricultural food production, tried to reveal a "fact"

that animals in China were fed with GM crops, which was driven by the cost of feeding. He/she believed that people could not rid themselves of the risk of GM as long as they ate meat. Based on his/her personal working experience relevant to the industry of agricultural production, the discussant left the controversial issue of GM safety aside and provided an analysis of the possibility of preventing the negative effects of GM: first, was it possible to avoid unless avoiding meat, and ‘Can you afford it?’ Although ‘**Gemoshijian**’ did not challenge or express opposition towards the scientist’s argument, it is clear that Prof. Huang’s belief in the future of GM does not persuade ‘**Gemoshijian**’ to trust the safety of GM food.

In connection with Prof. Huang’s comment, ‘**Geshimojian**’ gave an interpretation of how he/she thought about scientists’ arguments about GM technology, which is very representative of the data overall. In his/her words, people who have no idea about GM technology prefer to turn to authoritative statements (from the scientific community) for comfort or help, which is usually the first step of understanding scientific issues. However, as conversations which cite scientific evidence but ignore it in favour of more emotional responses demonstrate, facts from the scientific community do not convince the public about the safety of GM technology. Panic or insecurity about something uncertain that may happen in the future makes people extra cautious about the information released from various parties, including the scientific communities, governments, NGOs, etc. In other words, uncertainties existing about new technology might result in a sceptical attitude among the public, which observing the online discussions of the present research will lead to discussions of controversy for a long time.

As seen from the data, discussants have expressed their own concerns or have challenged the authoritative voice of experts. However, interactive exercises, or in other words, public engagement of science in its true sense is rarely seen. Specifically, the present data show that, in most cases, conversations about GM future happen among ordinary discussants, rather than between scientists and the lay public. For instance,

conversations on Weibo were caused by the comments made by scientists but took place mainly among normal social media users. After posting initial Weibo content, scientists seldom participated in subsequent discussion, neither replying nor forwarding any comments.

Compared with the rare interactive manner of experts on Weibo, scholars with GMO research-related academic backgrounds tended to be more active in communicating with either laypeople or peers. Twitter user ‘**C.S. Prakash**’ (@AgBioWorld) is self-described as a professor specialised in GM research at Tuskegee University in the USA (C.S. Prakash [Twitter page], 2017). The conversation below was selected from the numerous discussions on GM technology taking place between him and his Twitter followers.

C. S. Prakash Jun 12, 2017

@AgBioWorld If a cow eats #GMO feed, will its milk be GMO? Yes, just as the cows fed with chocolate produce chocolate-milk!

Richard Reesor Jun 12, 2017

@AgBioWorld @kevinfolta If an organic farmer fertilizes crops to feed cows with compost and blood meal from livestock fed GMOs should the milk be labelled GMO?

C. S. Prakash Jun 12, 2017

No, then the milk should be labelled COMPOST & BLOOD MEAL MILK!

Kim Jun 14, 2017

@AgBioWorld if a cow eats GE chocolate, will the GE protein(s) be used in the milk production process? this would be a fair question. as is, simplified

C. S. Prakash Jun 14, 2017

Only if that makes any difference in the milk quality, biochemistry, taste....

Richard Cowley Jun 13, 2017

@AgBioWorld @kevinfolta dont[don't] forget, pasta comes from animals too! [bracketed word in original tweet]

Jason Cunliffe Jun 13, 2017

@AgBioWorld Interesting & tricky question. Chocolate-milk joke analogy does **not** help. more helpful = software licensing issues such as GNU vs APACHE

V Z @VZufferey Jun 17, 2017

@AgBioWorld @nomadics

Actually, 7% of Americans indeed believes chocolate Milk comes from the Brown kind of cow...

((Stuart Hayashi)) Jun 18, 2017

@AgBioWorld @BeatSpath@VZufferey

Anti-GMO people will take that literally. Aha! You admit there is a GMO Chocolate Milk conspiracy.

Retweeting a piece of science news report entitled 'If a cow eats genetically modified feed, should its milk be labelled as GMO?' with a joke, '**C. S. Prakash**' raised some small-scale discussion among his/her Twitter followers. The data cited above indicated that responses were directly given to every discussant, and some, such as the conversation between '**C. S. Prakash**' and '**Richard Cowley**', even led to further talks. In addition, conversations also happened among other discussants after '**C. S. Prakash**' put forward the initial topic.

Here the interactive communication model was working in spontaneous discussion. Different from the previous conversations discussed on Weibo, the expert took part in the interaction actively instead of being the creator of Twitter content or just being a

part of the content. However, interactive communication was not always used as a way of communicating on social media by GM scholars, other than **‘C. S. Prakash’**. For instance, Twitter user **‘gmopundit’** (@gmopundit), an ‘academic with expertise in genetics, biochemistry biotechnology, microbiology and food science’ (gmopundit [Twitter page], 2017) according to his/her self-introduction on Twitter, preferred to retweet the content or comments that he/she was interested in with no additional comment on them. However, a low frequency of discussion participation does not result in low activity on social media. On the contrary, a very high frequency of users retweeting and commenting on Twitter content illustrated **‘gmopundit’**’s dynamic use of social media.

Academically, the interactive communication taking place on Twitter shows the existence of a ‘two-way’ communication model or, in other words, public engagement of science on social media. As one of the main functions on social media, retweeting also represents engagement through the application of interactive functions. In some cases, participants choose to quietly take part by retweeting or liking original content, as retweeting further shares information they think is worth spreading the word about. In this research, I decided to label participatory behaviour that uses interactive functions, such as ‘retweeting’ and ‘liking’, without adding additional comments or responding further ‘quiet engagement’. Quiet engagement could be found in many cases of spontaneous discussion, nevertheless, regarding Irwin’s theory about the model of science communication, my contribution of the term ‘quiet engagement’ might indicate an incomplete transition from the ‘deficit model of science-public relation’ to public engagement as it is a form of one-way communication (Irwin, 2014).

Alan Irwin who raised the ‘third-order thinking’ theory of science communication has pointed out three major characteristics of the ‘first order exercise’, also called, the deficit model of communication. First of all, ‘an authority claim based on the language of certainty’ (Irwin, 2014: 202) can be clearly identified from the deficit model of communication. Secondly, regarding science-oriented issues, the scientific community

is isolated from either government or industries. Thirdly, the ‘top-down’ model dominates communication while public engagement is rarely adopted in meaningful ways (Irwin 1995: 53).

In regard to the present data as an academically authoritative voice, statements, particularly explanatory ones, made by scientists are normally presented in a tone of certainty. For instance, ‘**Ludaru**’ placed emphasis on the necessity of GM research when expressing personal attitudes to GM technology, whilst Prof. Huang described GM as an ‘inevitable historical trend’ of agricultural development in his argument, showing strong confidence in the value of future GM technology, even without going into further details. As can be seen from the data, claims of authority do not persuade the lay public and receive a number of challenges. Although the discussants are aware of the difference between a scientist’s argument and governmental opinion, which could be clearly seen from the radically different attitudes towards GM research and towards GM policymaking (as mentioned in the former section), discussants are unlikely to ignore the powerful influence of a scientist’s suggestions on policymaking similar to what ‘**Dalishuanglangguzhen**’ was concerned with. Thus, science was not able to be completely distinguished from governmental or industrial manners, so the purpose and attempts of scientists were frequently doubted and considered to be serving the authorities to make a profit. No matter how the purposes of scientists were surmised, I uncovered the indisputable fact that interactive action seldom happens between scientists and the lay public. The way, in which scientists communicated with discussants on social media, established that ‘one-way’, or in other words, ‘top-down’ communication remains the major model of communication between scientists and the public, in which equal dialogue or deliberation is uncommon.

Drawing upon Barben et al.’s argument (2008) about the engagement exercise of anticipatory governance, representative forms of public engagement, such as consensus conferences and public debate, have not appeared among online spontaneous discussions. Nevertheless, it is simplistic to classify the communication between

scientists and the public under a ‘first-order’ model because the initiative public engagement model has emerged from spontaneous discussion occurring on social media. An incomplete transition from a ‘deficit model’ to public engagement works better to describe the characteristics of the online communication model. Specifically, two apparent changes revealed that a process of transition was taking place. Firstly, it is a fact that the adoption of social media as a platform of science communication shows an apparent willingness to engage with the wider public. Here, the challenges to claims of authority can be understood as a direct consequence of opening up a previously closed off area, and offering greater transparency to the wider public. According to the deficit model of communication (Irwin, 2014: 202), science is regarded as an authority while the public are passively instilled with what they need to know without taking into account any meaningful consultation. However, with respect to the data, discussants are equipped with the ability to raise doubts about and challenge the claims of authority often with rational and convincing reasons. In this case, the public has initiative to react to scientific issues in their own way rather than being passively informed.

Secondly, it is obvious that ensuring the openness and the transparency of the scientific community results in a large diversity of public opinion . Compared with a conventional ‘one-way’ model, communication taking place on social media better accommodates the free exchange of ideas, which literally opens topics up to a whole spectrum of public opinions. As can be seen from the present data, although the interactive action between scientists and the public remains limited, abundant personalised arguments are visible among follow-up debates over scientists’ statements, which is worth drawing upon as valuable reference. For example, responding to one statement of Prof. Huang, discussant ‘**Maerhunzi**’ shared his/her own view on the basis of his/her personal experience as a practitioner of agricultural crop production. ‘**Maerhunzi**’’s perspective added a new attribute to the GM debate—the cost of GM products compared to non-GM products. This point then gave rise to a further collision of thoughts among the discussants.

Apart from the incomplete transition of the communication model, Nabatchi and Leighninger's theory (2015) of 'thin participation' also makes sense to explain the interaction between scientists and the lay public on Twitter and Weibo. Specifically, the way in which experts and non-experts interact in future-oriented discussion on social media belongs to 'thin participation'—one of three direct forms of public participation, distinguished from the traditional concept of public engagement and extended to a wider range of participations online (see Section 2.3.2). According to Nabatchi and Leighninger's theoretical explanation, thin participation 'activates people as individuals rather than in groups' (2015: 17), different from public engagement in traditional sense that 'enables large numbers of people, working in small groups, to learn, decide, and act' (2015: 14), which is defined as 'thick participation' by the scholars (Nabatchi and Leighninger, 2015). In other words, the participants of thin participation engage with public affairs in an independent capacity, instead of working in a small group with other members, which could be exemplified by spontaneous discussion on social media, formed by considerable user-generated content. In addition, thin participation covers a variety of activities, especially online participations, such as 'sign[ing] an e-petition, 'lik[ing]' a cause on Facebook, retweet[ing] an opinion, or rank[ing] ideas in a crowdsourcing exercise' (ibid.). Referring to spontaneous discussion on Twitter, the very intensive retweeting behaviour taken up by user '**gmopundit**' could also be identified as a means of thin participation in the theoretical framework of Nabatchi and Leighninger.

Although, compared with the classic forms of public engagement as mentioned by Barben et al. (2008), thin participation requires less intellectual contribution, is less time consuming and works in a relatively looser structure, the real impact of thin participation is exerted when sufficient numbers of participants are engaged (Fung, Gilman and Shkabatur, 2013). The powerful networking resource of social media makes thin participation possible. As can be seen from the present data, the high volume of comments and retweeting on Weibo following a scientist's statement about the prospects of GM technology illustrated the substantial attention the scientist obtained

from the social media users, as well as the large population base of engagement. Besides, surrounding GM future issues, a broad spectrum of opinions emerging from spontaneous discussion reflects the broad dynamics of participation on social media. To paraphrase Nabatchi and Leighninger, the influence of engagement relies heavily on how eager the participants are to be involved, to be heard and to make a contribution (2015: 18-19). As mentioned at the beginning of this chapter, regarding scientific issues, especially controversial ones, the lay public are interested in and sometimes pay extra attention to scientists' or experts' statements for trustworthy wording.

At the same time, social media have created opportunities for users to meet a higher level of engagement by enabling the public to find out what they want to know from experts, who also offer 'people the chance to make comments, engage with civil servants or other citizens, or help gather more data' (Nemani, 2014, cited in Nabatch and Leighninger, 2015: 19). Specifically, recruiting a large mass of participators with real influence over online society, spontaneous discussion on social media might give rise to a new turn of rigorously organised public participation to specify the issues on a deeper layer, while thick participation is also in need of expanding the scale of engagement for embracing crowdsourcing opinions among the public rather than working with select groups. Thick participation could overcome its limitations through the follow-up exercise of thin participation. In this case, as Nabatch and Leighninger argued, moving back and forth between two forms of participation could be a way of implementing public engagement gradually and steadily (*ibid.*). Therefore, even if the voices of experts on social media do not persuade the public alone, interactive communication between experts and the lay public could make a meaningful difference to the whole process of the public engagement of science.

5.2 Leading the mediating 'mid-politics' of GM: opinion leaders, public intellectuals, and the anti-GM movement

As the key actor with the largest population base in science communication, the masses

are located at a central position of the relation network where they affect the interaction model among experts, government and media. For instance, academic experts seeking to maximise economic and political support for advancing science research are required to emerge from their ivory tower, and actively engage with the lay public to promote public understanding of science by striving for the wider public acceptance of scientific research (Wooden, 2006: 1058). Considering the remarkable potential of science and technology to give impetus to social improvements, governments should, ideally, work for the public to convert scientific achievement into social wealth (ibid.; Stilgoe, Irwin and Jones, 2006: 20).

Even though the masses are sometimes treated as an object that scientists and governments are trying to engage with, it would be too naïve of us to consider the public as a “receiver” who passively acquires information from a provider. On the contrary, in terms of the results of the present research, the grass-root movement is full of initiative and valid points to confront controversial scientific issues in the political sphere. With respect to spontaneous discussion about GM issues on social media, a salient grass-roots movement has been protesting about the illegal commercialisation and application of GMOs. This campaign, known as the anti-GM movement, has been expanding and represents a powerful opposition to GM industry with meaningful political influence. The leaders of the movement, who could also be identified as public intellectuals in a Chinese context, have made significant efforts to strengthen the movement, and then to the emergence of a new political culture.

In the Digital Age, public opinion leaders, who were initially defined as the elite of their communities ‘influencing other people in their immediate environment’ (Katz and Lazarsfeld, 1955: 3), are now actively making use of the Internet as a resource to expand their personal influence and steer public opinion (Choi, 2016: 697). The present data indicate that, compared with communications between scientists and laypeople, the interaction between opinion leaders and the masses (non-leaders regarding their level of activeness) is much more dynamic. Against different social and political backdrops,

the opinion leaders in the Chinese anti-GM movement demonstrate extraordinary social influence, distinct from opinion leaders in Western societies. I will explain further. If we consider non-governmental organisations (NGOs) on Twitter such as ‘GMO Inside’ with 59 thousand followers and ‘GMO Free USA’ with 47 thousand followers, they serve as an initiator and a salient opinion leader of the anti-GM movement, as these NGOs actively update Twitter with content directly relevant to their proposition (Jensen, 2012: 71).

