What are the Success Factors of Municipal Solid Waste (MSW) Management? Research on the Application of the Public-Private Partnership (PPP) Model in Wuhan, China

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Master Thesis

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Research on the Application of the Public-Private Partnership (PPP) Model in Wuhan, China

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Abstract

With the rapid development of China's economy, municipal solid waste (MSW) is also increasing rapidly day by day, and the management of MSW has become a more prominent problem in the process of urbanization. How to reduce the generation of garbage, ensure the provision of high-quality services in processing, and realize the reduction, harmlessness and recycling of garbage has become a hot spot of social concern.

Public-private partnership (PPP) serves as a bridge connecting the public sector and the private sector. While alleviating the government's financial burden on the project, it also incorporates the private sector into the public sector and improves the operational efficiency of MSW management projects with the help of the market.

Solving the problem of municipal solid waste disposal in the form of public-private partnerships has become a common way all over the world. In China, the form of public-private partnership has set off an upsurge in the field of municipal solid waste treatment as an innovative means in recent years. However, due to the late development and lack of experience, there are still a series of problems in the current PPP mode of MSW management in China. This paper analyzes the current PPP model of MSW management in China and researches the factors that affect its success or failure, which has certain significance for the long-term development of the PPP model.

This study takes the PPP MSW project in Wuhan, China as a case study. In order to achieve the purpose of the research, a successful MSW PPP project of Chongqing Tongxin MSW project is added as a comparative case. The main research method is a comparative case study by interviewing project leaders. Two interviews will be conducted. The first interviewee is the person in charge of the MSW project in Chongqing, who is the head of the China region of the private enterprise WTT (Waste Treatment and technologies). The second interviewee is the person in charge of the government's Wuhan MSW project. Thematic analysis will be used to analyze my interview data. Through interviews, data collection, and thematic analysis, six codes most relevant to the research questions were screened out, (1) The level of local economic development of the project, (2) Resident acceptance, (3) Government regulatory ability and experience, (4) Government Administrative risk, (5) Government financial tolerance and risk control ability, (6) Strengths of private enterprise. Then compare the success and failure factors of the PPP model application in Chongqing and Wuhan. Because of the deficiencies in the current PPP mode of MSW in China, the establishment of relevant industry and legal systems is proposed from the four perspectives of the government, private sector, residents, and waste disposal methods. Some opinions and relevant suggestions are put forward for the sustainable development of the MSW management industry.

Contents

1. Introduction

1.1 Research Background

Since the emergence of human beings, domestic garbage has appeared. In the early days, the living area of human beings was relatively small, the economic development was relatively backward, and the harm caused by domestic garbage was minimal. After the modern industrial revolution, the level of urbanization has greatly improved. While urbanization has brought us convenience in life, it has also brought about "urban diseases." Municipal solid waste (MSW) management is one of the more prominent problems. The contradiction between the amount of garbage removed and the amount of garbage produced, and the contradiction between the variety of garbage types and the garbage treatment technologies have led to the deterioration of the quality of the urban living environment. The situation of MSW disposal in China is serious, and it is urgent to break the dilemma of "garbage surrounding the city".

The harm caused by MSW is not only manifested in occupying too much land, forming a harsh environment surrounded by garbage, but also polluting the atmospheric environment, groundwater sources, soil and crops, and the harm of such pollution is difficult to eliminate. In addition, garbage also contains factors that endanger human health such as pathogenic bacteria and parasite eggs, so improper disposal will cause the spread of diseases and affect the life and health of urban residents. But every coin has two sides, it should be noted that MSW is also a potential resource while polluting the environment. MSW contains a large amount of combustible organic matter, which has a certain calorific value and can generate a certain amount of heat after incineration. The waste of a city is like a low-grade coal mine, which can be developed in a long-term cycle. The methane produced by landfill can also be used scientifically to benefit mankind.

