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Collaborative Governance for Responsible Innovation in the Context of Sharing Economy: Studies on the Shared Bicycle Sector in China

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Abstract: The shared bicycle sector is a new type of rental business that combines the sharing economy with technology platforms. With its convenience, efficiency and low cost, the business has become popular in China. However, alongside the development of the shared bicycle industry, the increasing number of products, lack of governance, distrust between companies and users cause problems due to irresponsibility. This paper focuses on the governance of the shared bicycle sector, with the aim of achieving responsible innovation through a collaboration among stakeholders. Through case studies on two cities in China, the paper identifies government policies in the traditional context of hard-law regulation, and in the new context of multi-collaborative governance. The roles of government, industry and society are specified in the innovation ecosystem and are linked with the key dimensions of responsible innovation, anticipation, reflectiveness, inclusiveness and responsiveness. Based on the findings, a model is proposed, suggesting the new government roles of alliance facilitator and platform coordinator. Finally, our recommendations for the improvement of the shared bicycle sector are made and areas for future research are discussed.

Keywords: responsive innovation; collaborative governance; sharing economy

1. Introduction

In the process of urbanization, transportation has been greatly developed. Meanwhile, with scientific and technological advances, there is growing attention being paid to sustainability and responsibility in innovation nowadays [1]. Sustainability responds to environmental and social changes and can be considered in relation to products and production, supply chains and the ecosystem [2]. The term responsible innovation can be defined as taking care of the future through collaborative innovation in the present [3]. This concept can be extended to the context of the sharing economy. With technological advancements, mobile payments and the exchange of supply and demand, the sharing economy currently covers the medical, education, public service and transportation sectors. Among the facets of the sharing economy is the shared bicycle industry, which was developed based on the public bicycle sector, which was first commercialized in China in 2016. With the advantages of its convenience, high efficiency and low cost, the shared bicycle industry is widely recognized in China for enabling transportation inside major cities. The number of shared bicycle users has increased greatly and several bicycle enterprises have entered the market. Although traditional public bicycles utilize big

data monitoring, these data are normally collected and used by the local government. There is no technological connection between citizens and bicycle companies. However, with the advent of the internet, global positioning systems (GPSs), big data capture and the full coverage of mobile internet networks, the shared bicycle sector has been developed further. Users can now download a mobile application, register on the system, pay a deposit and scan a code to rent a bicycle. While shared bicycling improves public transportation, problems arise in relation to traffic planning, bike parking, deposit management and user safety, and these issues have drawn the attention of government, companies and the public. Take the city of Nanjing, China, as an example. Based on our interview with the Nanjing Traffic Management Bureau, by the end of 2017, there were 11 bicycle enterprises in the city, including OfO, Mobike, Hellobike and Bluegogo.

Traditionally, the government plays an important role in initiating the public bicycle sector by providing direct funding. However, more shared bicycle businesses have originated from the market. When private companies first entered the market, the Nanjing government took a non-oppressive attitude, hoping that commercialized and publicly shared bikes could jointly create a healthy environment for citizens. In addition, the Nanjing government actively encouraged technological innovation by providing financial subsidies for three high-tech software parks in the city. However, with the increasing volume of bicycles due to company competition, bicycles were parked and placed everywhere at random, especially near the subway and bus stations, which seriously hindered nearby traffic. Moreover, there were risks related to users' deposits, which were paid directly to the bike companies, if companies went bankrupt. In November 2017, Nanjing media reported that many users failed to get their deposits back from Bluegogo. Under the new business model of the sharing economy, what role should the government play? How can the government, companies and citizens work together to achieve sustainable and responsible innovation? Meanwhile, as collaborative governance becomes important and focuses on collaboration from multiple stakeholders, involving both the private and civil sectors in the management of public services, how can different stakeholders be involved in the shared bicycle industry? These issues need to be investigated.