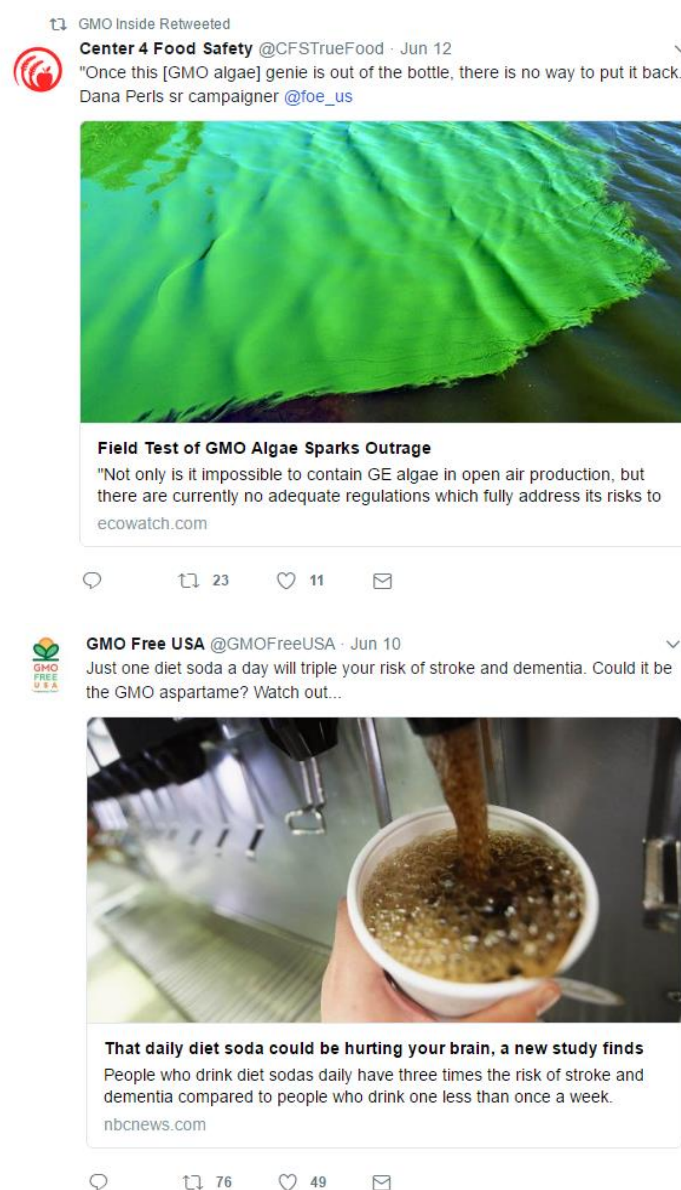


Image 1. Screenshots of anti-GM NGOs Twitter content

According to the data, dialogue or discussion rarely happened between NGOs and their followers on Twitter (see Image 1). Even if comments were made by one or more followers independently, response was so seldom that interactive communication was not generated. However, the amount of ‘retweets’ and ‘likes’ generated explain how the opinion leaders of anti-GM movement on Twitter spread claims and expanded their social influence on social media. What is more, it was notable that apart from NGOs verified accounts on social media, NGOs also launched activities to promote the anti-GM movement through their official websites.

In contrast to Western societies, instead of operating in groups or through institutions such as NGOs the Chinese anti-GM movement on Weibo is led by individuals, who can be identified as opinion leaders in terms of the amount of ‘retweets’ and ‘likes’ generated, and also according to their number of Weibo followers. Due to the different political and social environment, NGOs supporting the anti-GM movement are not yet available in China according to official government records (China Development Brief, 2017). The anti-GM movement also lack their own websites. Therefore, third-party social media platforms, such as Weibo, become a major site for the anti-GM movement in China. Different from the NGOs endorsing anti-GM movements on Twitter, the statements of GM public opinion leaders, or to be more precise the voices of influential public intellectuals, stand out from the other opinion leaders because of their existing social influence and prestige in professional fields. Statements posted on Weibo have unlocked a torrent of debate on the policy about commercial GM cultivation with a boom of diverse opinion which has influenced the mediating sub-politics of GM—an updated version of sub-politics (see Section 5.3).

Unlike public figures who have a clear political position or standpoint, the well-known opinion leaders of the anti-GM movement in China, such as Yongyuan Cui and Xiulin

Gu, are public intellectuals who remain independent from any political party regarding GM issues. Among the few public intellectuals in the Chinese anti-GM movement, Yongyuan Cui stands out as the most representative. Yongyuan Cui, was a famous television presenter and producer in China Central Television (CCTV) (Li, 4th March 2014), he is now teaching at the Communication University of China (The Communication University of China, 2017). Without being identified officially, or specifically, as the opinion leader of anti-GM movement, Cui became well-known and followed by a large number of social media users because of his spicy criticisms about governmental behaviour concerning GM supervision, and his active social work uncompromisingly opposing the commercialisation of GM (Li, 4th March 2014).

Hong Kong Commercial Daily Jul 15, 2017

[U.S. Congress has passed the GM labeling bill]

The U.S. House of Representatives passed the GMO labeling act on Thursday, mandatorily requesting food producers to label GM ingredients. This act has been passed by the Senate last week. A spokesman from the White House said that the Obama administration is expected to sign the bill. This bill will replace the one previously passed by Vermont to become the general GMO bill that applies to every state.

Cuiyongyuan Jul 15, 2017

Labelling GMO products shows a respect to customers' right to know and the right to choose. The messy consequences of illegal planting and unclear GM labelling harm the rights and interests of consumers.

Dingdingyoulan8 Jul 15, 2017

Replying to @Cuiyongyuan

What we need is just the right to know and the right to choose.

Cuiyongyuan Jul 15, 2017

Replying to @Dingdingyoulan8

The masses who handle the truth are strongly backing [the right to choose]

Ziyoudemengfeifei Jul 15, 2017

*Replying to @**Cuiyongyuan** Who is supposed to be responsible for the messy market of GM food in China? Are they [the government] in dereliction of their duty?*

Cuiyongyuan Jul 16, 2017

*Replying to @**Ziyoudemengfeifei** The Department of Food Safety of the Ministry of Agriculture should have provided strict control to GMOs, they have to be responsible. And their ineffective supervision, of course, is a dereliction of duty.*

Ziyoudemengfeifei Jul 16, 2017

*Replying to @**Cuiyongyuan** The warrior of anti-GM! Support Yongyuan Cui!*

With over 10 million followers on Weibo, Yongyuan Cui is definitely an influential public intellectual. Taking a look at his Weibo account (Yongyuan Cui [Weibo page], 2017), it could be seen that most of his Weibo content focuses on GM issues, including plenty of open debates with Weibo users from all walks of life, followed by a large number of comments and replies. The case mentioned above is a typical one found on his Weibo page. This conversation took place among Cui and two other Weibo users, named ‘**Dingdingyoulan8**’ and ‘**Ziyoudemengfeifei**’. Cui retweeted a piece of news posted by ‘**Hong Kong Commercial Daily**’ about the GM labelling policy passed by the House of Representatives in the USA and received commands from a numbers of users, including ‘**Dingdingyoulan8**’ and ‘**Ziyoudemengfeifei**’. Cui believed that clearly labelling GM food respects people’s right to know what is in the products they buy and their right to make a choice. Otherwise, consumers’ rights would be infringed upon. ‘**Dingdingyoulan8**’ showed his/her agreement with Cui’s statement and received acknowledgement from Cui, ‘the masses who handle the truth are strongly backing’, in his reply. ‘**Ziyoudemengfeifei**’ raised a question about ‘who is suppose to be responsible’ in GM supervision and also received a response from Cui. Both of the users

received a direct response from Yongyuan Cui in an interactive communication.

Regarding the format of communication, it is clear that the ‘two-way’ model of communication happens during the above conversation. By providing direct responses to the commenters, Cui has made the followers aware that their opinions were heard and corroborated. It is also clear from Cui’s replies that explanatory comments alongside encouragement was given to the followers who showed a supportive attitude to Cui, through which the opinion leader was able to establish a close connection to his followers. Unsurprisingly, Cui’s voice of GM opposition was raised in parallel with his supportive one. What actually enabled Yongyuan Cui to gain considerable attention regarding GM issues was the “battle of words” breaking out between Cui and his opponents, who questioned, critiqued or fought against Cui’s anti-GM claims. The case below presents one such battle between Cui and Weibo user ‘**JiaojiangyeSir**’, including the follow-up discussion taking place among the supporters of both sides.

JiaojiangyeSir Jul 15, 2016

Yongyuan Cui slandered me, saying that I was the scum of police. As a CPPCC member instead of an ordinary person, his attitude has been clarified. He started to lie. As a former famous journalist of CCTV, he always comes up with an excuse for his abuse, which is a shame. How could a CPPCC member quarrel with netizens online? As an adult, he has to be responsible for what he did! I’ve never abused anybody. People know that!

Cuiyongyuan Jul 15, 2016

Replying to @JiaojiangyeSir Making a talk show on CCTV is not like what you did, such as making a fraudulent report to the highest level. What a journalist does depends heavily on daily accumulation and real-time judgement so that every reaction in a talk show is true instead of prepared. In this case, you are spreading rumors. That’s why I said you were scum. I’ll remind you about that in time.

Yintianqingtianwumaitian Jul 15, 2016

Replying to @Cuiyongyuan Yongyuan Cui is just saying something true, especially about GM food which is labelled or not recommended in many other countries. What about China? The anti-GM movement led by Cui is suggesting not to eat GM food, which is followed by so much abuse. If you wanna eat, just eat, you mad guys. Don't show off by arguing!

Chunan zuoshifu Jul 15, 2016

Replying to @Yintianqingtianwumaitian How do you know that the government from other countries suggest not to have GM food? From Cui? Making non-scientific-based statements is a rumour, which causes public panic!

Qingtian yintianwumaitian Jul 15, 2016

Replying to @Chunan zuoshifu Then where do you think the GM food comes from? Don't tell me that I have tried GM food for ages

Chunan zuoshifu Jul 15, 2016

Replying to @Yintianqingtianwumaitian From the books with scientific evidence.

Yintianqingtianwumaitian Jul 15, 2016

Replying to @Chunan zuoshifu Let me tell you this. No one at the moment is able to provide a certain conclusion about whether GM is harmful or not. Did you compile the book in your dream?

Chunan zuoshifu Jul 15, 2016

Replying to @Yintianqingtianwumaitian The book is published by People's Education Press. If you are not able to prove the harm of GM, why do you slander that GM is widely spread in China?

Yintianqingtianwumaitian Jul 15, 2016

Replying to @Chunan zuoshifu How could you prove that it is safe? Tell me the page and the row of the statement clearly saying that GM food is safe.

Chunanzuoshifu Jul 15, 2016

*Replying to @**Yintianqingtianwumaitian** GM food is proved not to cause any illness or allergy by experiments. You'll know why GM food is safer than the natural one if you've learned the principle of GM in high school.*

In the conversation cited above, user **'JiaojiangyeSir'** criticised Cui's behaviour, particularly as a well-known person in the public eye, which involved quarrelling with ordinary users on social media using foul language. While Cui replied and countered that **'JiaojiangyeSir'** was 'spreading rumors'. In Cui's reply, foul language was still present in words such as 'scum'. Opinion leaders use foul language as a way of influencing the public—as mentioned in the literature concerning the normative working principle of opinion leaders (Katz and Lazarsfeld, 1955; Choi, 2015). User **'Yintianqingtianwumaitian'** tried to defend for Cui, by saying that Cui was telling the truth about GM risks as the GM policy in China was imperfect compared to other countries. This opinion was questioned by **'Chunanzuoshifu'**, who doubted the source of **'Yintianqingtianwumaitian'**'s evidence about GM policy in other countries. After that, a debate over the influences of GMOs took place between **'Chunanzuoshifu'** and **'Yintianqingtianwumaitian'**, which drew plenty of attention from Weibo users as can be seen from the number of 'likes' attached to each Weibo reply (with 231 'likes' being the least attention given to one post at the moment of data collection). It is noteworthy that Cui also 'liked' **'Yintianqingtianwumaitian'**'s comment.

The present data show that even without any rigorous organisation, people voluntarily join discussions about GM issues on social media: by either jumping into the conversation and expressing their own perspectives, or liking the discussions that they have resonate with. Here, the influence of Yongyuan Cui, as an opinion leader, actively engaging the public on social media should be given attention. Likewise, the large-scale anti-GM movement led by public intellectuals like Cui is also worthy of analysing as a consequence of interaction with the public on social media. In the subsection that follows, Cui's performance in GM discussions on Weibo will be interpreted from two

aspects: the role of opinion leader and public intellectual.

5.2.1 Opinion leaders

Speaking of the influence of opinion leaders for public engagement on social media, the ‘two-step flow of communication’ theory put forward by Katz and Lazarsfeld in 1955 is likely to give an explanation. In a communication flow from the mass media to the public, opinion leaders, who ‘tend to be more exposed and the more responsive group’ (Katz and Lazarsfeld, 2005: 309), act as mediators of communication. Through further interpreting the content of mass media in subjective expression, opinion leaders, sometimes, try to affect or steer the opinion of the non-leaders to the viewpoint which is ‘most closely associated with their leadership’ (2005: 316). In this instance, the personal influence of an opinion leader is believed to be much stronger than that of the mass media in Katz and Lazarsfeld’s theoretical framework.

As time passes, the influence of opinion leaders in the Digital Age is not weakened. On the contrary, with more frequent interactive communication taking place between opinion leaders and the masses, the social influence of opinion leaders is likely to be achieved and be expanded. In a development of the original theory, Choi pushed the research of two-step flow of communication forward to consider social network sites. Regarding the behavior of opinion leaders (2015: 700), Choi concludes that ‘explanatory power in online public forums’ is working through the efforts of opinion leaders, even though they are not necessarily the creators of media content. Besides, in a social media environment, opinion leaders try to maintain high exposure by ‘having their messages spread by others’ (Choi, 2015: 706).

Most of these conclusions are supported by the present data. As can be seen from the data, being regularly retweeted by other Twitter users has demonstrated the spreading social influence of NGOs within social media. While providing explanatory comments to followers who raised questions was employed by Yongyuan Cui as a means to build

up a relationship with the masses. In the conversation between Cui and ‘Ziyoudemengfeifei’, the user raised a question of responsibility and received a direct explanation from the opinion leader. Without creating the original Weibo content, in this case, the opinion leader provided an explanatory response to discussants and formed an interactive style of communication. Subjective factors brought into content interpretation could be clearly seen from the foul language (‘That’s why I said you were scum’) appearing in Cui’s reply. Meanwhile, the large number of ‘likes’ (312 times) and ‘retweets’ (225 times) certified Choi’s conclusion that the social influence of opinion leaders is expanding on social media environment.

5.2.2 Public intellectuals

In online discussion centered on public issues, the identity of the public intellectual (as an opinion leader) has entailed more significant social responsibility through their actions instead of merely making a difference to trends of discussions. Jacoby’s, Bourdieu’s and Posner’s understanding of public intellectuals, along with the social and cognitive function attached to the role, can be seen in the case of Cui. First of all, the active interaction taking place between Cui and his followers serves as a good example of the regression of public intellectuals (Jacoby, 1987). At the same time, Cui’s engagement with the public hints that the social responsibility of public intellectuals was not regressing but instead being reshaped (Posner, 2003). In other words, unlike the phenomenon described by Jacoby that forced public intellectuals to escape the stresses of living and struggling in the public realm, public intellectuals, such as Yongyuan Cui and Xiulin Gu, are actively mobilising in the public sphere and passionately engaging with ordinary Weibo users regarding GM controversy. In addition to the personal blogs mentioned in Jacoby’s updated work about public intellectuals (Jacoby, 2009), personal pages on social media have made full use of interactive functions to achieve effective two-way communication between public intellectuals and the lay public. In this way, the regression —has been realised.

As a member of the National Committee of the Chinese People’s Political Consultative

Conference, Cui is qualified to involve himself in political action by virtue of his fame and social influence (Bourdieu, 1991). Rather than escaping from the complicated issues of society and politics, and hiding in the “greenhouse” of university, Cui overstepped the boundary of his own specialised field and got involved in public debate centered on controversial issues—the commercialisation and the governance of GM (Jacoby, 1987; Cushman, 1999; Posner, 2003). Trying hard to make the public aware of the potential risk of GMO, Cui actively engaged with the general public through social media and physical activities, such as the physical debate between the Chinese journalist Yongyuan Cui and an unknown economics scholar from Fudan University (Raider Knight, 2015), as he speaks for the public in defense of their ‘right to know’ (Cushman, 1999). As can be seen from the data, Cui clearly declared his standpoint concerning the governance of GMO in understandable language. A style of communication that involves frequent interaction with the general public, discussing derivative topics, such as criticising the unreasonable attribution of responsibility. His performance on Weibo has nearly covered all the means at his disposal to act in a social responsible way through public intellectual work (Jacoby, 1987; Posner, 2003). The ‘public’ features of a public intellectual, understood as a close connection with the public through engagement exercises, has been fully accomplished through his actions on social media.