However, at present, the Chinese government has not properly disposed of MSW as a resource and harmless utilization. In 2018, the total amount of MSW removed and transported nationwide was 21.529 million tons, of which the innocuous treatment capacity was 21.342 million tons, the sanitary landfill in the non-hazardous treatment was 12037.6 tons, the incineration was 8463.3 tons, and the other 533.2 tons (Ministry of Ecology and Environment of PRC, 2018). The garbage that has not been treated in time is directly accumulated and the degree of resource utilization is low. This garbage disposal method occupies limited land resources and aggravates the conflict between people and land. As residents' awareness of the "Not in my back yard" is strengthened, the location of garbage disposal sites is also more difficult. Furthermore, according to the China Eco-Environmental Statistics Annual Report

2019, environmental pollution causes a loss of US$54 billion to China every year, accounting for 8% of the national GDP, of which MSW accounts for 51% (The National Bureau of Statistics of China,2019). Whether the MSW can be properly handled is not only related to the appearance of the city and the health of the residents but also as a usable resource, the reuse of waste is a necessary condition for the realization of sustainable economic development. Therefore, the scientific and reasonable reduction, recycling, and harmless treatment and utilization of MSW are not only the needs of human environmental protection but also the needs of social development for the recycling of valuable materials, which will have an important impact on China's economic development.

For a long time, MSW management was monopolized by the Chinese government and was mainly carried out by the municipal environmental sanitation departments. The department plays the dual role of "actors" and "referees" (ShiMing Song 2000). The system of integration of government and enterprise has caused problems such as excessive financial pressure on the government and poor waste disposal results. In 2009, the Chinese Ministry of Finance issued the "Guiding Opinions on Encouraging Government and Enterprise Contracting to Promote the Development of China's Service Outsourcing Industry" and in 2016, "Notice of the General Office of the State Council on the Establishment of a Leading Group for Government Purchase Service Reform" was issued. With the introduction of policies, all provinces have outsourced to promote the marketization of public services. In addition, The Chinese central government encourages private capacity to invest in public service areas such as municipal construction, medical and health care, and garbage disposal, to give full play to the power of social capacity (National Development and Strategy Research Institute, 2015). The Third Plenary Session of the 18th CPC Central Committee proposed to expand the government's purchase of public services, introduce a competitive mechanism for transactional management services, and realize service packages through contracts and commissions. Encourage the government to adopt the form of outsourcing to hand over municipal solid waste to qualified private enterprises for MSW processing, so as to attract social investment and high-quality and efficient MSW management (Guobin Zhan 2011).

The Chinese central government's vigorous promotion of the PPP model of cooperation between the government and social capacity has brought new hopes for the establishment of a sustainable development model for the municipal solid waste management industry. Public-private partnership (PPP) serves as a bridge connecting the public and private sectors while alleviating the government's financial burden on the project, it also incorporates the private sector into the public sector and uses the market to improve the operational efficiency of MSW projects. Solving the problem of municipal solid waste disposal in the form of public-private partnerships has become a common way all over the world. (Osborne & Gaebler 2011). On

the one hand, the PPP operation model can effectively solve the problems of the long-standing lack of management mechanisms and low MSW operational efficiency in China. On the other hand, China lacks the necessary technical accumulation and operational management experience in this field. The government's management of the target requirements is weak, and the necessary subsidy mechanism is lacking. There are still certain problems to be solved in the promotion and development of the PPP model of MSW management (XuHong Ma2015). In order to help the Chinese government successfully cooperate with the private sector to carry out MSW outsourcing projects, this paper will research **what are the success factors of municipal solid waste management in the PPP model.**

This study takes the PPP MSW project in Wuhan, China as a case study. In order to achieve the purpose of the research, a successful MSW PPP project of Chongqing Tongxin MSW project is added as a comparative case. The main research method is a comparative case study by interviewing project leaders. Two interviews will be conducted. The first interviewee is the person in charge of the MSW project in Chongqing, who is the head of the China region of the private enterprise WTT (Waste Treatment and technologies). The second interviewee is the person in charge of the government's Wuhan MSW project. Thematic analysis will be used to analyze my interview data. Through interviews, data collection, and thematic analysis, six codes most relevant to the research questions were screened out, (1) The level of local economic development of the project, (2) Resident acceptance, (3) Government regulatory ability and experience, (4) Government Administrative risk, (5) Government financial tolerance and risk control ability, (6) Strengths of private enterprise. Then compare the success and failure factors of the PPP model application in Chongqing and Wuhan. Because of the deficiencies in the current PPP mode of MSW in China, the establishment of relevant industry and legal systems is proposed from the four perspectives of the government, private sector, residents, and waste disposal methods. Some opinions and relevant suggestions are put forward for the sustainable development of the MSW management industry.