Based on the background, this paper aims to explore the possibility of collaborative governance in the context of the sharing economy in order to achieve responsible innovation. Through in-depth studies of China's shared bicycle sectors in two major cities, Hangzhou and Nanjing, the research will specifically answer three questions: (1) In the context of the shared bicycle sector, what is the changing role of government policy? (2) What is the impact of local government policy on the key dimensions and responsiveness of innovation? (3) What are the required roles of and interactions between the government, industry and society at large that will achieve responsible innovation through collaborative governance? Based on these research questions, the study will also test the following hypotheses: (1) with the development of the sharing economy and the emergence of the shared bicycle industry in China, the government must create new policies and take on new roles. (2) In order to achieve responsible innovation, the government should work together with other stakeholders, including the shared bicycle industry and society at large. (3) During the emergence of the shared bicycle industry, hard-law policy can generate better standardization and overall industry planning, thus improving the anticipation dimension of innovation. (4) However, as the shared bicycle industry becomes mature, hard-law regulation can hinder innovation to some degree. (5) In the long term, soft policy and collaborative governance can result in better, more responsible innovation within the sharing economy.

2. Literature Review

The current literature can be explored mainly from the aspects of policy and governance, the triple helix and responsible innovation as well as studies on the shared bicycle industry.

2.1. Government Policy and Governance

In general, policies supporting knowledge creation and innovation can be categorized into either supply-side policies, which include funding, financial subsidies, clusters and training, or demand-side policies, such as standardization and regulations [4]. Government policymaking changes along with the trend of the current circumstances, such as due to technological advances [5]. In particular, science, technology and innovation-related policies have passed through Frame One, which addresses market competitiveness, mass production and national innovation systems in a centralized way and Frame Two, which focuses on clusters, cultivating entrepreneurship and knowledge networks in a decentralized way; these policies now approach Frame Three, which is concerned with sustainable development and transformative change [5]. It is suggested that with the current social and environmental challenges, innovation related policies need to engage public, private and third sector actors, with anticipation of consequences and generating inclusive ideas with communities and civil society [5]).

Governance can be regarded as the coordination and coherence among a variety of actors with different interests and objectives [6]. In the early years, studies of governance in public affair management were mainly from a policy perspective. Core concepts of governance can be informal and non-mandatory [7]. Specifically, informality means that governance activities are not limited to the government and formal institutions, but also extended to individual citizens and spontaneous organizations [7]. Non-mandatory refers to the fact that governance activities can occur without the government authorization and the guarantee of state power [7]. To solve global environment and sustainability related challenges, multi-level governance is required, which involves international organizations, non-governmental organizations (NGOs), communities and consumers [6]. For example, Janicke et al. [8] proposed a multi-level governance approach with the coalition of government, business and civil society to achieve environmental innovation [6]. The theory of polycentric governance can also be applied to the private sectors, where shared responsibility needs to be defined alongside the improvement of public goods and service efficiency [9]. Emerson et al. [10] generated a framework for collaborative governance, which contains the components of system context, drivers, collaborative dynamics such as principled engagement, shared motivation, capacity for joint action, outputs collaborative actions, impact and adaptation. Studies on joint governance in China are still underdeveloped. It is suggested that collaborative governance can be achieved through equal participation, consultation and dialogue, and win-win cooperation [11]. Moreover, the cooperation should take the public interest as the common goal, along with a comprehensive and effective social governance system within the scope of law and ethics. Elements of joint-up governance can be identified as collaborative subject, object, form and environment [11]. The theory of governance also evolves with the role of government policy, which changes at different stages of the innovation system. An in-depth case study on the innovation ecosystem of Changzhou, China, indicates that government policy can play a leading role at early stages where the knowledge resource from universities and companies is limited [12]. However, once the innovation ecosystem becomes mature, government can step down as a facilitator and coordinator [12].

2.2. Triple Helix and Responsible Innovation

With government policies currently emphasizing sustainability through joint effort, the innovation system also requires for interactions among multiple stakeholders. The triple helix innovation model describes the non-linear relationship among university, industry and government, in order to promote national and regional innovation systems [13]. The quadruple innovation helix theory further identifies the role of civil society, addressing top-down knowledge production from university, industry and government, in combination with bottom-up contribution from the society [14]. Through studies on western societies, the institutionalization process of the triple helix is divided into four stages: realization of the needs, intra-organizational transformation, interactions between organizations and institutionalization [15]. Specifically, the process requires for shared beliefs on knowledge at the beginning, and democratic policy making at later stages [15]. Studies on developing

countries recommend reward system reformation as a fundamental component of the triple helix institutionalization [16]. A recent conceptual framework, the quintuple helix, includes the fifth element of innovation, environment [17].