In accordance with the data retrieved from spontaneous discussion on social media, and the qualitative method of data analysis, although unlikely to reveal statistical evidence indicating an association between the influence of public intellectuals and quality of public engagement, Jacoby’s concern about the online habit of ‘one-stop thinking and instant commenting’ (Jacoby, 2009: 40-41), which results in the decline of intellectuals influence in digital environment does not happen. On the contrary, public intellectuals’ efforts are widely spread on social media and contribute to the rising of the anti-GM movement.

I will now consider the combined influence of public opinion leaders and public

intellectuals. According to the Nabatchi and Leighninger's analysis on the model of public engagement online, which is also identified as thin participation, this quickly-spread large-population-based participation model on social media is able, theoretically, to facilitate the large-scale expansion of public intellectuals' or opinion leaders' personal influence. Specifically, rather than being the creator of Twitter or Weibo content, the main way of expanding personal influence is by spreading opinions as widely as possible, for which a huge network connecting vast population of users become an indispensable condition. Regarding this, social media have provided an ideal platform, on which people whose opinions are steered by opinion leaders assemble spontaneously and compose an online community based on common standpoints such as pro-GM and anti-GM. The members of communities take part in normal activities carried out on social media as individuals, by which thin participation is carried out on social media; meaning that the opportunities and the content of participation are likely to rapidly spread through the existing social network.

In the process of engagement on social media, participants are continuously influenced by and, meanwhile, influence others, including opinion leaders, through all kinds of interactions (e.g., reply, discuss, retweet, like, follow, unfollow). As the influence of opinion leaders, public intellectuals in particular, and of the anti-GM movement widely spread out through the network, an increasing number of people with a wide spectrum of perspectives are likely to get involved, engaged, on social media. Here, the engagement of public intellectuals, who have existing authority and fame acquired from their own intellectual fields stamp the movement with political features, as they are able to interfere political issues through either deliberation or democratic consultation. In this way, engagement activity is continuously extending in scale and strengthened social impact, and the online anti-GM movement get a chance to achieve considerable political influence. Therefore, on the one hand it is reasonable to say that the anti-GM movement led by opinion leaders serves as a typical case of engagement behaviour on social media. On the other hand, a mutual improvement of ideas does exist due to the interaction between public intellectuals and the engagement activities taking place on

social media. In other words, the present movement led by public intellectuals on social media is likely to be a new power facilitating social media engagement which involves public intellectuals discussing with and convincing the public to share their viewpoints, and meanwhile offers a valuable resource of reference to the government to support anticipatory governance.

5.3 A massive protest movement: The mediating ‘mid-politics’ of GM

Apart from the constantly expanding impact of public intellectuals and of opinion leaders, the spectacular discussion on, or to be more specific, debate over GM and the anti-GM movement have directed the mediating mid-politics of GM—an updated version of sub-politics.

In 1987, Ulrich Beck (1987) raised the theory of risk society, which refers to the transition of society from industrial into a ‘postindustrial’ or ‘risk society’ which means having to find a way of dealing with hazards and insecurities induced and introduced by modernisation through the process of ‘reflexive modernization’. According to Beck’s explanation, ‘risk’ was sociologically defined as the ‘historically new phenomenon of the socially produced but unaccountable possibility of destroying all life’ (1995: 85). Advancements in technology and science, and the technical and scientific rationality of their methods has drawn extensive discussion due to the existing or potential risks resulting from techno-scientific development. In this case, citizens gradually become aware of the negative side effects (risks) of industrial society and try to anticipate the future hazards. This process of self-confrontation (Beck et al., 1994: 6) and seeking a solution to the technological risks is defined as reflexive modernisation.

The large-scale anti-GM movement led by opinion leaders is capable of characterising Ulrich Beck’s theory of sub-politics. In terms of the interpretation given by Beck, ‘the fissures and gaps between scientific and social rationality in dealing with the hazardous potential of civilization’ (1995: 30) contribute to a discussion of risk which leads to the

process of reflexive modernisation. With respect to the present data, ‘fissures and gaps’ indeed exist between the demands of taking advantage of GM technology to cope with urgent troubles in the real world, such as the world-wide insufficient supply of crops, and the lack of scientific results guaranteeing the long-term safety of GMOs. In addition to the uncertainty of GM use, the ambiguous connection between scientists and the authorities, and unclear governmental attitudes towards GM development are likely to result in a crisis of trust towards GMOs among the public. Given the wide range of potentially affected people and the high density of controversial GM issues exposed to the public, negative emotions to the relevant risks of GMOs are on the verge of breaking out among the public. Once a public affair relationship to GMO arises, such as the exposure of GM rice in the Chinese food market, a new wave of anti-GM movement will be triggered, as seen from the nationwide discussion happening on Weibo in 2014. Apart from that, according to the data vague government attitudes towards GM technology has further irritated the public who was already sensitive to GM issues. For instance, in the UK the news article ‘Brexit: Government to review GM crop regulations in preparation for leaving EU?’ (Sims, Wednesday 26 October 2016) drew extensive attention and also caused a new turn of anti-GM actions on Twitter with the appeal ‘don’t let Brexit open the door to GMO’ (see the cases below).

GM Freeze Jun 7, 2017

Don’t let #Brexit open the door to #GMO. #GE2017 manifesto for responsible, safe, sustainable food.

Olive Thyme & Figs Jun 7, 2017

Is UK ready to say a big NO to GMO food from US after the Brexit? #Brexit #London #NoGMO

In China, a ‘Report on the Work of the Government 2010’ (Jiabao Wen, 2010) supported further research on GM technology and the promotion of public understanding as one emphasis of agricultural development required in China. Despite

this recommendation, the opposition to GMOs in China was not weakened because of the government's unclear attitude to the cultivation, commercialisation and international trading of GMOs (see the cases below).

Tengxundepiaopiaohebianliu Aug 11, 2015

Replying to @Xiatianderejifeng Here is my view of GMO: I support scientific research on GMO and the legal action of popularizing GM technology. I reject illegal or private planting. I don't agree with the idea of holding GM product tasting event nor the mandatory label of GM even though I believe a GM label makes sense. That's it.

Xiexizhe Aug 11, 2015

I don't oppose the scientific research of GMO, but I will fight for any action of illegal promotion. The judicial authorities should also fight against GM criminals

No matter what risks people resist, they are trying to prevent potential dangers by promoting the anti-GM movement as a reaction to the uncertain future of advanced technology—which could be clearly identified as a process of reflexive modernisation within Beck's theoretical framework (1995). Creating a public sphere in virtual reality with interactive functions, social media facilitates reflexive modernisation by establishing a large-scale interactive network and the construction of numerous communities. As discussed before, large-population-based thin participation enables the wide expansion of the anti-GM movement on social media. Along with the growing scale of the anti-GM community, the activists of the anti-GM movement (the public intellectuals) are able to raise clear political propositions with the possibility of influencing government's policymaking work based on the comments of substantial population of supporters. For example, Yongyuan Cui has been a clear advocate for GM labelling in his Weibo content as follows.

Cuiyongyuan Feb 13, 2017

The ministry of agriculture has invested in GMOs regardless of the opinion of the mass of

tax payers! They obstruct GM labelling while enjoying all kinds of special offers. Please condemn the government's dereliction of duty, criticize their malfeasance and reject the shameless actions they've taken!

Cui criticised the Agriculture Department due to their dereliction of duty in supervising GM cultivation in China. He advocated citizens to exercise their rights by 'condemn[ing] the government's dereliction of duty, criticiz[ing] their malfeasance and reject[ing] the shameless actions they've taken'. Following Cui's advocacy, a large number of supporters organised themselves to promote the need to resist the illegal promotion of GMOs on social media. Bypassing traditional political processes, such as deliberation and policymaking, a new form of politics arose through a massive protest movement on social media. That is sub-politics.

In Beck's interpretation (Beck et al., 1994), sub-politics is a new grass-roots-oriented political culture generated against the backdrop of reflexive modernisation; thus, the power of decision-making is being decentralised from a traditional political system (Beck, 1994; Holzer and Sørensen, 2001). Mobilising outside the political system of nation states, collective agents, such as NGOs and individuals (like the majority of anti-GM followers), turn out to be a key component of sub-politics. They 'are allowed to appear on the stage of social design' (ibid.: 22) via social media, a public democratic input in response to the perception of potential risks brought by new technologies and their potential negative side effects (Beck, 1995; Jensen, 2012: 2). No less important than other forms of politics but less institutionalised, sub-politics normally shows up on a small-scale and often as 'individual decisions that either have a direct political frame of reference or achieve political significance by way of their aggregation' (Holzer and Sørensen, 2001: 3). Shifting from a 'rule-making system' to a 'rule-altering system' (Beck et al., 1994: 36), sub-politics requires a participatory political system and also the 'de-monopolization of expertise' (Chan, 2008: 262).

Regarding the present data, the involvement of public intellectuals (as mentioned in Section 5.2.2) for the purpose of affecting GM-related policymaking characterises a notion of ‘politics’, instead of being a means of opinion delivery. The effort of sub-politics in making difference to ‘social design’ can be seen from the negative attitudes toward GM revealed from spontaneous discussion online (see Section 4.3, Chapter 4); it can also be seen from a variety of offline workshops centred on discussing the societal implications of GM, and the prospect of GM as a controversial technology with great potential to create social wealth. For instance, an offline workshop held by Fudan University clearly illustrated the enormous influence of the offline anti-GM movement. A physical debate took place between Yongyuan Cui and an unknown economics scholar from Fudan University (Raider Knight, 2015). In the debate, the economics scholar tried to challenge Cui using logical and reasoned economic principles about the cost of the GM industry, the scholar’s argument did not receive a straight answer but he was verbally abused by Cui ‘with anger’ according to a video record, which was posted on Weibo, followed by 949 replies at the moment of data collection. The video raised numerous intensive follow-up discussions online.

Nevertheless, it is noticeable that on social media, the force of the anti-GM movement could not overwhelm opposing voices which question the scientific rationality of GM protesting. For instance, in the response of user ‘**Chunanzuoshifu**’ to ‘**Yintianqingtianwumaitian**’, the anti-GM movement led by Cui, which is believed to be scientifically unfounded, was suspected of creating rumours and of causing panic among the masses.

Chunanzuoshifu Jul 15, 2016

Replying to @Yintianqingtianwumaitian How do you know that the government from other countries suggest not to have GM food? From Cui? Making non-scientific-based statements is rumour, which causes public panic!

According to the reply given by ‘**Chunanzuoshifu**’, the anti-GM movement, especially the fierce and emotional expressions that apply to online discussion, was regarded by some people as a hidden danger or a potential risk, threatening social stability by causing panic and suspicion. Compared with the power of anti-GM movement, activists resisting the anti-GM movement are not fewer in number as can be seen from the frequency of their participation in discussions, which results in an evenly matched battle between the pro- and the anti-GM groups.

Facing up to industrially produced risks (Beck, 1992: 183), sub-politics represents a democratic way of opening politics up to the masses through extensively political participation. Rather than being led or organised by political parties or official departments, the anti-GM movement has brought about extensive social and political impact through public engagement (Clancy et al., 2016: 288) under the leadership of public intellectuals on social media. However, it is noteworthy that although some features of sub-politics are observable through an anti-GM movement on social media, it is inaccurate to say that the anti-GM movement has fully exemplified the definition of sub-politics provided by Beck (1994).

Cuiyongyuan Jul 12, 2016

*Replying to @**Pinglunyuannlitie** Netizens are spectating for fun and want to see us swearing. Let's entertain them! I swear that your last interview, which according to your words was for investigating me, is actually for money! Let me tell you a secret! I fight the USA for GM investigation and stayed there for one week only in October while my documentary set out at the beginning of December. So you are definitely bullshitting if you say that you start to investigate me following my documentary before December.*

Dghhfhjy Jul 12, 2016

Hhhhh, I'm a big fan of Cui. I'm on your side. Completely eliminate these bad guys!

Xumourenzaici Jul 12, 2016

Replying to @**Cuiyongyuan** A public intellectual? Lier!

Shehuizhuyixiaoquexin Jul 12, 2016

Replying to @**Dghhfhjy** Stupid fan

Yixiangtiankailijingping Jul 12, 2016

Cui is speaking for the public by fighting against GMO. Why do many netizens attack him online? It's such a simple question which shouldn't have been challenged. Is this nation problematic? Don't challenge Cui! Target me!

Shaobaotongzi Jul 12, 2016

I really like Cui and his live streaming!

The case cited above represents numerous discussions, which originated from the controversy of GM but diverge to a debate over the support or opposition of public intellectuals. In accordance with Beck's argument, sub-politics refers to the politics emerging from new places other than parliamentary debates or party elections, as such we can include for example the daily activities and choices of ordinary, spontaneous or informal political actions (Beck, 1994: 22; Holzer and Sørensen, 2001: 3). Here 'new places' refer to substantive actions or behaviours taking place physically outside of personal concerns, while online public debate over controversial topics (like GM-related issues) had not yet been taken into consideration by researchers. In addition, although online engagement was carried out parallel to offline activities in China, the new political culture generated from the subjective-factor-driven debate online, involving verbal abuse or emotional expression, suggests that topics of concern have been extended from the original debate to contention over whether public intellectuals leading anti-GM movement should be supported, which resembles a partisan debate taking place in the political system. In other words, even though the main participants and the driving factors of the anti-GM movement in China match the concept of sub-

politics, to some extent, party-competition-like content and the advanced digital environment distinguished the practice of the Chinese anti-GM movement from the tradition of sub-politics.

Nevertheless, public intellectual-oriented discussion in public debate by no means undermines the dynamics of public movement. On the contrary, as analysed in the previous section, the intensive battle between the supporters and objectors of public intellectuals is able to draw attention, thus attracting new participants who hold divergent views and attitudes so that the movement is likely to be enlarged. Meanwhile, under the assistance of a well-structured social media network, claims and their emotional spirits spread broadly and rapidly, pushing the anti-GM movement forward on social media. In this instance, it would make sense to distinguish the anti-GM movement on Weibo from the conventional concept of sub-politics by defining a new category. The new category that I propose is mid-politics, which has a broader range of manifestations and lies between sub-politics and traditional politics, as a supplement to the theoretical framework of sub-politics. Mid-politics therefore refers to a new type of sub-politics, which is led by public intellectuals and pushed forward in the form of public debate over either controversial issues or surrounding movement leaders.

Within the Chinese one-governing-party political environment, public intellectuals, together with the new political culture of mid-politics that they are leading, occupy a special role in China's political life. Facilitated by social media, mid-politics creates a new pathway of political engagement in China bypassing the traditional system and enriching democratic politics. The form of mid-politics gives an explanation to how democratic input exists in a Chinese context where no ruling right is given to any traditional political parties.

With regard to the Chinese political context, the system of 'political consultation' makes sense to explain how mid-politics is generated. Under the leadership of the Communist Party of China (hereafter CPC), 'the multi-party cooperation and political

consultation system', which is called 'political consultation' for short, is one of the basic political systems of China (China.org.cn, year unspecified). Under the system of political consultation,

[A]ll parties, mass organizations and representatives from all walks of life take part in the consultations of the country's basic policies and important issues in political, economic, cultural and social affairs before a decision is adopted and in the discussion of major issues in the implementation of the decisions (ibid.: n/a)

Referring to Chinese formal political culture, political consultation is launched for achieving 'socialist democracy' (Lawrence and Martin, 2013: 32-33) because the right of supervision is supposed to be given to parties, organisations and individuals outside the party in power through public deliberation. In the Chinese People's Political Consultative Conference (CPPCC), members, like Yongyuan Cui and Xiulin Gu, are given a chance to make suggestions on policy-related proposals by raising diverse concerns or different attitudes. After the conference, all deliberated issues and suggestions are recorded in the form of a written report which is then submitted to government offices for reference (CPPCC, 2017). The effort made by CPPCC 'can thus ignite and influence policy debates' (Lawrence and Martin, 2013: 33) and plays a powerful role in the democratic supervision of policymaking. According to records provided by CPPCC, Yongyuan Cui has submitted anti-GM related proposals in three consecutive years since 2014 (CPPCC, 2017). Each of the proposals received a response, which is closely relevant to the concerns held by the government about policymaking.