1.2 Current Situation and Problems of MSW Management in Wuhan

The Wuhan Municipal Government has carried out a series of beneficial explorations in the outsourcing of municipal solid waste management: for example, the establishment of an institutionalized management mechanism, the government's public bidding, and the enrichment of outsourcing forms. These practices have achieved certain results in the outsourcing of MSW management, but they still cannot fundamentally solve many of the problems. For example, inaccurate government role positioning, insufficient system supply, low degree of industrialization, weak social organization, and imperfect cooperation mechanism.

First, Wuhan's environmental protection investment is very small. The proportion of environmental protection investment in the regional GDP is 0.65% during the "Eighth Five-Year Plan" period and 0.90% during the "Ninth Five-Year Plan" period, which is far lower than the national average during the same period. During the tenth five-year period, with the large-scale investment of the central government in the construction of environmental protection facilities in the Yangtze River Basin, the investment in environmental protection in Wuhan increased rapidly (China Solid Waste Website,2015)

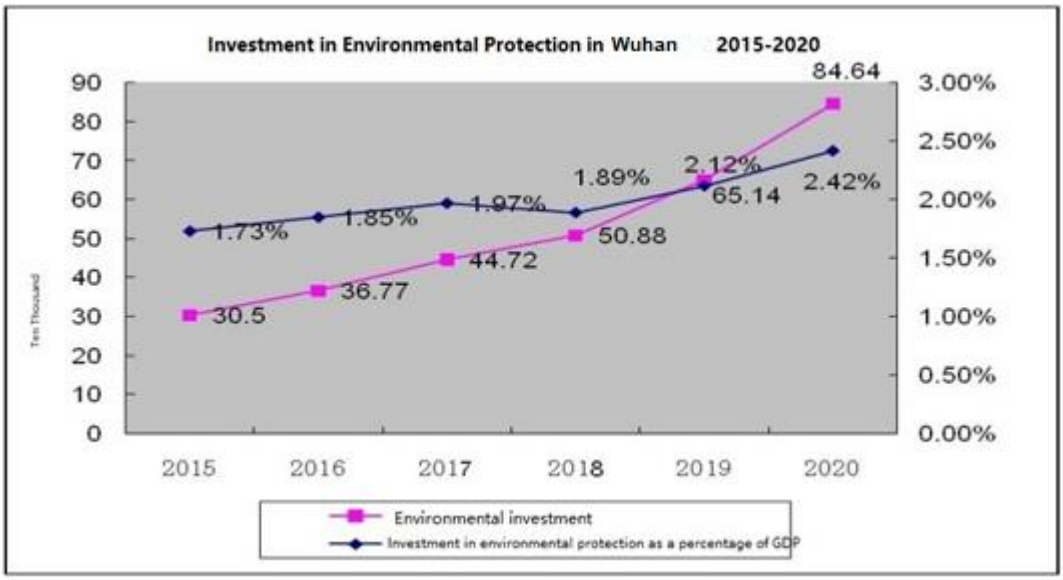


Fig 1.1 Investment in environmental protection in Wuhan 2015-2020

(Source: The Municipal Solid Waste Evaluation Report, Wuhan China, China Solid Waste Website,2015)

The current source of funds for the construction of municipal solid waste treatment facilities in Wuhan is government investment. With the urbanization of Wuhan City, the rapid growth of the urban population has driven the increase in demand for sanitation facilities. The huge investment in sanitation infrastructure construction and operation and maintenance costs, only relying on government investment has made the government powerless, whether it is

construction or operation. There is a huge financing gap.