The concept of responsible innovation is promoted by the European Union to solve the challenges of climate change and health [18]. It is still a developing area in terms of business practice and academic research [18]. A conceptual framework proposed by Stilgoe et al. [3] defines the dimensions of anticipation, reflectiveness, inclusiveness and responsiveness. The development of anticipation involves risk research while seeking new opportunities of innovation [3]. Technology assessment and horizon scanning are typical methods [3]. Reflectiveness means bottom-up self-governance, which can be realized through ethical technology assessment, midstream modulation and institutions to reflect value systems [3]. The dimension of inclusiveness is associated with stakeholder engagement and public participation [3]. Responsiveness can be measured by the capacity to change and the response speed to new knowledge [3]. From the perspective of governance, responsible innovation can be achieved with more self-regulation and proactive action, rather than hard-law regulations [19]. Such a trend is observed along with the evolution of innovation system from national to global governance, and from private investment to collective innovations [19]. Studies also emphasize that networks, academic and policy contributors can act together as carriers of responsible innovation alongside institutionalization [18]. The keys to responsible innovation are proactive risk management and public engagement [18]. As for the linkage of innovation and sustainability, it is believed that a combination of micro-dynamic and macro-dynamic mechanism is the future trend [1]. At the micro level, effective control of the open innovation complexity can result in evolutionary changes to companies [1]. At the macro level, mutual transformations occur among market close innovation led by large organizations, open innovation from the collaboration of SMEs' collaboration and social innovation initiated by the society [1]. For the purpose of sustainability, government should change the role from a regulator to collaborator, whereas users should become innovative actors rather than passive buyers [1].

2.3. Shared Bicycle Industry Studies

As shared bicycles were first commercialized in China in 2016, studies mainly focus on this sector in China. It is noted that users are mainly university students and young office workers for the purpose of short-distance daily commutes [20]. The demand in the densely populated areas of the first and second tier cities in China is huge [20]. There are several characteristics of China's shared bicycle industry: first, through the green concept, it can protect the environment; second, it can solve the problem of "the last kilometer", and improve the public transport system; third, alongside the shared bicycle industry, various supporting sectors also grow rapidly [21]. Nevertheless, there are also problems such as the uncivilized way of riding and parking, lack of a way to monitor users' behaviors, poor product quality and ineffective operations management [21]. Issues of over-supply of bikes, defects in timely response during the operations, and a lack of control on consumer behavior have raised much attention [22]. Other concerns include the high cost of bicycle delivery, difficulties in maintenance, man-made damage to bicycles, disconnected information system and risk in the deposit system [23]. In fact, companies should not only rely on the users' deposit to make profit, but also need to launch a personalized service [24]. A possible legal framework for operating the shared bicycle sector is discussed [25]. Through evaluation on OfO bikes, suggestions are made to optimize the product design from ergonomics aspects [26]. Based on the case study of Hellobike, factors including user-friendly product design, big data capture, standardization and a credit system are prioritized to achieve responsible innovation [27]. Recent research focuses on the free-floating bike sharing system in Shanghai, China from governance perspective, and highlights the role of social actors such as user groups [28]. Furthermore, in the sharing economy, government should be more agile to accommodate, nurture and integrate social actors to achieve urban sustainability. Comparative studies on the car-sharing industries in China, Korea and the USA revealed that business models in the sharing economy can change dynamically [29]. The sustainability of the car-sharing sector requires interaction

among government regulations, the car industry as well as public and private transportation [29]. Revenue models and responsibility of shareholders should also be considered in the open innovation system [29].

From the literature review, it can be seen that current studies on the governance aiming for responsible innovation in the context of sharing economy are still new. Details on responsible innovation dimensions and decision-making areas are underexplored. For the purpose of responsible innovation, there is a trend of the government role transforming from being a hard-law regulator towards being a coordinator of collaborative governance, yet this process is not clear. Thus, this paper focuses on the governance of the shared bicycle sector, with the aim of achieving responsible innovation through collaboration among stakeholders.