The one Cui produced in 2014, named 'The Proposal of Immediately Terminating GM-related Researches Nation-wide' (Li, 09th Oct 2015; CPPCC, 09th Oct 2015), caused a stir among the public, discussing whether GM should be completely banned. However,

it is the fact that the Chinese government is not obliged to act upon the suggestions submitted by CPPCC even though a detailed response is requested (CPPCC, 2017). In terms of Holzer and Sørensen's perspective (2003), active mid-politicians are no longer satisfied with the only channel provided by the formal politics. They therefore attempt to make use of power of public opinion underpinning the proposal. In order to draw due attention from policymakers and also from the whole of Chinese society, the members of CPPCC (here referring to Cui and Gu in particular) are likely to turn for help to public opinion through igniting debate and then seeking massive support through actively mobilisation. Social media provided ideal technical and service support for accessing the masses and enlarging the influence of advocacy.

The mediating of mid-politics through social media creates strong evidence supporting the great efforts of social media to facilitate public engagement of science, and contribute to the democratic input of Chinese political life; which further strengthens the potential of social media as a forum supporting anticipatory governance. In regard to the characteristics of mid-politics appearing on social media: on one hand, mid-politics is in line with the goal of public engagement in contemporary science domain; on the other hand, mid-politics creates a chance to put Irwin's perspective about the 'third-order reflections' of science communication into practice. In Irwin's theoretical framework, the third-order principle is no longer concentrated on discovering an innovative approach to best engage the public about science, or to promote public acceptance of the emerging outputs of technology. Instead, a critical scrutiny reflecting the new challenges and dilemmas confronted by scientific governance and 'open(ing) up fresh inter-connections between public, scientific, institutional, political and ethical visions of change in all their heterogeneity, conditionality and disagreement' (Irwin, 2014: 210) is advocated on the basis of forming a good understanding of what the main challenges or dilemmas are.

According to the theoretical perspective of third-order reflection, an omnipotent panacea no longer works to address public concerns about GM controversy (Irwin, 2014:

209). In other words, any single model of science communication may lose its power when a flexible mixed approach to science communication is required, subject to the complexity of the social environment, where socio-technical change has gone beyond purely scientific research issues to address complicated matters. Matters such as the cooperation between various stakeholders, and the coordination between innovation strategy, policymaking, public deliberation and the power structure, which requires placing science and technology in a wider cultural context to enhance reflexivity and critical analysis. At this moment, mid-politics generated from the massive anti-GM movement on social media is likely to provide a considerable resource to governments for getting an insight of how public opinions on GM issue are influenced and steered.

It is also true that social media are not the only approach to obtain a snapshot of public opinions. Surveys aimed at eliciting public values and attitudes, like Satterfield et al.'s research on mapping out public attitude towards Nanotechnology (2009), may also work but surveys are highly likely to elicit 'informed preference' from the respondents instead of their true responses (Corner and Pidgeon, 2012: 171). While the tools for deliberative intervention do not work effectively, going beyond the closed system of traditional politics and placing the GM issue in an open environment, where freedom of speech is maintained, would not only map out specific controversial points, such as dissatisfaction about GM management and the anxiety towards the uncertainty of GM-related futures, but also provide information about how such controversy arises by capturing and observing the essential factors affecting public input, such as opinion leader's impacts and the battle between the anti-GM movement and their counterpart. All the information that could be gathered from spontaneous discussion on social media serves as a valuable resource for the government as an 'analytical and supportive instrument' (Grubmüller, Götsch and Krieger, 2013: 20) deducing the trend of public opinion, which, however, does not mean that governments are able to come up with a reasonable strategy to immediately cope with problems. On the contrary, a government's circumstance is never simple.

5.4 A government's dilemma: Insufficient interaction on social media

In official politics, political institutions, including parliament, congress and government, play the decisive role in affecting the development of science and technology through the mechanism of decision-making (Beck, 1992). As society moves towards a knowledge society, where techno-economic advancement becomes one of the impetuses of social development, can governments balance the demands of economic growth against the massive public condemnation about the negative impacts of failed scientific rationality? This question raises an unavoidable challenge faced by the authorities (Wilsdon and Willis, 2004). Regarding controversial GM issues, how are governments projected in the eyes of public, and how do the governments in turn react to the questions and doubts raised by the masses in social media? The answers to these questions become an indicator illustrating the extent to which governments engage with the lay public about emerging technologies, especially when the decision-making mechanism is still beyond the reach of the masses. Additionally, as can be seen from the interpretation of the discussion about GM governance, there is a contradiction between the administrative ability of the government and governmental actions and public desire (see Chapter 2, Section 2.3.5). In other words, public requirements, such as securing the right to know and the right of making a choice, were not completely satisfied by the authorities, which gives rise to negative emotions expressed on social media towards governments. In this case, how the dispute arose and how both sides (public and government) react to the issues are significant to foresee if the controversy will continue to escalate in the future. Simultaneously, as I will demonstrate, the dilemma that governments are suffering from when transforming from 'closed politics' to responsive 'open politics' could also be figured out from an analysis of the present data.

Although there indeed exists a strained relationship between governments and the public with respect to GM policy, according to the data gathered from social media the debate could hardly become an evenly matched competition. Instead, it is clear that the

GM governance issue has witnessed a process of highlighting the ‘rights maintaining’ of the public on social media and not expanded government perspectives. According to proportional statistics, 96.36% of the eligible content on Weibo focuses on the desires of the public (53 out of 55) with the only two pieces of content representing the government. The overwhelming amount of content speaking for the public enables the public to maximise their power of questioning and supervising on Weibo. The data on Twitter turn out to be more extreme. None of the eligible Twitter cases came from governmental accounts, such as ‘Defra UK’—the official Twitter account of UK Department for Environment, Food and Rural Affairs, and ‘Dept for BEIS’—the account of the newly formed UK Department for Business, Energy and Industrial Strategy. What is more, ‘Defra UK’ has clearly declared in their self-introduction section on Twitter that ‘we do not respond to queries on social media’ (Defra UK [Twitter account], 2018).

As analysed in Section 4.2.2, discussion among the public was critical and controversial, as was seen in the diversity of views expressed, and the multi-facet concerns surrounding issues that discussants pointed out. Compared with the high volume of public voice, governmental statements about GM governance reflected the lack of public engagement methods making use of social media, which, however, does not mean that speeches from government are easily ignored. On the contrary, they even have stronger influence than the public’s voice on public opinion, and even on the trend of public relations on government affairs.

Pengpai News Apr 12, 2016

[Exclusive interview with the former director of the National Institute of Biotechnology: GM is safe and the mainstream trend of development] Dafang Huang, the former director of the National Institute of Biotechnology states that there is an agreement in academia that GMO products coming with the approval issued by the authorities is safe. Regarding the future of GM technology, Dafang Huang believes that it is an inevitable historical trend of agricultural development to make use of GM technology.

The case above is one of two pieces of governmental opinion posted on Weibo released by ‘**Pengpai News**’, a Chinese news website. In this Weibo content, ‘**Pengpai News**’ interviewed Professor Huang Dafang, the supervisor of the Chinese Academy of Agricultural Sciences, and summarised his main ideas, which refer to the governmental strategy of GM development in China. In his words, there is a consensus in science community that GM products will be ‘out of risk’ once passing tests run by ‘relevant departments’. About the future prospects of GM technology, Prof. Huang believed that GM will undoubtedly lead agricultural development in terms of China’s strategic deployment of the agricultural industry. Unsurprisingly, closely following the release of this Weibo content were a number of comments expressing negative emotions.

Yibenzhengjin Apr 12, 2016

Huang is speaking for the authorities, not for us. The leadership is enjoying their special offer while the normal public are struggling with fake milk powder and the fraud of the center for food security, saying that those are totally safe and no worries. That is the standard that we are facing too.

Mowangchuzhongfangdeshizhong Apr 12, 2016

Replying to @Yibenzhengjin How dare the government talk about GMO when they could not secure the safety of food. GMO is probably safe but China is definitely not. Don’t mention GMO until food safety can be guaranteed. Or, give the supporters what they want, such as GM labelled products!

Tanianzhiqian Apr 12, 2016

Replying to @Pengpai News Pengpai, as a news media, be justice please. You can’t mislead public opinion with subjective imagination. The statement of the former director is full of bugs. Do something right!

People doubted the standpoint of government officials (see the comment by ‘**Yibenzhengjin**’); and of mass media (see the comments by ‘**Tanianzhiqian**’); people

criticised the ‘thoughtless’ plan of the government’s deployment (refer to ‘**Mowangchuzhong_fangdeshizhong**’); and even shouted abuse at decisions made by the authorities about GM technology (refer to ‘**Tanianzhiqian**’). Nevertheless, these complaints and criticisms do not completely dominate the comments on Weibo in response to content posted by ‘**Pengpai News**’. Users like ‘**Zuqiuxiaojiang**’ appealed to treat science research and development justly and rationally instead of blindly transferring anger felt towards the government to a distrust of scientific research, which extensively exists among the public, or among the online discussants of this research at the very least.

Zuqiuxiaojiang Apr 12, 2016

It’s absolutely irrational to convert the mistrust toward governments to the mistrust of science. While this irrationality originates from the science ignorant. The lack of trust is the sadness of a society, while the lack of knowledge is the sadness of an individual.

Bean ZH Apr 12, 2016

What the government need to do at this point is to ensure the transparency of information, which enables us to identify GMO product and make our own decision, rather than blindly propagate the advantage of GM tech. Otherwise we prefer to conservatively believe that the government has concealed the truth, which certainly results in mistrust

Compared with the high volume voice of the general public, government statements have been submerged by a flood of public opinion in quantity, which, however does not weaken the social influence of the government as can be seen from 487 replies and 2,473 forwards. With respect to means of expression, paraphrasing the words of Prof. Huang was supposed to be an effective way of objectively quoting a personal view without bias. However, the indirect citation of a scientist with an administrative position does not bring about that effect. Some Weibo users, such as ‘**Yibenzhengjin**’, insisted that Prof. Huang was speaking for the government rather than sharing a personal opinion, as clearly pointed out by user ‘**Zuqiuxiaojiang**’ as ‘convert[ing] the mistrust

toward governments to the mistrust of science’. Besides, as can be seen from ‘**Bean_ZH**’s words, ‘we prefer to conservatively believe that the government has concealed the truth’, people tended to hold either a pessimistic attitude toward the government or little confidence in the government when talking about the development of GM before they figure out if Prof. Huang’s statement really represents a governmental standpoint.

In addition, it is clear that the Chinese government has engaged with the wider public on social media at a very low level. They have not made use of the two-way interactive functions of social media at all for public relation affairs, which is the case for governments in Western countries as well. In most cases, although the majority of government agencies have opened up their official accounts on social media for providing access to the public, acts of engagement or interactive behaviours were seldom seen in practice. Accounts are regularly updated by releasing the latest news but rarely provide responses to any comments raised by the public.

On Twitter, a similar case, with high social influence but a very low response rate, was visible in the statement made by public figures and posted through their real-name Twitter accounts. Twitter content written by Hillary Clinton, the previous presidential candidate of the USA, before the general election of 2017 is cited as an example.

Hillary Clinton @HillaryClinton Mar 16, 2016

Congress shouldn't block states from giving families information about their food—glad the senate stopped this bill. <http://hrc.io/1U8jd0H>

At the moment of data collection, Hillary Clinton publicly expressed her support of the GM food labelling policy on her Twitter account, raising an intensive discussion with 320 replies, 2237 likes, and 860 retweets. The people involved in the discussion following Hillary’s pronouncement unsurprisingly disputed whether the policy ought to enforce the labelling of GM products and, as mentioned before, the supporters of

GM labelling were neck and neck with those who objected. The two sides remained at loggerheads, and Hillary Clinton, the initiator of the discussion, never took part in the discussion, she never replied to anyone's comment (I will shortly provide some potential reasons why).

Considering all the cases mentioned above, it is obvious that the use of social media, across government agencies or by well-known politicians, fails to rid itself of the limitation of one-way communication, which essentially offers little help to science communication about GM technology. Without due use of interactive functions, social media may lose value as a platform for dialogue and make no difference to traditional one-way media broadcasts (Jarreau et al., 2008). With respect to this phenomenon, Bertot, Jaeger and Hansen's analysis on the issues and challenges facing governmental usage of social media (2012) provide a clue to better understand the dilemma of government agencies when making use of the resource of social media for achieving political purposes. After comparing and analysing more than 20 nationwide policies regulating the use of social media in government agencies in the USA, the scholars inductively come up with three primary principles: 'access and social inclusion', 'privacy, security, accuracy, and archiving', and 'governing and governance', which were required to be complied with within the federal system of the USA.

To be specific, the first principle of social media use requires to equally offer effective access to 'persons with limited English proficiency' or people with disabilities for maintaining social inclusion through government services on social media. The second principle refers to significant information management issues influenced by social media usage. In short, the vital precondition of social media usage in government services requires protecting privacy, data security, information accuracy and data archiving. In the highly dynamic environment of social media, especially third-party platforms outside official governmental websites, social media carries information risks. The safety of information is the foremost problem for the government to solve before launching any activity on social media. Facing these three principles, as mentioned by

Bertot et al. (2012: 32), governments prefer to act conservatively by setting serious security control mechanisms. A self-evaluation system is required for the third principle of social media use. So, according to Bertot et al.'s interpretation (ibid.: 33), many detailed rules exist in governmental policy concerning the distribution of information that influence social media use.

As can be seen from these three principles, governments have realised the remarkable potential of social media in promoting 'e-government strategy' (ibid.), and they have put an emphasis on the appropriate application of social media. However, it is also very clear that interactive functions or the initiative of engagement with the end users on social media was either not given due attention or intangibly restricted by complex conditions. First of all, the objective of providing 'equal access' only takes the accessibility of Internet into consideration while interactive actions remain unsolved. In other words, by offering access to social media, people are only given an equal opportunity to enter the environment of social media. the further communication following, including some interactive actions, could hardly be guaranteed yet. Social media provide an opportunity for users to engage, but whether users would like to engage or how they would like to make use of social media can not be guaranteed. It gives an explanation to why some users still follow a 'one-way' model of communication on social media. Second, as mentioned above, choosing a conservative path brings restrictive conditions that form barriers to the progress of online engagement. For fear of disclosing information or of being attacked by viruses, a strict control of information on social media is given so that 'two-way' dialogue in such an open sphere is unlikely, especially when 'the archiving work of interaction remained unaddressed' (Bertot et al., 2012: 33). Third, establishing a regulation of governing and governance serves as an approach to better guide the application of social media. An approach which requires an effective mechanism controlling the flow of information. Therefore, less structured spontaneous discussion and interactive communication, which comes with many uncontrollable and unpredictable factors, are rarely seen in the actions taken by government agencies.

Apart from the concerns about security, privacy and civil fairness, the less-organised format of spontaneous discussion on social media has inherent limitations to be applied as a valuable reference by governments. As Alan Irwin mentioned in his ‘third-order thinking’ theory, public engagement of science is not the end of science communication. Instead, it will result in ‘the demand for further engagement’ and endless accusations of opacity (2014: 208). Confronting the possibility of controversy escalation, governments have to first of all maintain a stable and harmonious social order. Under that premise, governments’ commitment to engagement exercises, on one hand, should not be ‘more than what they can deliver’ (ibid.), yet, on the other hand, engagement should become a part of usual governmental processes ‘alongside the unavoidable requirement for accountability and leadership’ (Irwin, 2014: 209). With respect to this concern about accountability and responsibility, governments have to take conservative measures, such as turning off comment functions, or clearly declaring that no response is available on social media.