3. Methodology

As an emerging theme, collaborative governance for responsible innovation is currently underexplored. Qualitative methods are appropriate, and specifically in-depth case studies can explore details of on-going activities [30]. The shared bicycle sector in China was chosen, and the cities of Hangzhou and Nanjing were studied in detail. The research unit covered the governance activities from the government, industry and society. To collect data on government policies and activities, we reviewed documents and interviewed government officials in Hangzhou’s and Nanjing’s Traffic Management Bureaus. For industry data, we explored companies’ websites, industry reports and secondary case study documents. For public and society data, we went to representative places in Nanjing and Hangzhou such as train stations and university campuses for observation. In addition, we conducted interviews with shared bicycles users inside the campus of Nanjing University of Science and Technology. Details of data source are shown in Table 1. As for the data analysis, first, all policies and government activities were collected, recorded and categorized into “hard-law regulations” and “collaborative approaches”. Specifically, hard-law regulations were direct funding, financial subsidies, public sectors’ procurement, punishment, rules and restrictions, standardizations and other forms of centralized control. Collaborative approaches included stakeholders’ involvement, community engagement, industry collaboration and a communication platform with support and facilitation from the government. Second, content analysis was conducted to link forms of governance with dimensions of responsible innovation, namely anticipation, reflectiveness, inclusiveness and responsiveness. In particular, anticipation was linked to activities of risk evaluation, sustainable innovation and irresponsible behavior prevision before the operations. Reflectiveness was related to bottom-up practices from the industry and society, as oppose to centralized government policies. Inclusiveness was interpreted through measures of stakeholder participation. Responsiveness was analyzed in the form of new technology adoption, business restructure and other changes to the industry. For each dimension, analysis was made to address roles of the government, industry and society. Third, further discussion was made to generalize the findings, highlighting the changing roles of the government at different stages, in order to achieve responsible innovation. Based on the studies, more emerging themes were proposed for future research.

Table 1. Data source of case studies.

Case Studies	Data Source
Case One: shared bicycle in Hangzhou City	Document review: Government policies and online reports Interview: Hangzhou Traffic Management Bureau Observation: Hangzhou train stations
Case Two: shared bicycle in Nanjing City	Document review: Government policies and online reports Interview: Nanjing Traffic Management Bureau, users inside Nanjing University of Science and Technology campus Observation: Nanjing train stations, Nanjing University of Science and Technology

4. Case Analysis and Discussion

4.1. Case Study One: Hangzhou

Hangzhou, the capital city of Zhejiang Province, China, is a highly modernized city with rapid growth of private cars. By the end of 2017, the number of private cars in the city was 1.9985 million, showing an increase of 9.4% over the previous year. Hangzhou is also a famous tourist city with the West Lake located in the city center. Visiting the lake while riding a bike is considered to be convenient and comfortable. Therefore, when the local government launched the project of public shared bicycles on 1 May 2008, it was highly supported by the public. Since then, public shared bicycles and commercialized shared bicycles coming into market later on become important for the public transportation.

4.1.1. Government Plays Leading Role

The Hangzhou government has played a leading role in the shared bicycle sector. Shortly after launching the public bicycle rental system, the government issued “the notice of implementation opinions on strengthening the construction and management of public bicycle transportation system” to guide district governments and affiliated departments across the city. Meanwhile, to smooth the project implementation, the Hangzhou government formed a special team with the deputy mayor acting as the team leader. Team members included Hangzhou governmental departments and organizations, which were the Municipal Development and Reform Commission, Municipal Construction Commission, Municipal Urban Management Office, Municipal Planning Bureau, Municipal Public Security Bureau, Municipal Industrial and Commercial Bureau, Municipal Urban Management Law Enforcement Bureau, Municipal Price Bureau, Municipal Legal Affairs Office, Traffic Police of the Municipal Public Security Bureau, City Investment Group and City Public Transport Group. The Traffic Management Bureau defined the functions and responsibilities of each team member, in order to operate the system effectively and efficiently. In the beginning, the Hangzhou government invested 150 million RMB as start-up capital for bicycle hardware purchasing and infrastructure improvement. When the public bicycle sector entered the mature stage, the daily operations were conducted by the Traffic Management Bureau, which was partly funded by the government. The Hangzhou government also actively publicized responsible riding behavior to broader society, providing guidance and standardization. Citizens were invited to monitor and report improper riding behavior. These practices provided strong foundation for the responsible innovation of the shared bicycle system in Hangzhou.