The lessons of the ‘GM Nation?’ debate indicated that without feeling heard or considered, people panic about the uncertainties of GM technology and are more likely to be irritated which may worsen the strained relationship between the government and the public. However, it is still not accurate to define their relationship as one of opposition. It has to be acknowledged that emotional expressions or even online violence widely exist, which may dilute the value of public voice expressed on Weibo as a reference for policy-formulating, consider the provocative words of opinion leader Yongyuan Cui. Nevertheless, after filtering irrational voices out, it can be seen that interrogation or verbal abuse is not the only way of participating in online discussion. A majority of Weibo users actively look for an optimal balance taking multiple party’s into consideration.

Qiufengjingyun Oct 26, 2016

Please open the statistics of GM crops grown in China since GM is safe. Why does the government hold this back?

Amitufo-008 Oct 26, 2016

*Replying to @**Qiufengjingyun** The message that the Chinese government gave permission for the planting of GM crops will bring disastrous impact to the some profitable projects of China, including international trade of agricultural products, tourism, and investment projects. The policy-makers should think about it.*

Wojiushixiaoliyubufuyaowoa Oct 26, 2016

*Replying to @**Qiufengjingyun** and @**Amitufo-008** The researchers of GM technology are taking certain risks when conducting scientific studies. It is not fair to simply identify all the researchers as sinner. I believe that the advance of science and technology is always accompanied by doubts and disputes. We need to be more tolerant about it.*

As can be seen from the discussants' views above on government strategy, user '**Qiufengjingyun**' pointed out the necessity of transparency in China, while the other two discussants gave considered the possible consequences of information exposure. Discussant '**Amitufo-008**' concerned with many other associated industries and affairs, including the international trade of agricultural products, tourism and agricultural investments. He/she believed that a decisions on controversial projects has never been easy work because impacts are woven into a complicated network of economic gains and losses. He/she thought that figuring out a balance point between multiple profits and losses should be a crucial task undertaken by policymakers. Agreeing with '**Zuquixiaojiang**' that '[i]t's absolutely irrational to convert the mistrust toward governments to the mistrust of science', '**Wojiushixiaoliyubufuyaowoa**' argued that the improvement of science research is always accompanied by all kinds of disputes, which requires more tolerance from the public. No matter how intense the relationship between the public and governments are, or are perceived, the voices standing for understanding and support were not expressed less than the critiques in both quantity and influence, which, for governments and for anticipatory governance, is an opportunity to gain a balanced perspective.

The theoretical framework of anticipatory governance has explicitly highlighted the significance of public engagement model. However, as the present data show, there remain a huge space for governments to proceed and enhance the engagement actions in practice. Although it is inevitable to talk about the limitations of fully taking advantage of social media as the supportive forum underpinning anticipatory governance, the substantial resources of public opinion mobility, sub-politics movement, critical thinking and suggestion, and also the diverse interactions between scientists, lay public and governmental agencies are valuable material for policymakers as a mirror reflecting and helping restore the reality of GM problems, contributing to the strategic decision-making of nation states.

5.5 Deviant case analysis: a one-sided argument

As mentioned in the methodology chapter, deviant case analysis was employed in this study as a means of improving the quality and accountability of qualitative content analysis by examining cases going against the results described in the Section 3.7.5. A series of results from the data support that social media works as a site for anticipatory governance. Cases on Weibo interfering the practice of foresight and engagement are analysed below, by which the actions taken by the ‘Internet water army’—paid Internet ghostwriters existing in the Chinese Internet environment—are revealed.

As discussed before, the remarkable diversity of views involved in spontaneous discussion on social media enables critical and independent thinking, and facilitates the establishment of reflexivity for decision-making. However, there remain data extracts illustrating that entire conversations exist with only one opinion expressed towards GM technology, even though these comments were made by different ID accounts.

Monsanto China Dec 17, 2016

Monsanto selection: For farmers, every inch of farmland is unique because of the moisture, the nutrient level and the real-time variables of weather. The collection and the analysis of

these figures enable farmers to make a better decision based on the actual situation of the farmland so that the natural resources for farming work, such as land, water, fertilizers, fuel and so on, could be made use of more efficiently, which will reduce the waste of natural resource and then benefit sustainable farming.

Meixianer Dec 17, 2016

It is a very good App.

Yuebaifengqingdehuozhe Dec 17, 2016

The App becomes more and more functional with an increasing amount of data.

Chunzhengli Dec 17, 2016

It was issued last year. I believe we'll have more of these kind of Apps in the near future.

Kandaoshijianbaixiang Dec 17, 2016

Farmers are able to get rid of blindly planting with the assistance of this App.

Feifengfencou Dec 17, 2016

This App looks pretty practical.

Qianshitongshi Dec 17, 2016

Nowadays when most of the phone Apps provide either chatting or shopping functions, the farming-related service remains insufficient.

Erweiwangbianhuai Dec 17, 2016

It was impossible for an inexperienced farmer to properly plant without any assistance before the arrival of big data.

Guiqulaike Dec 17, 2016

Experience and data are money. I have a deep understanding about it.

Jipinfangzi Dec 17, 2016

I always believe that agriculture relies heavily on the natural environment, in which weather condition is an influential factor.

Slkepo726819 Dec 18, 2016

It is a very good App.

OVO TAT Dec 18, 2016

It is a very good App.

Feijitoudashu Dec 18, 2016

Every inch of farmland should be taken advantage of properly.

Shamayigetengli Dec 18, 2016

It seems that big data could be used in every single field.

Hualuoxiamoxiangli Dec 18, 2016

There is a huge population of farmers in China, which means there is a big need of farming-related services

Tianqinuamlefu Dec 18, 2016

The idea attached with the App is really forward-seeing and integrated, which contributes to the amazing work done by Monsanto.

Zhengmengshuo Cricoolgirl Dec 18, 2016

The application of science figures could be incredibly precise, which help cut down unnecessary waste.

Ranzi LRG kang Dec 18, 2016

Not sure whether this App is available in our country.

Lililiyikedalizi Dec 18, 2016

Every piece of farmland is unique with different conditions so that each problem requests a specialized solution, which it is able to achieve under the help of statistical science.

Yongzhenmingzhaoweixianpapapa Dec 19, 2016

It is a very good App.

Qingzhuangcainengzoudegengyuan Dec 19, 2016

It is a very good App.

Yanshizijidemianrong Dec 19, 2016

My first time of hearing about this App.

Baibianlinglongxichen Dec 19, 2016

The means of managing and the species of planting vary a lot because of the different climatic and soil conditions.

Andre Kim mi Dec 19, 2016

It is possible to be fully automatic? Soooooooo excited!

Shiwangyagao1117 Dec 19, 2016

It can be developed to another Alibaba.

Xiemideren Dec 19, 2016

I think if we can have this App in China, a large number of users will be recruited.

Wohuizuoniui Dec 19, 2016

Not sure whether this App is available in our country.

Lengshangbadu Dec 19, 2016

The high productivity is relying on science and technology now.

Xifuherenpaole Dec 19, 2016

The high pressure of agriculture comes after the increase of population, which requests us to enhance the scientific input in agricultural application.

The data extract cited above serves as a typical example of a one-sided argument, which only focuses on complimenting an App which monitors environmental conditions from several aspects. Comments are about the App's high practicality for farmers (see '**Kandaoshijianbanxiang**', '**Erweiwangbianhuai**', '**Hualuoxiamoxiangli**'); and the improvement of technology-based agriculture (see '**Zhengmengshuo_Cricoolgirl**', '**Lililiyikedalizi**', '**Xifuherenpaole**', '**Lengshangbadu**'). As can be seen from the data, although the original content posted by '**Monsanto China**' was followed by 51 replies and 82 retweets in total, two-way conversation was not visible in the discussion. Discussants participated only by providing one-sentence comments supporting the same argument—the advantages of the newly invented App. There was no interaction with any other participants. Although it is over-extreme to say the one-sided discussion, such as the one cited above, does harm to the value of social media as a supportive forum for anticipatory governance, the diversity of public opinion, which encourages critical thinking and feeds on the reference value of the spontaneous discussion on social media, was weakened somewhat by this example.

Regarding the results of the present research, intensive discussion involving a diversity of public opinions has undoubtedly dominated GM-related spontaneous discussion on Weibo in both quality and quantity. However, the discussion above with a one-sided argument is not a rare case. On the contrary, it has been identified as an inevitable weakness of less-organised public debates spontaneously taking place on social media (Jacoby, 2009). As discussed in the literature review Section 2.3.3, Jacoby and Potter updated their argument about public intellectuals on the basis of up-to-date knowledge

about the environment of social media, in which contemporary public intellectuals discovered a new “battlefield”. Nevertheless, the limitation of ‘one-stop thinking and instant commenting’ (Jacoby, 2009: 40-41), which identifies the deviant case cited above, has obstructed an in-depth and substantive debate, which should have been carried out with meaningful interactions between participants (Danowski and Park, 2009: 339). The establishment of reflexivity for anticipatory governance on the basis of the diversity of public opinion was discouraged by similar conversations.

Given this problem of social media usage, Danowski and Park believed that it was not reasonable to evaluate the quality or the influence of online discussion using the same criteria as those used for physical public debates. Since the unique habit of Internet usage has spread widely among the public, a new angle viewing spontaneous discussion on social media, in which the presence of social dimensions is given due attention, should be introduced (Danowski and Park, 2009). In other words, with respect to seemingly one-sided arguments, an alternative pathway looking at the diversity of attached social dimensions will work to unearth the potential of these conversations on a deeper level. For example, in the case cited above, the advantage of this newly invented App was interpreted from at least two dimensions: the advanced application of technology in modernised agricultural production and the benefits for farmers to enhance their productivity. These two dimensions of social influence should be taken into consideration rather than being tangled in the absence of an argument about the downsides of such an App.

Apart from limiting the depth of discussion, what makes the cited data problematic is a suspicion that these conversations have been influenced by an ‘Internet water army’. In terms of the definition given by Chen et al. (2011), in a Chinese context ‘Internet water army’ refers to ‘hidden paid online ghostwriters’ (2011: 1), who are hired to post ‘comments and new threads or articles on different online communities and websites’ (ibid.). A well-organised group of people paid to post comments ‘flood the Internet’ (Chen et al., 2011: 2) with a powerful influence on public opinion about the targeted

issue. Different from the personal influence of opinion leaders or the existing fame of public intellectuals, the ‘Internet water army’ attempts to steer the direction of opinion by purposively posting a high volume of comments (Yu et al., 2015: 1148). These comments are comprised of brief and repeatedly-expressed arguments that form an overwhelming advantage in quantity so that the original Weibo content is given ‘artificially inflated popularity’ (Yu et al., 2015: 1150). Comments or retweets with low value become spam information (ibid.). According to Yu et al.’s introduction, an ‘Internet water army’ has been applied by numerous companies as ‘a unique promotional method’ for developing and maintaining public relations (2015: 1142).

Although the present research methods are unlikely to accurately identify the behaviour patterns of the ‘Internet water army’, signs about the involvement of online paid posters has been revealed by the data. Firstly, the poster of the original Weibo content was ‘**Monsanto China**’, the official Weibo account of the Monsanto Company. The purpose of the original content was to promote an App newly invented by Monsanto. Secondly, as could be seen from the data above, users ‘**Meierxian**’, ‘**Slkepo726819**’, ‘**Yongzhenmingzihaoweixianpapapa**’ and ‘**Qingzhuangcainengzougengyuan**’ replied to the initial Weibo content using the same comment: ‘It is a very good App’ respectively, which creates suspicion that their comments are targeted towards bringing ‘artificially inflated popularity’ to the original Weibo content. With these two indicators, it makes sense to speculate that the comments in the cited data have likely been posted by the ‘Internet water army’ due to the two reasons mentioned before (original content is posted by companies; comments are repeated and targeted towards bringing ‘artificially inflated popularity’ to the original content). This is my assumption only. Further studies are needed in the future to test my assumption. If this assumption can be examined and confirmed in a reliable way, as Yu et al. (2015), and Chen et al. (2011) accomplished, the one-sided argument will then become one of the direct consequences of the ‘Internet water army’. In other words, it is very likely that with the effort made by the paid posters, discussants’ opinions towards the newly invented App have been steered to the positive side while the negative comments stayed in silence. In this case,

the spam information brought by ‘Internet water army’ will turn out to be a new interference factor of social media research, which requests a special means of coping with for securing the validity and reliability of research.

5.6 Chapter Conclusion

Concentrating on the key actors of science communication, this chapter analysed the role of scientists (experts), the lay public, and governments in GM future-oriented discussion on social media. Correspondingly, the chapter was divided into three sections, focusing on experts (Sections 5.1 and 5.2), the lay public (Section 5.3) and governments (Section 5.4). Among the lay public, opinion leaders and public intellectuals were given special attention due to their extraordinary personal influence on steering public opinion and the significant anti-GM movement that they are leading. Considering the vague identity of opinion leaders, who have no GM-related educational or research background but have a higher social influence than that of GM scientists in GM issues, and Section 5.3 also investigated the ongoing sub-politics movement led by opinion leaders. Apart from that, interactions between three actors emerging from spontaneous discussion were thoroughly analysed using qualitative content analysis, by which a series of theoretical concepts and up-to-date research outcomes were employed to identify, explain and conceptualise phenomena recorded in the data to continue to compare interactions occurring on Twitter and Weibo. After that, a deviant case analysis (Section 5.6) was enclosed to probe the factor resulting in the one-sided argument entangling in the spontaneous discussion of GM future on social media.

The present data indicated that the statements made by GM scientists involved in spontaneous discussion on social media raised massive concerns that were expressed in the comments of lay-people, but scientists’ mode of communication failed to achieve any persuasive impact. Accusations arose in discussion pointing out the associated interests of the scientific community and the government. Compared to the experts who actively interacted with followers or peers on Twitter, Chinese scientists showed a lower

level of vitality when making use of the interactive functions of social media to communicate with the lay public. Applying Alan Irwin's 'third-order thinking of science communication' (2014) as a theoretical concept, this research identified that the model of communication between experts and non-experts indicated an incomplete transition from a first order (deficit) to a second order (dialogue) model, which implies that the public engagement of science taken by the scientific community on social media has not yet reached the requirement of anticipatory governance to engage the public, but has shown some initiative and a desire to transition from a one-way model to engage in 'two-way' dialogue. Nabatchi and Leighninger's three-type classification of public participation (2015) also helped identify the science communication model as 'thin participation'—a typical form of engagement taking place on social media where engagement is equated to post likes or number of times a post is shared, which confirms 'incomplete transition' has occurred under the theoretical framework of 'third-order thinking'. The potential of 'thin participation' in bringing about further public engagement exercises is likely to increase the value of spontaneous discussion on social media as a pathway to implement anticipatory governance.

As an extraordinary participant of GM discussion, opinion leaders are leading a massive anti-GM movement on social media, as the present data have illustrated. It is noteworthy that, different from NGOs in Western countries, opinion leaders in the Chinese social environment exist and mobilise as individuals. Through their existing personal influence and prestige, opinion leaders actively work to steer public opinion on GM future-oriented issues so as to achieve their political goal of making a difference to policymaking. The role of opinion leaders emerging from the data exemplifies Choi's recent research conclusions about the effectiveness of a 'two-step flow of communication' in the social media environment (2015). While the anti-GM movement, led by either NGOs or individuals, has been conceptualised as the manifestation of reflexive modernisation—as put forward by Ulrich Beck (1992). Under the assistance of online public engagement, the community of anti-GM supporters are able to quickly expand and generate a power of sub-politics (ibid.) with political influence. In this case,

as a consequence of spontaneous discussion on social media, the mediating of sub-politics provided strong evidence that individuals and groups on social media made a great effort to develop and cultivate democratic input; input that can facilitate public engagement exercises and support anticipatory governance in practice.