4.1.2. Industry Participation with the Regulations from Local Government

The public sharing bike project started through tendering. The Little Red Bike by the company Yong An, which demonstrated good quality, was selected as the supplier by the Hangzhou government. Public procurement can ensure local government’s dominant control on the project, preventing improper supply or poor quality products in the market. For the bike rental, Hangzhou government collected a certain amount of deposit from the users, which was not only a supplement to public procurement and bike maintenance, but also a restriction on irresponsible consumer behavior through assessment and punishment. In addition, Hangzhou government outsourced daily maintenance to private service companies. With the success of the public shared bicycle system, commercialized bike companies were allowed to enter the market with strict assessment and operations support from the government.

4.1.3. Society Cooperation with the Local Government

Before launching its public shared bicycle project, the Hangzhou government collected opinions from its citizens. This provided foundations of the public support. During the operations, the public were also engaged. For example, users were invited to monitor and report those who violated laws and regulations. Two hotlines, 12345 and 12319, were set up. The public were also involved in reporting

damaged bikes, which can help the government to detect and solve problems quickly. This also contributed to later stages of product repair and recycle. In addition, the Hangzhou government also collected public feedback from time to time, which in return benefited the public.

4.2. Case Study Two: Nanjing

Nanjing is the capital of Jiangsu province, China. In 2015, the local government issued the policy of “unified planning, unified standards, unified policies and unified operations” for public bicycles. Nanjing Public Transport Group was selected to supply and operate the project after tendering. At the end of 2015, there were nearly 40,000 public bicycles in Nanjing. In June 2016, the private company OfO introduced the Yellow Bike in university campuses. Then Mobike, Hellobike and other enterprises successively entered the Nanjing market. However, due to operation problems, by the end of 2017, only three commercialized shared bike companies survived in Nanjing. Among the 437,500 shared bicycles available then, there were 42,000 from Hellobike, 115,000 from Mobike and 16,000 from OfO. The number of commercialized shared bicycles was six times more than public bicycles.

4.2.1. Government Limited Control at the Beginning

Nanjing government did not control the private bike sector, believing it was complimentary resource to the public shared bike system. As a result, there was fierce competition in the commercialized bike market. For public shared bike, the Nanjing Transportation Bureau planned for the infrastructure. The Nanjing Urban Administration Bureau was in charge of urban landscape and environmental improvement. The Nanjing Traffic Management Bureau was responsible for road traffic management. With the government not interfering with the private shared bicycle system, there were various problems such as over-supply of products, disorderly parking, quality failure, road accidents and inefficient maintenance. In July 2017, the Nanjing Transportation Bureau, Nanjing Urban Administration Bureau and Nanjing Public Security Bureau jointly issued “the opinions on guiding and regulating the development of Internet rental bicycles (for trial implementation)”. This was followed by the issuing of industry standards. With collaborative governance, the governmental departments also inspected user behavior and fined those who broke the regulations. In February 2018, the Nanjing Transportation Bureau used data analysis and analogy method to refer to Shenzhen, Suzhou and other cities with similar populations. From the research, the feasible number of shared bikes in Nanjing was suggested between 245,000 and 341,000. Under the government forecast and guidance, companies then registered products through the Nanjing Transportation Bureau. In 2018, damaged and unregistered bikes were removed and recycled by the government. New bikes were not allowed to come into market without the government permission. In January 2018, Qixia district government and Nanjing government jointly proposed a governance approach, through which bike companies should be evaluated regularly in terms of their operations and maintenance capability, and speed of responding to emergency. In the proposal, district governments were suggested to adopting real-time monitoring and communication platform, which would allow resource integration across the public and private sectors.

4.2.2. Industry from Competition towards Responsible Innovation

The Nanjing shared bicycle business basically followed market principles. It was believed that whoever launched more products could seize market share. This resulted in over-supply, capital competition and careless quality standards. In 2018, two years after the introduction of commercialized shared bicycles, there were already 12 major brands in Nanjing. The daily turnover rate was 2–4 times per bike. Due to massive dispersion and high labor cost, companies were unable to dispatch bikes in time. To use the bikes, users must download the companies’ application (App) and pay deposit. There were security and information leaking risk, as personal information was given to the companies. From 2016 to 2017, there were many cases in Nanjing where users could not claim the deposits back from the companies who went bankruptcy. Realizing the problems, Nanjing government began to standardize the product quality and operations management in 2018. Companies gradually followed

the regulations and conducted social responsibility. For example, in June 2018, working with the Nanjing New City Science and Technology Park Administration Office, Hellobike maintained parking areas in a pilot area and guided riders to park properly. This demonstrated collaboration between the industry and local community. Technologies such as big data platform were applied for real-time bike condition detecting. An alarming system and GPS intelligent lock were also used to remind users of responsible riding and parking.

4.2.3. Society Role

One of the irresponsible consumer behaviors in Nanjing was man-made damages to bicycles and components. Parking problems were also widely criticized. Since March 2018, shared bike companies decided to remove the deposit system, and instead used the Alipay credit system to record and evaluate users' behavior. Nanjing government also set up a hotline for citizens to report damaged public shared bikes.

4.3. Analysis on Government Policy

The above two cases demonstrate different approaches of governance. The Hangzhou shared bicycle sector is an expansion from the public bicycle system led by the local government, and thus more hard-law regulation and centralized decision are observed. This ensures good product quality, and prevented irresponsible behaviors at early stages. As the industry becomes mature, companies and the society also participate for joint governance, under the guidance and standardization from the government. Public are engaged in terms of providing feedback, monitoring and reporting on-going issues to the government. In Nanjing, the shared bicycle industry follows free market competition with limited government interfering at early stages. However, due to a lack of planning and control and irresponsible consumer behavior, untrusting relationships between companies and users and other problems develop. With the government later on issuing standards and hard-law regulations, alongside companies implementing new technology, there is a trend towards responsible innovation. Joint collaboration between the government and industry is also observed. Technology development and the user credit system also help companies to improve performance. Currently there is no apparent evidences showing active user engagement in Nanjing, apart from using the government hotline. Table 2 contrasts the government policies and practices in the contexts of hard-law regulation and collaborative governance, based on the two case studies.

4.4. Collaborative Governance for Responsible Innovation

As analyzed in Table 3, roles of the government, industry and society can be linked with the dimensions of responsible innovation, which are anticipation, reflectiveness, inclusiveness and responsiveness. Specifically, government forecasting and planning, technology development and information sharing between the industry and government, collecting public opinions, education and guidance to the public and issuing standards before launching the system can achieve better performance of anticipation. Reflectiveness requires on-going supervision and evolution from the government, as well as monitoring through the joint governance of the industry and the public. Inclusiveness can be improved through collaborative governance among the government, industry and the public through community engaged pilot projects. Responsiveness can be achieved through technology advancement, and real-time communication among the government, industry and users.

Table 2. Government policies in the context of hard-law regulation and governance.

Hard-Law Regulation	Collaborative Governance
<ul style="list-style-type: none"> - Government setting up a specialized team and project on a centralized base, putting responsible innovation at strategic level. - Government defining roles and responsibility of each department involved in the team. - Government directly funding the public shared bicycle project, including purchasing products and services. - Government controlling the bicycle companies' quality during suppliers' selection stage. - Government providing regulations and standards for companies to follow. - Government providing financial subsidies for shared bicycle companies. - Government outsourcing part of maintenance to service companies who meet standards. - Government assessing the consumer behavior through the government-led deposit system. - Government providing hotlines for users to report irresponsible behavior. - Government forecasting the number and allocation of the bikes. - Government removing unregistered bikes with hard-law regulations. 	<ul style="list-style-type: none"> - The public providing opinions and suggestion at early stages of the project. - Government collecting public feedback to improve service and system operations in time. - Government proposing evaluation system for companies to understand responsible innovation, and to get improvement. - Government proposing solutions for companies to integrate resource, operating the shared bike system collaboratively. - Government educating citizens about responsible consumer behavior. - Government supporting technology development for companies, e.g., big data platform, real-time communication system. - Government launching pilot projects for local communities and companies to work together. - Government setting up hotlines for citizens to report failure and provide solutions.

Table 3. Collaborative governance for responsible innovation.