Taking into account a governmental angle, whatever social and political backdrop governments are positioned in, insufficient interactive behaviour was observed from the data between governments and the public, which illustrates a dilemma that governments are encountering. Pursuing the reasons causing this situation, Bertot et al.'s study (2012) on the challenges and principles of social media usage by governmental agencies explained why. To be specific, with respect to the social functions of governments, a variety of principles, such as protecting civil equality, securing information safety and personal privacy, are set prior to any other goals. Irwin's 'third-order thinking' theory also pointed out an inherent weakness of the 'two-way' dialogue model, which might slow down the pace of implementing public engagement online. That is, the endless requirements to further engage online, such as responding to the public's comments and concerns, might escalate a controversy and a mishandling of the issues involved carries the risk of undermining social stability. For maintaining the smooth operation of society, governments prefer to follow a conservative pathway, which, however, does not imply that the considerable resource on social media is useless. On the contrary, as the present data illustrated, rational and critical comments distinguished from the emotional expression serve as a valuable reference to policymakers for deducing trends of public opinion and implementing the strategy of anticipatory governance to confront the intense relationship between governments and the public regarding GM future-orientated prospects.

In my research, conversations with one-sided arguments were identified as deviant cases because of the way in which they created an obstruction to opinion diversity on social media. After analysing typical deviant cases, a doubt about the influence of the 'Internet water army'—paid Internet ghostwriters—was raised alongside supportive

evidence that some ghostwriting was occurring. Although the present research methods are unlikely to be able to further examine the degree to which spam information interferes with spontaneous discussion on social media, ghostwriting has turned out to be a meaningful area that could be explored in future studies.

Chapter Six. Discussion

6.1 Reflection

This research project was dedicated to assessing the potential of social media, Twitter and Weibo in particular, in facilitating the implementation of anticipatory governance, and to explore the possibility of applying the strategy of anticipatory governance to the governance of GM technology in a Chinese context. This aim was achieved through a horizontal comparison of GM-related spontaneous online discussion taking place in two Chinese and English language environments on Twitter and Weibo. In doing so I addressed, a gap existing in social media-related evaluation within the structure of anticipatory governance: between the demands of carrying out anticipatory governance and the advanced functions provided by social media to support anticipatory governance which are not being utilised to their full potential. After a comprehensive overview about the features of social media and anticipatory governance (outlined in Chapter 2), foresight capacity and engagement exercises, essential to the realisation of anticipatory governance, were conjectured to be reflected in spontaneous discussion taking place on social media. Following this theoretical inference, the present study set out to seek factual evidence supporting this connection, by which to evaluate the potential of Twitter and Weibo to support governmental public engagement.

To summarise, 381 groups of samples consisting of 3,194 pieces of user-generated content were collected and analysed with the assistance of QSR NVivo software. Qualitative content analysis was adopted as the instrument of analytical work to apply an in-depth interpretation to every single group of data. In addition, the methodological consideration underpinning the choice of analytic method—qualitative content analysis—was also enumerated (see Chapter 3). The analysis underwent a ‘back-and-forth’ movement between theory and data. In other words, although the literature review (see Chapter 2) provided a theoretical basis, the analysis still began with an open mind to what was likely to be found from the data. Once any meaningful phenomenon was captured, further relevant literature was consulted for theoretical evidence either

identifying or giving an explanation for these findings.

At the same time, the analytical results (of Chapters 4 and 5) in turn feed on the development of theory, or the improvement of previous studies. In addition, a series of quality assurance methods, including ‘triangulation’, ‘reflexivity’, ‘thick description’, ‘transparency and procedural clarity’ and ‘deviant-case analysis’, were introduced into the present research for securing a high degree of rigor. However, the inherent limitations existing in the research design should not be ignored even if quality assurance techniques have been applied.

The major limitation of this research is the absence of investigation on the practices of policymaking, which severely restricted the assessment of the potential of social media to promote integration capacity. In relation to this research integration capacity refers to the capacity of a government to support and integrate close cooperation in their policymaking procedures, specifically, between natural science researchers working on GM-related research and social science researchers exploring the societal dimensions attached to the development of GM technology (Barben et al., 2008; Guston, 2014) (The term integration capacity will be returned to in Subsection 6.4.2.). As an advanced idea of science governance, anticipatory governance is mainly realised through the formulation and the implementation of public policy. Thus, even though the connection between social media and the demands of anticipatory governance has been assessed through this research, whether the potential or the value of social media has been noticed by policymakers is still unknown. Without direct comprehension about the course of policymaking, whether the capacity of integration, could benefit from the remarkably high diversity of public opinion generated from the spontaneous discussion on social media remains an unsolved problem.

All these problems could have been addressed via in-depth interviews with relevant policymakers, which was planned as the second research phase in addition to the study on the textual data of social media. However, I was not able to accomplish the interviews. In spite spending two months contacting and negotiating the content of interviews with proposed interviewees. The main obstacle came from the trepidation of Chinese local government officials, responsible for the policymaking of regional science governance. These officials were afraid of being accused of disclosing confidential information. For this reason, I revised my research proposal and focused mainly on the textual data provided by social media. Fortunately, the exploratory approach of the present research resulted in many unexpected findings, such as the appearance of mid-politics on social media, suggesting that it is worth further investigating the value of social media as a “battlefield” of democratic politics (See Subsection 6.3.2).

In addition to the major limitation addressed above, some defects existed in the research design. First, regarding the constitution of the theoretical framework, the theoretical basis backing-up the foresight capacity of social media (Subsection 2.1.3.1) turned out to be relatively weak, especially compared to the comprehensive theoretical framework supporting public engagement (Section 2.3). The reason for this unbalanced situation came from the different approaches of measuring two capacities possessed by social media. In the theoretical concept of anticipatory governance, the foresight capacity refers to a synthetic capacity to see ahead of today’s decision-making, while the public engagement exercises such as group work are closely associated with a mainstream approach to science governance (explained in Chapter 2). Based on the understanding of those two capacities in the literature, the present research set out to examine the performance of social media. The foresight capacity of social media was tested by exploring how alternative futures are projected, which was majorly addressed by interpreting the literal content of the collected data and then producing a descriptive result. While engagement practice was examined by measuring the interactions taking place between the major stakeholders of GM technology and resulted in an in-depth

interpretation on the content of discussion and the complicated actions and reactions taken by participants. Thus, a comprehensive theoretical framework consisting of adequate knowledge (constructed in Chapter 2) was necessary at this stage to properly interpret the newly discovered phenomenon related to engagement practices.

Second, the application of a single data analysis method could be seen as another defect of the research design. Considering the character of the textual data collected from Twitter and Weibo as well as the two research questions that needed to be addressed by data analysis, I adopted a qualitative content analysis method and conducted the analytical work with the assistance of CAQDAS (as mentioned in Chapter 3). Although the qualitative application of content analysis has made up for the deficiency of quantitative content analysis that concentrates on revealing and describing what is observed only (Krippendorff, 2012: 21), content analysis could not compete with sociological discourse analysis regarding the capacity of fully analysing the latent dimensions involved in discussion, such as the motivation and socio-psychological factors of individuals. Introducing a discourse analytical lens into the present research may provide further explanation for the interactions taking place between stakeholders on social media, extending the outcomes of the research to a broader range; which not only considers what social reality is, but ‘how the social reality comes into being’ (Hardy et al., 2004: 20).

Nevertheless, it has to be clarified that qualitative content analysis is more or less similar to that of discourse analysis in practice (Herrera and Braumoeller, 2004: 15), particularly when existing theoretical concepts or research outcomes are introduced into analytical work to give an explanation to what was newly discovered from the present study. Besides, the methodological choices of this research are subject to the demand of the research questions: to seek evidence to support social media’s potential to facilitate the implementation of anticipatory governance. Qualitative content analysis,

through the interpretation of the construction of future-related issues or the interaction between major stakeholders of GM, achieves sufficient analysis with descriptive findings and the supportive theoretical reasoning used in this study without supplementing the methods with discourse analysis. In addition, the operational consistency of the present research has been secured with the selection of a single method.

The third defect of this research is a consequence of the inherent limitations of qualitative research. That is, picking GM technology as a typical representative of highly and globally contested emerging technology, the outcomes of the present research exclusively apply to GM technology. In other words, whether social media are affecting other emerging technologies as significantly as they did for the GM debate requires an additional evaluation. However, the methodological design of this research, which tracked and qualitatively interpreted the interactive communication taking place on social media can be applied more generally to all kinds of public opinion studies that express an interest in social media resources. For example, previous studies which, usually, adopted quantitative content analysis or frame analysis, could be developed through the lens used in this study, comprised of the social media representation of technology debates, to observe and extend their ideas to new media arena (as mentioned in Chapter 2). On the other hand, opinion surveys on the GM issue are also able to gather social media data as a valuable resource reflecting the attitude distribution of GM to some extent. In addition, regarding a group of conversations rather than a single piece of user-generated content as a sample, the present research has taken the interactive nature of spontaneous discussion into consideration and interpreted this conversation against a background of two different language and social environments, which is in line with the routine of two-way communication (Wilsdon et al., 2004).

6.2 Summary of findings

Regardless of the limiting factors, the present research has looked into spontaneous discussion on Twitter and Weibo and identified emerging themes relating to future-orientated discussions of GM. Interactions taking place amongst the major stakeholders of GM were also measured and interpreted in terms of the existing literature, theories and research outcomes. As a comparative study, this research has also discerned the differences and similarities between two language environments regarding each finding of the research. With respect to the alternative future of GM framed on social media, the high level of overlap existing in the thematic distribution took precedence over any similarity between Weibo and Twitter, suggesting that the controversy of GM has spread across national boundaries and become a global issue. In spite of that, the construction of each specific theme relating to the future of GM technology differs on Twitter and Weibo, as discussions are influenced by the respective social, cultural and political factors of each context (see Chapter 4, Section 4.3).

As elucidated in Chapter 4, the extensive debate over GM labelling is capable of exemplifying the public's general response to the uncertain future of GM technology - doubt exists parallel with support when discussing the long-term implications of GMOs that are likely to happen in the future. This rational and forward-looking action that confronts an uncertain future does not show significant discrepancy between Twitter and Weibo. In other words, aspects of the foresight capacity of social media was equally seen on Twitter and Weibo. Securing the 'right to know' and the 'right to choose' was a high-frequency argument appearing on both Twitter and Weibo, indicating a common concern. This problematic point aroused dissatisfaction from the public concerning the the insufficient or inappropriate management of GM technology by the government—according to the data analysis in this research. Referring to the problematic work done by governments, social media users engaged in spontaneous discussion by freely and openly expressing personal views, emotions and attitudes towards governments or GM

technology itself. Negative emotion therefore becomes another salient content commonly spreading over Twitter and Weibo—again according to this research. Nevertheless, influenced by different background factors, negative emotion is displayed in different ways over the two platforms. Twitter users tended to directly express suspicion of either the long-term implications of GM or the government's capacity to manage GM technology, while discussants on Weibo were shrouded in a mood of panic, worrying whether and how to get rid of the negative impact of GM technology they anticipated in the near future. Whatever negative emotions manifested in different language environments, they stemmed from the unknown future consequences of GM technology.

Participating in spontaneous discussion and making personal statements became a basic way for the public to engage with GM technology on social media. At the same time, social media turned out to contain a diverse spectrum of public views, attitudes and preferences, which as an online resource becomes an influential factor affecting public affairs through reaching more and more people, and this online movement represents the power of the masses that should never be underestimated. For instance, a severe crisis of trust towards defective GM governance fermented from wide-spread negative emotion, is rising in China and continuously driven by the extensive public debate over GM on Weibo. Considering stakeholders' interactions, this crisis is only one part of the ongoing anti-GM movement on both Twitter and Weibo, which could be identified as a massive collective event, as well as a consequence of dynamic online public engagement with a controversial emerging technology.

Whatever reasons they used to backing up their arguments, the participants of the anti-GM movement are strongly opposed the application of GM technology and condemned their opponents. Looking into the details of movement, it is observed that wherever movements rose in influence (either Twitter or Weibo), opinion leaders were playing

significant roles in steeling public attitude towards not only GM but also towards local government. Katz and Lazarsfeld's theory (1955) provided an explanation for the influence of opinion leaders in collective affairs, like the anti-GM movement on social media (see Section 2.3.3). Nevertheless, there seems to be a difference in opinion leaders' modes of existence on Twitter and Weibo. Specifically, on Twitter the leaders of the anti-GM movement exist and make efforts in the form of NGOs, which, however, is not legally permitted in China. Thus, with respect to Weibo context, the opinion leaders of the anti-GM movement are those who possess existing fame acquired from their own professional fields and mobilise their personal name towards the anti-GM cause. The present research identified Chinese opinion leaders of the anti-GM movement as public intellectuals in terms of Jacoby's (1987, 2015) and Bourdieu's (1991) theories. Different from the movement on Twitter – on a large scale, or with great momentum, echoed by a few people – the anti-GM movement on Weibo was followed by a considerable number of participants and has witnessed the generation of sub-politics (Beck, 1992) in the Chinese social environment, which was defined in the present research as 'mid-politics', and is believed to represent a new form of democracy in a single-party political environment like the one in China.

Apart from the grass-roots-oriented anti-GM movement, another noteworthy interaction is taking place between GM-related experts and non-experts on both Twitter and Weibo. This research found that wherever and whatever the fields that experts are rooted in, their voice or statement indeed raised concern among non-experts but without a persuasive effect. In order to gain insight into this interaction, Irwin's (2008) theoretical framework of 'third order thinking' was applied as an analytical lens, through which to evaluate the communication model embedded in the interactions between experts and non-experts. As can be seen from the data, in spite of the existence of 'two-way dialogue', the interaction between experts and non-experts still follows the deficit one-way communication model (Irwin, 2008) in most cases. On Weibo, although the content posted by experts drew considerable replies or was retweeted many times,

responses from experts were rarely given, which does not form a model of two-way dialogue. Compared with experts' indifferent response to interactive communication on Weibo, the interaction between scientists and the general public was more active on Twitter. Nevertheless, experts participating in discussion were observed to quietly get involved by 'retweeting' and 'liking'. This response has been defined as quiet engagement, yet indicates that there has been an incomplete transition of science communication from a one-way to a two-way interactive model. Thus, the interactive functions provided by social media created opportunities for public engagement to occur between science experts and the public online, but these interactive functions have not been fully taken advantage of by the experts.

As the executor of policymaking, governments or the authorities play a decisive role in balancing the realisation of GM technology's social value and protecting the basic rights of ordinary citizens. Every single move taken by governments can cause a stir among the public, especially when the mechanism of decision-making remains beyond the reach of the public. It can be observed from the present data that the governments of Chinese and western countries have taken a step forward to transform the 'closed politics' of the past to a responsive 'open politics'. They have achieved this step forward by getting involved in public engagement exercises on social media. By launching official Weibo or Twitter accounts and releasing government work-related information, governments have clearly realised the significance of public opinion spreading on the Internet. In spite of creating access for the lay public on both Twitter and Weibo, the interaction between governments and the masses is rare in terms of the present data. Responses as clearly said by certain official accounts are not available on Twitter, and has never been available on the Chinese governments' account on Weibo, so a two-way model of communication does not form and the one-way top-down model still dominates communication between governments and the masses on social media.

Regarding this phenomenon, Bertot, Jaeger and Hansen's work (2012) gives an interpretation for the reasons that result in insufficient online interaction by governments, namely 'access and social inclusion', 'privacy, security, accuracy, and archiving', and 'governing and governance' (Bertot et al., 2012: 30). Even though a number of concerns, like the safety of government information, the protection of personal privacy and the security of social equality, restrict governments' usage of social media and limit the possibility for the government to directly participate in spontaneous discussion on social media, the considerable resources of public opinion and the diverse interactions present among scientists, the lay public and governmental agencies are valuable material for policymakers to understand the reality of GM problems that they face, a potential contribution to strategic decision-making.