Responsible Innovation	Government	Industry	Society/Users
Anticipation	<ul style="list-style-type: none"> - Setting regulation and quality standard during suppliers' selection stage. - Public procurement to avoid risk. - Data analysis and forecasting the number and allocation of bikes. - Evaluating companies based on operations capability and responsibility. - Educating the public through media. 	<ul style="list-style-type: none"> - Providing training to improve product and service quality. - Technology improvement, e.g., alarm system to detect irresponsible riding behavior. - Adopting user credit system, instead of deposit system. 	<ul style="list-style-type: none"> - Providing opinions at early stages. - Exploring innovation opportunities together with the government. - Using credit system for self-monitor and self-improvement.
Reflectiveness	<ul style="list-style-type: none"> - Real-time monitoring users' behavior with the assessment system. 	<ul style="list-style-type: none"> - Technology improvement, e.g., real-time monitor big data platform 	<ul style="list-style-type: none"> - Community engagement in pilot projects.

Table 3. Cont.

Responsible Innovation	Government	Industry	Society/Users
Inclusiveness	- Asking for public opinions and suggestions during early stages.	- Collaborating with the government to improve operations. - Collaborating with the community to standardize riding and parking behavior. - Cross-company resource integrating for operations	- Providing opinions continuously. - On-going community engagement for pilot projects.
Responsiveness	- Defining roles and responsibilities to support effective response to emergency. - Collecting public feedback for solutions. - Evaluating companies by the speed of responding to emergency.	- Technology improvement, e.g., automatic failure detecting, communication platform.	- Reporting to government hotlines for irresponsible behavior. - Provide solutions/suggestions to the government and industry.

4.5. Towards a Framework of Dynamic Collaborative Governance

From the above analysis, it is seen that in traditional innovation policy frames, Frame One and Frame Two, government policies can influence the supply and demand of innovation such as new technology, product and service. This is consistent with the shared bicycle sector in Hangzhou in its early stages. The local government plays the leading role of launching the public bike sharing project, selecting and purchasing from suppliers, quality control, and maintenance. As the public bike sharing system becomes mature, the government gives some degrees of autonomy for commercial bike companies, provided that they follow the standards. In the later stages of Hangzhou and Nanjing’s shared bicycle industry developments, there is evidence of collaborative governance among the stakeholders. This demonstrates features of the Frame Three policy with responsible innovation and sustainability. Rather than guidance from the government to industry and society in a single direction, two-way interaction and dynamic involvement are gradually formed, targeting for anticipation, reflectiveness, inclusiveness and responsiveness. Figure 1 summarizes the dynamic roles of government. In Case One, the government acts as a hard-law regulator, whereas in Case Two, there is limited government interfering initially. The traditional role of government is centralized planning, control and public procurement. Regulations such as punishment to irresponsible consumer behavior are also observed in Case One. Figure 2 proposes a model of collaborative governance with the government providing platform and facilitating alliance among the industry and society. It aims to achieve responsible innovation through collaborative governance. In this framework, the industry mainly provides product and service of high quality, sharing operations related information with the government and continuously improving product design and operations technology. Through the credit system, users can develop a sense of responsibility, and contribute to the system improvement. Instead of centralized control from the government, benchmarking and joint decision making can be conducted between the government, industry and society.

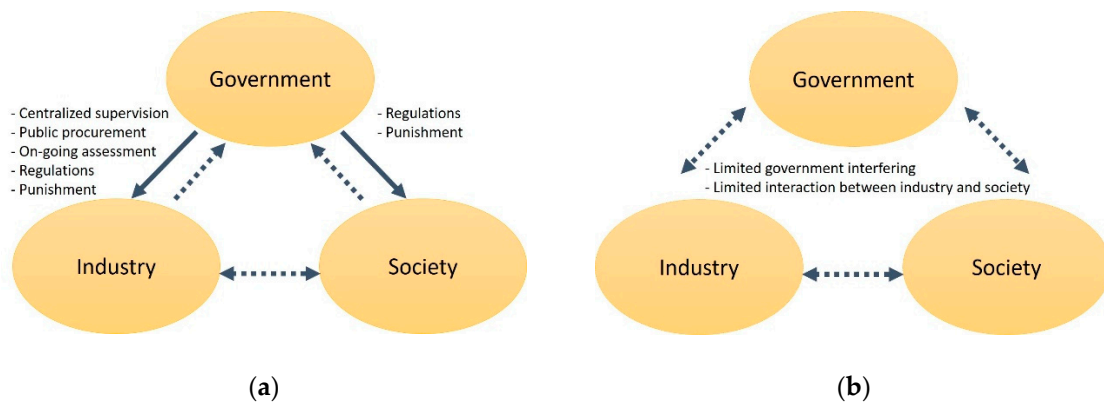


Figure 1. Traditional government roles: (a) Government as hard-law regulator; (b) Limited government control.



Figure 2. Collaborative governance model.

To generalize the research findings, there are two different forms of government policies. The Hangzhou case represents a gradual movement from the previous hard-law regulation system to collaborative governance. This goes along with the transformation of the public shared bicycle sector towards a combination of public and commercialized shared bike systems. In Nanjing, the original model is self-regulation without interfering from the government. With problems occurring, there is a change from purely self-organization to higher degrees of government control and guidance. The difference reveals that policy and governance approaches should be reconfigured according to the maturity stage of the industry, resource availability, market demand and many other factors.

5. Conclusions

This paper explores the role of government policies in the context of the sharing economy, in order to achieve responsible innovation. Through studies on the shared bicycle sector in China, it is found that the traditional hard-law regulation system can control the quality of suppliers, providing guidance to consumer behavior, planning and anticipating the business scale, and monitoring the operations. Thus, it meets the anticipation and reflectiveness dimensions of responsible innovation. This can be helpful at early stages of a new business sector, as seen in the case of Hangzhou. As the industry becomes mature, there is a trend of government moving away from the role of being a hard-law regulator towards being a facilitator, coordinating stakeholders including the industry and society. Collaborative governance can improve the inclusiveness and responsiveness through technology innovation, real-time platform operations, standardization and public engagement. This is also observed in the case study of Hangzhou, where the local government has initiated the public bicycle sector, and gradually developed a system combining public and commercialized shared bicycle systems. The case of Nanjing also demonstrates the importance of government control and regulation before the

fully establishment of a sector. The paper contributes to the theory of innovation policy by linking the governance mode with responsible innovation from stakeholders. A dynamic model is proposed with the growth path of government policies, eventually aiming for responsible innovation.

There are some limitations of the paper. The case studies cannot represent the whole shared bicycle sector in China, and more in-depth exploration on other cities needs to be conducted. So far, case studies with semi-structured interview, document review and content analysis are adopted. The research methodology can be improved with more semi-structured interviews with the industry, participatory observation and customer surveys. A comparative case analysis can also be conducted, covering more cities inside and outside China. Meanwhile, the study can also involve quantitative methods for theory improvement and validation. Based on this paper, future research can focus on specific dimensions of responsible innovation such as anticipation or inclusiveness, and explore more details on how collaborative governance can be conducted at different stages of the sector.

As for the practice and policy implementation, there are several recommendations. (1) Government needs to work with industry and the society at early stages to clarify the responsibilities and to form the information sharing system. Under the traditional mode, the government plays central role, whereas the shared bicycle sector is a new business model with characteristics of decentralization. A combination of hard-law and self-regulation can be helpful. (2) Government can still play a leading role in coordinating resources such as forecasting, data analysis and credit system monitoring. (3) Government needs to improve the transportation infrastructure, such as by setting up bicycle lanes. It is also important to collect public opinions by means of questionnaires, hotlines and social media. (4) Information sharing needs to be achieved between the government, industry and society, so that operations systems are more effective.

As representative first-tier cities in China with large populations, advanced technology, well-established transportation infrastructure and diverse business sectors, both Hangzhou and Nanjing are globally recognized. The governance models of their shared bicycle sectors can potentially be applied to other cities of a similar scale. Apart from achieving responsible innovation at the industry level, collaborative governance can also be linked with themes such as knowledge management, product design and development, urban planning, environmental management and public education. Globally, the sharing economy is emerging with the disruptive innovation of business models. The phenomenon happens not only to the shared bicycle business, but also to sectors such as car-sharing, accommodation rental businesses and food delivery platforms. As most sectors of the sharing economy are motivated by the market demand, and supplied by communalized firms with technology systems, the governance requires coordination and collaboration among the stakeholders. Traditional top-down centralized planning and government control is no longer appropriate for sectors generated by bottom-up initiatives. Based on this study, the recommendation of the government's role changing at different stages of the innovation system can be of international significance.

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