Although the present research broadly supports the argument that the engagement function of social media and the remarkable diversity of opinion resource are valuable for the implementation of anticipatory governance, one-sided arguments mixed in with arguments containing a diverse amount of public opinion on Weibo raises doubts about the value of spontaneous discussion—regarded as deviant cases in the present research. The possibility of being influenced by an 'Internet water army' (Chen et al., 2011; Yu et al., 2015) posting in one-sided debates was also brought to light. Jacoby's (2009) updated argument about social media as the new "battlefield" for the public intellectual, has attributed the fact that one-sided arguments exist to the new Internet usage habits—'one-stop thinking and instant commenting' (2009: 40-41). This possibility inspired researchers to assess online spontaneous discussion with a set of new criteria, different from the one applied to evaluating the physical public debate. Up to this point, all the findings discovered from the research have been summarised and analysed. I will now discuss the implications of the research for public engagement on social media.

6.3 Implications for the engagement function of social media

Regarding the conceptual context of anticipatory governance, engagement refers to an effective way of ‘encouraging the substantive exchange of ideas’ (cited in Guston, 2014: 9) among the major stakeholders of the specified advanced technology. In this research, spontaneous discussion and interactive functions provided by social media are believed to fulfil the engagement exercise required by anticipatory governance in an Internet environment, and, meanwhile, the interactive function provided by social media technology exerts an impact not only on the transition of science governance from PUS to PES, but on the overall improvement of science democracy at a global level. In what follows, I will contextualise the findings of my research within the existing sociological knowledge that relates to engagement and science governance. I will also explore the implications of the present findings for engagement on social media on a broader scale. In short, the present results have an implication for the engagement function of social media from three respects. First, engagement on social media has been equipped with political influence in two different models applied to Western countries’ and the Chinese context to increase the quality of social democracy. Second, the discovery about public intellectuals’ efforts in the Chinese mid-politics culture illustrates that engagement on social media became the new “battlefield” where people struggle for the improvement of social democracy. Third, this research brought the phenomenon of quiet engagement to light, which did not draw due attention in the academic literature, and may result in a new reflection on the theoretical definition of engagement.

6.3.1 Political engagement on social media: Transforming politics and promoting democratic governance

For the purposes of this thesis, political engagement on social media refers to individual and/or group participation on social media for the purpose of influencing decision-making at a political level. In line with the results of the present research, online engagement on social media surrounding GM issues, political influence was generated through two different models in the disparate political environment of the Western

countries and China. As will be discussed in this section, through my research American scholars Fung, Gilman and Shkabatur's research about 'six models for the Internet + Politics' (2013) was exemplified and further developed. Moreover, my study shows that the political implications for social media engagement benefit science democracy in contemporary society.

In 2013, Fung et al. put forward six models of democratic politics that are transformed under the influence of 'digital intervention' (2013: 31). Two of them, namely 'the muscular public sphere' (see Figure 3) and 'here comes everybody' (see Figure 4), are exemplified by the present results. Specifically, 'the muscular public sphere' refers to an acceleration of 'the flow of communication' with the support of information and communication technologies (ICTs), which enlarges the scale of public sphere and exerts direct communicative pressures on the authorities (2013: 33). The 'Here Comes Everybody' model describes the growth of a democratic force generated outside of the traditional political system where political influence is brought about through collective actions (2013: 35). Narrowed down to the context of social media, increased accessibility and the open environment provided by social media both enable a large-scale engagement practice online, leading to a high volume of user-generated content and a remarkable diversity of public opinion (see Chapter 5). Such practices emerging from the data demonstrate that the enhanced public sphere exists as mentioned in Fung et al.'s work.

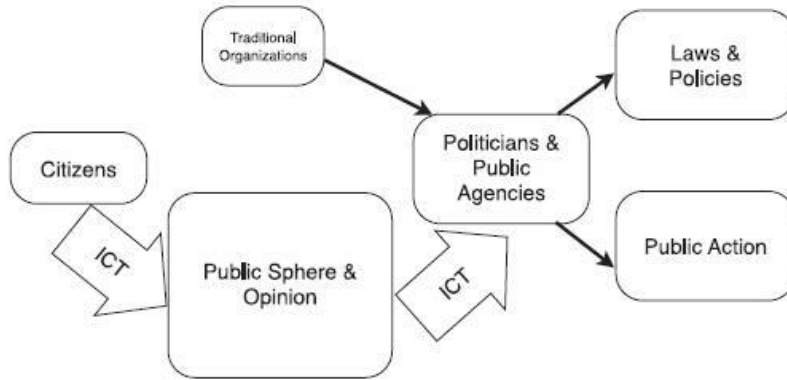


Fig. 1 The muscular public sphere (Fung et al., 2013: 33)

In terms of Fung et al.'s interpretation, as depicted in Figure 1 above, an enhanced public sphere and powerful public opinion exerted through an increase flow of communication affects the decision-making of governments. For example, through the existing 'mechanism of elections, lobbying, and communicative pressure' in Western countries (2013: 32), the engagement of citizens on social media is equipped with political influence on the authorities. However, the pressure exerted by public opinion 'through the mechanism of election' on governments does not make sense in the Chinese case because of its single-party political environment where citizens have no chance to vote. According to the comparative results of the present research, China, which is defined as a mid-politics political system in this study (see Chapter 5), represents another model of interaction that by passes the traditional political system to exert pressure on the authorities. Pressure that is enabled through members of CPPCC via the mechanism of political consultation. Fung et al.'s model 'Here Comes Everybody' (2013: 35) provides a basic explanation of the Chinese situation (see Figure 2).

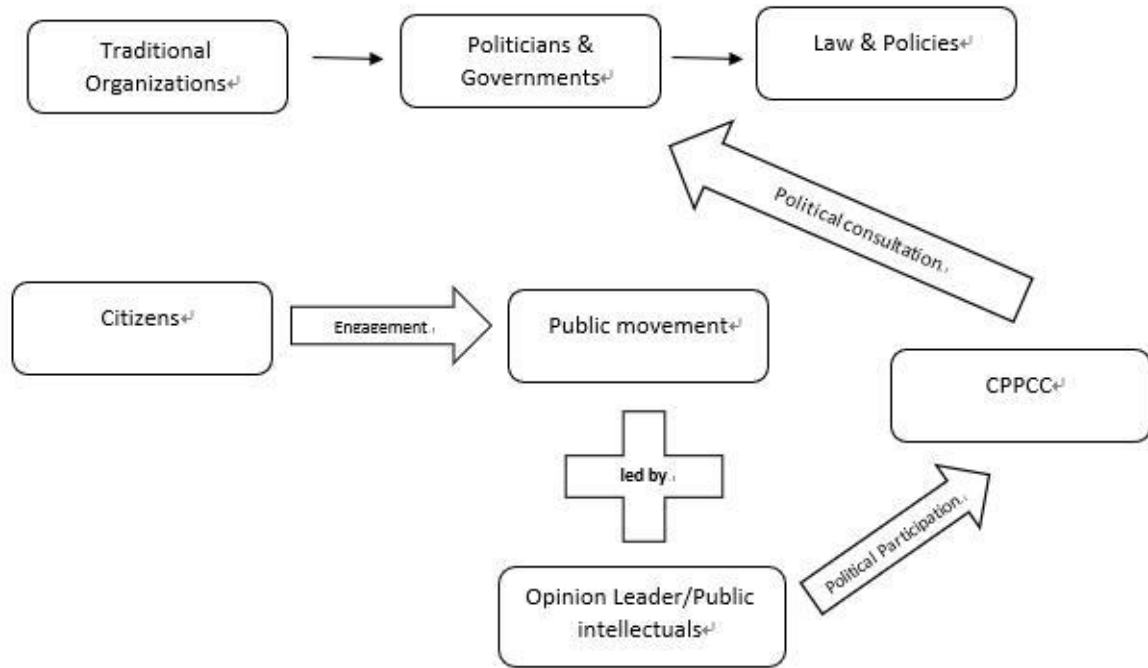


Fig. 3 Mid-politics in a Chinese context

Through spontaneously participating in online discussion, citizens gathered on social media around a common interest. Under the leadership of public intellectuals, who are influential to policymaking work via the mechanism of ‘political consultation’, spontaneous discussion on social media rapidly grows and develops into a public movement on social media that exerts either pressure and impact on the authority through the direct political participation of public intellectuals. The views and opinion of public intellectuals are submitted to CPPCC in the form of a proposal. Within the political consultation system, the government provides a response to all proposals before formulating public policy. In this way, the opinion of public is endowed with political influence on the policymaking process in a Chinese context.

Although the results of this research majorly concentrates on GM technology, the discovery of political engagement on social media is undoubtedly an indicator of the improvement of social democracy. Whatever model is followed, political engagement

on social media is definitely an outreach process of democratic politics, extending from the official political system to a self-organised and crowd-participatory platform with a high level of social inclusion. In other words, the existence of political engagement on social media enables an alternative way of translating public views into political decision-making to promote the quality of democratic governance. Furthermore, the creation of the mid-politics concept, retrieved from Chinese social circumstances (see Chapter 5, Section 5.3), has outlined a new pattern of the generation and the growth of grass-roots democratic force in a one-party political environment, which illustrates a blueprint of emerging democratic culture in China that parallels the traditional democratic mechanisms of Western countries.

6.3.2 Engagement on social media: The new public intellectual “battlefield”

With respect to the present results, social media engagement became an emerging approach for public intellectuals to form connections with the general public and mobilise them towards a political purpose—the struggle for social democracy. The up-to-date efforts made by public intellectuals—which in Potter’s (2009), Jacoby’s (2009) and Ribuffo’s (2009) work refers to a shift of the public intellectual’s main “battlefield” from traditional media to new media—have been fully exemplified in this research. The dynamic actions taken by Yongyuan Cui and Xiulin Gu, two of the most representative public intellectuals in China (see Chapter 5, Section 5.2), have met the expectation of Posner (2003) in that their actions rebuild the social accountability and responsibility of public intellectuals. Additionally, the discovery of mid-politics in a Chinese context provides a new interpretation to the contribution made by public intellectuals on the improvement of social democracy. In the present research, public intellectuals act as influential public opinion leaders in the massive anti-GM movement taking place in China. Taking advantage of their established personal influence, public intellectuals are actively mobilising on social media through self-expression and frequent interaction with the general public. The analysis I offered on the mid-politics in Chinese context gave particular emphasis on the role of public intellectuals in leading emerging

democratic forces, promoting anti-GM movement and translating public appeal into political proposal, which extends Posner's (2003) traditional understanding of public intellectual's way of working (See Section 2.3.3). The acquisition of political influence for the grass-roots movement is realised through the political participation of public intellectuals. In this way, engagement on social media is equipped with political influence by the efforts of public intellectuals so that the democratic force is likely to be continuously strengthened based on the remarkable social inclusion of online engagement.

6.3.3 Quiet engagement: Incomplete transition or new dialogue?

In previous academic literature, little attention (e.g. Nabatchi and Leighninger, 2015) was given to quiet engagement, which is therefore defined vaguely. Quiet engagement is a unique phenomenon exclusive to the engagement function of social media, discovered in the present research, which refers to a silent participatory behaviour on social media using the 'retweet' and 'like' function to interact with other participators. In this research, two analytical perspectives were applied to quiet engagement, firstly the incomplete transition of science communication, and secondly a new type of dialogue exclusive to social media. These analytical perspectives re-established a reflection in the field of sociology on the definition of not only quiet engagement, but on the format of engagement itself.

The phenomenon of quiet engagement could be interpreted as a sign of the incomplete transition of science communication, from the deficit 'one-way' model to the two-way dialogue model in terms of Irwin's third-order-thinking theory (Irwin, 2008). 'Third-order thinking' theory outlined three different cultures of science governance co-existing in contemporary society (ibid.). By naming these cultures as first, second and third order, Irwin tries to point out the constant improvement necessary to effectively deal with science communication and risk management (2008: 7) in self-recognition of 'the limitations and strengths of all approaches' (2008: 10). Engagement is undoubtedly

the core characteristic of second-order thinking of science governance in terms of Irwin's interpretation (2008: 7), which is also put into practice as a means of approaching social democracy (ibid.). In Irwin's work, the co-existence of three cultures is emphasised, in that 'the situation in most national and local contexts is of these different orders being mixed up (or churned) together' (2008: 1), as has been mapped out by this research. To be specific, the one-way deficit model of communication was found to be still adopted in the engagement practices of stakeholders on social media. According to the analysis of the interactions among the participants in the present research, there is an obvious disparity between what interactive functions social media provides and what functions participants use—due to all kinds of reasons. The stakeholders of GM technology did not fully take advantage of the interactive functions provided by social media when participating in spontaneous discussion online. Even though the two-way dialogue is enabled and encouraged by social media, some participants, like governments and some scientists (see Chapter 5), preferred to stay with the one-way model by relinquishing the chance of replying and instead silently 'retweeting' and 'liking' certain pieces of content. In regard to this finding, an incomplete transition of the science governance model occurs. This incomplete transition provides an explanation for the existence of the deficit model being used in engagement practice, which in turn confirms Irwin's argument about the co-existence of different cultures (2008: 8).

Based on the interactive function provided by social media, quiet engagement could be seen as a particular format of engagement that has not been theoretically classified yet. Quiet engagement in the present research refers to the behaviour exhibited by certain participants who use some interactive functions provided by social media but do not form two-way dialogue with other participants. As mentioned in results Chapter 4, some participants, such as GM-related experts, chose to participate in the discussion quietly by 'retweeting' and 'liking' others' content instead of responding with direct comments and then forming a two-way dialogue. In Nabatchi and Leighninger's purely

format-focused classification (2015: 17), the action of ‘liking a cause on Facebook’ is identified as a means of ‘thin participation’, subject to various factors that range from personal social media usage habits (e.g. instant commenting and one-stop-thinking) to the social environment of a nation state (e.g. the system of media censorship in China).

The reason for identifying ‘liking’ and ‘retweeting’ as engagement is simply that the purpose of these behaviors is measurable - showing agreement by ‘liking’ and so on (Nabatchi and Leighninger, 2015: 9). Thus, it makes sense, somewhat, to identify quiet engagement as a representative participatory behaviour of the social media context for the purpose of opinion expression. Nevertheless, expression is still far from the ‘substantive exchange of ideas’ (Guston, 2014: 9), which locates quiet engagement in between the two-way and one-way model as mentioned above. In this instance, the findings of the present research further question the previous definition of the ‘two-way dialogue’ of science communication: a definition too simple to identify models of communication in terms of focusing on format rather than considering individuals’ original motivations within the context of the Internet. The incomplete transition from PUS to PES or quiet engagement located between a one-way and two-way dialogue model indicate the existence of a grey area, where a number of phenomena generated in practice have not been properly explored in the previous online engagement literature, or in the theoretical framework of public engagement.

Therefore, how to properly identify engagement practices in an Internet environment is an emerging research issue, requiring deeper analysis. In regards to future engagement studies, engagement on social media should by no means be neglected, considering public engagement’s wide range of impact and the remarkably high diversity of opinion to be collected from online participation. Yet, it is necessary to return to the basic practices of online engagement and draw comparisons between “ideal” and “real” functional usage. I predict that disparities between ideal and real functional usage will

contain abundant information about the actual value of social media as a tool for the improvement of social democracy. Besides, any emerging phenomenon discovered from public engagement on social media is worth of being interpreted and analysed, supporting researchers to reflect on the validity and reliability of engagement theory, which in turn will improve government public engagement practices.

In general, the understanding of the engagement function of social media is further deepened from three dimensions by this research: social media's political influence; the value of social media for democratic movement; and social media's contribution to the integrity of engagement theory. Meanwhile, the results of the research have developed the previous literature about the transitions occurring in politics in an Internet environment; mainly by introducing the concept of mid-politics into the Chinese context, which in turn stresses the significance of social media as a supportive platform promoting democracy outside of the political system. Even though the concept of anticipatory governance originally and majorly applies to the management of emerging science and technology, the involvement of social media, especially dynamic engagement practice online, expands the impact of anticipatory governance in both width and depth, benefiting the progress of social democracy overall.

6.4 Implications for other aspects of anticipatory governance:

Foresight and integration

As a growing synthesis, assembling the ingredients of 'forward-looking, engagement-oriented, and results-seeking' (Barben et al., 2008: 991), anticipatory governance is carried out through systematic collaboration and active interaction among the capacities of foresight, engagement and integration. None of these capacities is able to work independently because of inherent overlaps which closely bond or permeate them into each other (ibid.: 998). For example, according to Barben et al.'s interpretation, foresight capacity set the main tone of 'future commissions' (Guston, 2014:7) for

anticipatory governance, as well as the two other aspects (engagement and integration). The cultivation of foresight capacity is undertaken through several distinct techniques that reflect on lessons drawn from the past and anticipate long-term implications, amongst which, public participation is a way of structuring the ‘debate about the societal implications of new technologies’ (Barben et al., 2008: 986). Similarly, the capacity of integration, which refers to the ‘sociotechnical integration’ that comes from ‘social and natural scientists work[ing] together in dialog’ (ibid.: 988), relies heavily on engagement programs for encouraging the collaboration between social and natural scientists to achieve ‘a broader societal consideration’ (ibid.: 989). Hence, engagement practice serves as a main approach to implement anticipatory governance while developing the other aspects of capacity.

The present research measured foresight capacity carried by social media via an exploration of the construction of GM future-related issues distributed over Twitter and Weibo. The multi-layered thematic distribution, the pluralism of public opinion, and GM labelling all denoted the prominent performance of social media in catalysing foresight capacity, which feeds on the establishment of reflexivity for anticipatory governance. Additionally, the discovery of widespread negative attitudes towards either the management or the uncertain implication of GM technology is a way to uncover the reasons behind individual’s uneasy emotions to prevent the likelihood of negative attitudes about GMOs escalating into a serious social problem. In what follows, I will discuss how these findings are effective for policymakers and also to what extent the results of the present research are useful to the authorities from a theoretical perspective in Section 6.4.1. Regarding integration capacity, although in this research I was unable to take a meaningful measurement of the practice of cooperation between participants, largely because of the lack of access to interview policymakers to gain their understanding of policymaking procedures, the overlaps between integration and public engagement enabled me to map out integration from an analysis of spontaneous

discussion taking place on Twitter and Weibo, which will also be elaborated under Section 6.4.2.

6.4.1 For foresight capacity: A future commission

The implications of the present research findings for the foresight capacity of anticipatory governance can be understood as a way of approaching future issues: a commission for the future in terms of investigating the future outcomes of current issues. The governance to GM or to any other emerging technology is likely to benefit from foresight. Two aspects, namely scenario development and the establishment of reflexivity, are relevant here. Firstly, the results of the present research are beneficial to the growth of foresight capacity, especially regarding scenario development methods. In terms of the definition provided by Guston, foresight is described as ‘a methodologically pluralist approach to plausible futures with an emphasis on such methods as scenario development that provide a more diverse and normative vision compared with other methods that seek to identify a single, more likely future’ (2014: 9). Guston’s definition is slightly different from the previous concept of foresight strategy as a method that eliminates ‘bad outcomes *ex ante* [before the event]’ (Osborne and Gaebler, 1993: 230).

Foresight capacity today is more open to any alternative scenarios of the future, even the negative implications, and then preparing for the future after reflecting on the public’s responses and/or cases from the past. Obviously, outside the official political system, previous experience of GM technology and its current status is likely to be detected from a future-related spontaneous discussion on social media; thanks to the open environment, in which freedom of expression is, to some extent, protected. In addition, conversations about the future of GM technology on social media give rise to a full range of subsidiary topics, relevant to all kinds of probable scenarios, such as the management of GM technology, safety issues about GM food, and new achievements

by GM technology, which can all be regarded as valuable resources in support of and supplementing a scenario development technique.

The rich source of public opinion revealed on social media is valid to policymakers because of its potential to affect policy formulation via the mechanism of reflexivity, which, together with scenario development, is a special approach to obtaining foresight capacity (Barben et al., 2008: 985). According to Barben et al.'s interpretation, the establishment of reflexivity in an innovative system aims at integrating 'reflection with everyday decision-making' (2008: 986). Apart from providing probable scenarios, that can be refined from the massive amount of UGC data, the large number of public opinions on social media serve as a natural resource that reflects a collective conscience towards the future of GM technology, to some extent. The relationship between public opinion and policymaking is central to the debate over 'representative democracy' and is still frequently discussed in the academic literature.

Pawson and Wang's outcome about 'adding authority to public opinion data via systematic reviews of existing research' (2013: 434) highlighted the value of public opinion to affect the formulation of public policy. The result of the present research is likely to extend a systematic review; from the results of academic opinion surveys to a broader analysis of public opinion spread over social media. In other words, academic literature is no longer the only reliable indicator of public opinion, social media is an alternative source for detecting what the public thinks. Even though the status of public opinion on social media can be rather fickle (Pawson and Wang, 2013: 435) due to certain vexatious voices or spam, the value of highly diverse public opinions on social media, such as detecting the trend of public opinion and offering typical evidence for policy formulation, still works for 'determining viable options' as 'a means toward prudent action' (Barben et al., 2008: 986).

6.4.2 In support of integration capacity: A real practice

Integration capacity, according to Guston's explanation, refers to 'the creation of opportunities, in both research and training, for substantive interchange across the two cultures divide that is aimed at long-term reflective capacity building' (2014: 9). As an emerging strategy of science governance, the ideas of anticipatory governance need to be put into practice through the mechanism of policymaking in a traditional sense. Therefore, a rigorous assessment of integration capacity should gain valid access to the procedure of policymaking and evaluate the extent to which natural and social scientists are collaborating with each other.

However, as interpreted by Barben et al. (2008) and Guston (2014), the integration of anticipatory governance has never been a stereotyped action because it could be achieved in many ways. Instead, the nature of integration varies widely and often 'overlaps with the programs of public engagement, foresight, and imagination and of identifying and analysing ethical and societal issues' (Barben et al., 2008: 988). In other words, a substantive sociotechnical collaboration is likely to happen at anytime, anywhere, in any form in the world. In spite of this, whatever the cooperation looks like, the aim of integration remains to 'increas[e] the reflexivity of the actors and social processes that comprise the objects of study' (Barben et al., 2008: 988). With respect to the present research, although the lack of access to policymaking procedures obstructed the evaluation on integration, the interpretation on spontaneous engagement taking place on social media (see Chapter 5) is able to offer information about how integration occurs outside the traditional political system, by which the format of, and even the understanding of integration is likely to be further extended. In addition, the present research has given considerable attention to the construction of GM technology future issues (see Chapter 4), by which a series of societal issues surrounding GM and its prospects have been brought to light and analysed, suggesting that the present research, to some extent, is an actual practice of integration.

A representative exercise of integration can be seen from the online interaction between experts and non-experts, in which scientists' voices on social media drew attention from the public but did not convince them to immediately accept the emerging technology. A number of societal issues about GMOs, such as the safety of GM food and quality testing (see Chapter 4, Section 4.1.4 and Chapter 5, Section 5.1), are raised by the non-experts as evidence, challenging or doubting experts' optimistic arguments about the future of GMOs. Quite different from the traditional concept of collaboration, the interaction between experts and non-experts becomes less-organised, and even appears to hold each other back by challenging and refuting each other's opinions. However, it is clear that a lot of societal concerns outside of purely technical problems, such as GM management and GM labelling, have been brought in and discussed in a critical manner so that a less-structured reflexivity is likely to be built up during the discussion. In this case, integration does not have to be a form of cooperation, which synthesises two forces pointing in the same direction. Instead, integration could be a purposeful involvement of diverse, or even opposite, views relevant to societal issues in research and training, resulting in a critical and reflective culture of governance once such a rich net of opinions are taken into account.

Additionally, the thematical analysis done in Chapter 4, and the highlights concerning widespread negative emotion towards GM technology, could be seen as an action 'identifying and analysing ethical and societal issues' (Barben et al., 2008: 988), which aims at creating a broader context involving a wider range of 'societal considerations' (ibid.: 989) for the development of GM, so that the readers of this research are able to obtain an overall understanding about the societal outreach of GM-future orientated ideas. In this way, GM technology is no longer a purely technical issue which will generate great social wealth as well as massive controversy, but a representative of sociotechnical issues exerting considerable influence on the progress of scientific democracy (see Chapter 5). I analysed the interaction occurring among the major stakeholders of GM on Twitter and Weibo to reflect on the social discussion

surrounding GM-orientated futures, and used these discussions to figure out the features of online participation. By doing so, the present research is actually a practice of integration aimed at establishing reflexivity on the emerging societal issues of a GM future, a reflexive practice which is believed to benefit the development of GM technology as a whole (Barben et al., 2008; Guston, 2014).

6.5 Conclusion

Through comparative analysis on GM future-related spontaneous discussion taking place on Twitter and Weibo, this research shows the potential of social media, Twitter and Weibo in particular, in performing and even further developing the strategy of anticipatory governance. In summary, Twitter and Weibo are playing the role of a supportive forum for anticipatory governance, where GM future, which turns out to be a globally controversial issue in this research, is intensively conceived and debated via the wide participation of individuals in spontaneous discussion.

My research advances and extends our understanding of the engagement capacity of anticipatory governance through a qualitative content analysis approach by creating a theoretical framework as an instrument. The theoretical framework of public engagement, composed of Irwin's third-order thinking theory (2014), Nabatchi et al.'s three-type classification of participation (2015), Choi's two-flow communication theory in an Internet environment (2015), Beck's sub-politics theory (1992) and Bertot et al.'s academic work on E-government (2012), interprets the phenomena revealed by the interactions taking place among the major stakeholders of GM technology during online discussion. I argued that GM future-related spontaneous discussion can be identified as an incomplete transition from the deficit one-way communication model to a two-way dialogue model (see Chapter 5, Section 5.1). In addition, the appearance of quiet engagement suggests more possible formats for online engagement, which led

me to a reconsideration of the definition of public engagement in an Internet environment.

Regarding the massive ongoing anti-GM movement on Twitter and Weibo, the impressive effort of public opinion leaders has been highlighted (see Chapter 5.2). In a Chinese context, the shared identity of the opinion leader and the public intellectual combines two theories and points to an emerging format of Chinese social democracy—mid-politics. I proposed the term mid-politics to justify the unique style of sub-politics rooted in China, which is led by public intellectuals and pushed forward in the form of public debate by controversy or movement leaders. This theoretical innovation enriches Fung et al.'s theoretical model of democratic politics (2013), and reveals the existence of a new political culture in a one-party political environment, giving prominence to Chinese democracy outside of the traditional political system.

In addition to performing the foresight and engagement capacity of anticipatory governance, I argue, based on the present research, that online public engagement is dedicated in practicing the integration exercise given a number of emerging societal issues relating to GM future and which outline a comprehensive picture of GM's societal outreach. The original concept of integration (Barben et al., 2008) can be thus extended from a format of collaboration to a purposeful involvement of diverse voices in research, leading to a critical and reflective culture of governance.

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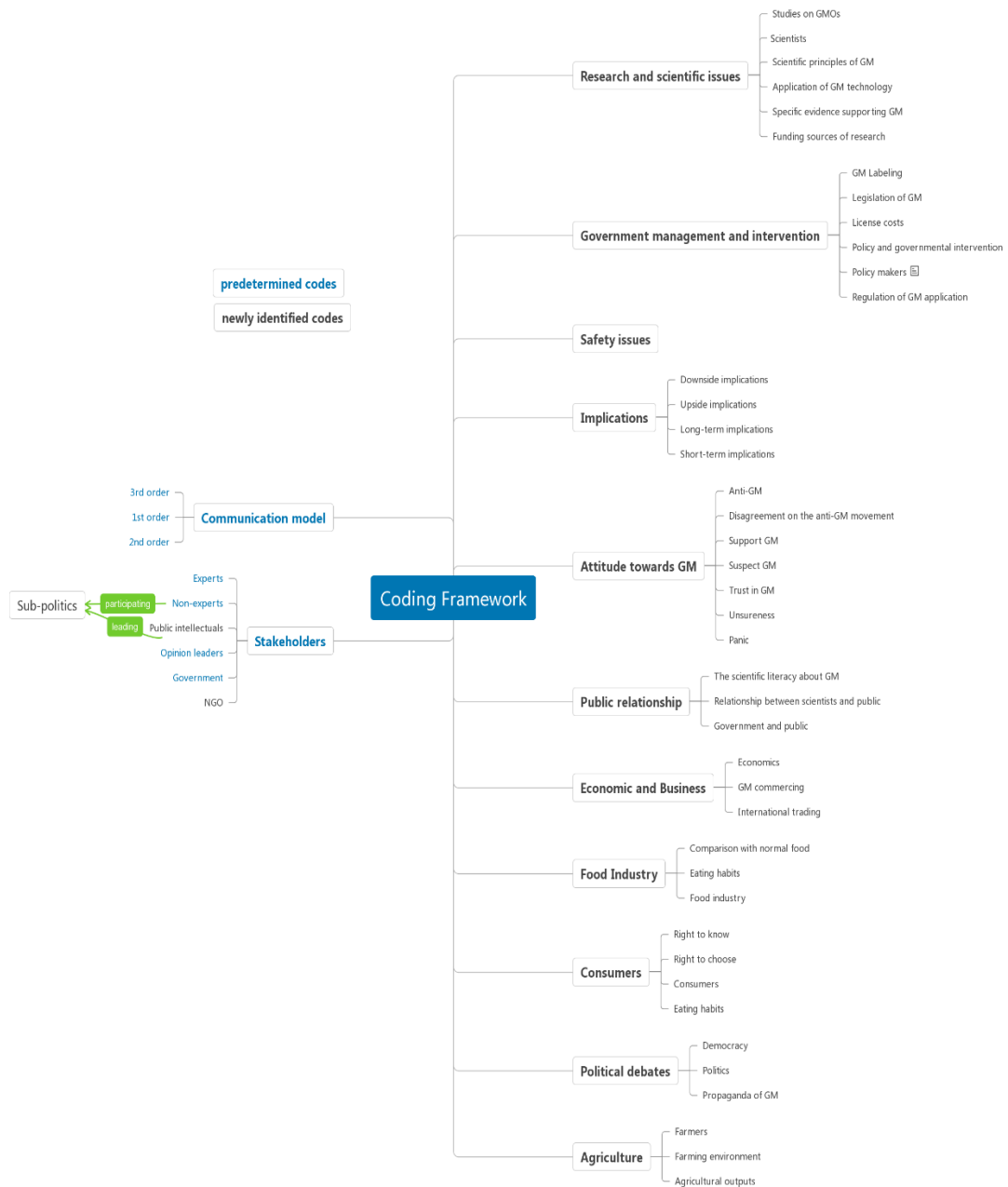
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Appendix

Appendix 1. Coding framework



Appendix 2. The result of inter-coder reliability test

	Code	File	File Size	Agreement (%)	Disagreement (%)
	Experts	GM Food in the future---Weit 35156 char		98.89	1.11
	Governments	GM Food in the future---Weit 35156 char		100	0
	Non-experts	GM Food in the future---Weit 35156 char		100	0
	Public intellectuals	GM Food in the future---Weit 35156 char		73.6	26.4
	Opinion leaders	GM Food in the future---Weit 35156 char		97.46	2.54
	Research and scienti	GM Food in the future---Weit 35156 char		89.34	10.66
	Governance and gov	GM Food in the future---Weit 35156 char		81.87	18.13
	Attitude towards GM	GM Food in the future---Weit 35156 char		96.12	3.88
	Safety issues	GM Food in the future---Weit 35156 char		81.23	18.77
	GM labelling	GM Food in the future---Weit 35156 char		98.77	1.23
	First-order	GM Food in the future---Weit 35156 char		100	0
	Second-order	GM Food in the future---Weit 35156 char		95.23	4.77
	Third-order	GM Food in the future---Weit 35156 char		94.3	5.7

Appendix 3. The proportion of stakeholder's participation