Second, the market-oriented reform of domestic waste treatment in Wuhan has not achieved substantial results. At present, the transportation and treatment of domestic waste in the main urban area of Wuhan is monopolized by Wuhan Sanitation Group, which is a semi-state enterprise. The construction and operation of sanitation facilities are lacking effective supervision and management mechanisms, which makes a large number of garbage disposal sites in an inefficient operation state, resulting in double loss of environment and capacity.

Third, the popularization rate of garbage classification knowledge in Wuhan is low, and the residents are not active in cooperation. Since the garbage classification standards are not clear, citizens do not know much about garbage classification and how it should be classified. If garbage is thrown in strict accordance with garbage classification, and garbage is collected on time and by location, citizens will feel inconvenienced in life and a waste of personal time and energy.

Due to the shortage of operating capacity and the unsmooth operation management system, the role of the Wuhan garbage disposal plant has not been brought into full play. At present, Wuhan produces about 2,285 tons of domestic waste every day, but only 1,510 tons of domestic garbage enters the garbage disposal plant every day. The harmful treatment rate is only 66% (Wuhan Ecological Environment Bureau,2018). A large amount of domestic waste continues to enter the old garbage dump for simple treatment, resulting in secondary pollution still occurring.

The PPP model is an important way to connect the government and enterprises. From source classification, collection and transportation to processing and resource disposal, MSW Management is inseparable from the cooperation of government enterprises and residents. The entry of the PPP model into the MSW management industry requires specific changes to deal with the particularity of MSW management.

1.3 Research Significance

This paper uses the PPP theory, combined with the interview with the project leaders and a successful MSW PPP project in Chongqing city as a comparative case, trying to analyze the success factors of the PPP in the field of MSW management in Wuhan. Finally put forward relevant suggestions to make a concept for the sustainable development of the MSW management industry.

(1) Theoretical relevance

China's previous economic system was a planned economy, and experts started their research on MSW relatively late, so the research on the public-private partnership governance model also started late, and the research content and research methods were not advanced enough. From the perspective of research content, most of them focus on the study of MSW methods

and technologies. Some experts believe that to effectively manage MSW, it is necessary to purchase foreign advanced technology and equipment (Yan Ke 2015) or strengthen laws and regulations (Ju Long 2014). Some experts regard public-private partnerships as privatization, lacking an analysis of the governance model of public-private partnerships (Xiaodong Zou 2010). There are certain flaws in the research of these scholars. Most of them focus on how to deal with the terminal disposal of municipal waste. They focus on practice and lack theoretical research, so it is impossible to achieve a cure for the root cause.

This study provides a theoretical basis for the MSW PPP model. At the theoretical level, the necessity of government responsibility in the outsourcing of municipal solid waste management and treatment is expounded by using market failure theory and social governance theory. This study combines the theory and practice of PPP to better localize the theory and provide effective decision-making reference for the public sector to formulate PPP special regulations and related policies. It also provides theoretical guidance for transforming government functions, improving PPP service quality, improving public satisfaction, and building a service-oriented government.

(2) Societal relevance

At present, the huge amount of urban solid waste has become an increasingly serious threat to the ecological environment of the city and its surroundings. According to statistics, China produces 150 million tons of municipal solid waste every year, but China's ability to deal with these wastes is only 56% of the total weight of waste, which is far from the level of harmless treatment (Guojun Song 2015).

Therefore, MSW management and improvement of environmental quality have become important aspects of urban governance. However, a large amount of municipal solid waste faces difficulties such as lack of effective management, unreasonable industrial structure, low degree of marketization, insufficient production capacity, outdated equipment, and serious secondary pollution in the process of disposal.

Reasonably optimizing the use of the PPP model as a means of MSW market reform can effectively solve the above problems. This study explains the necessity of PPP in MSW management and examines the factors that affect the success or failure of PPP. Then put forward ways to improve the PPP model and establish regulations and related policies. This has important practical significance for improving the urban environment and promoting high-quality economic and social development.

2. Literature Review

2.1 Research on Public-Private Partnership (PPP)

1. The origin of public-private partnership (PPP)

In the 1990s, the UK took the lead in proposing the concept of public-private partnership, which is mainly a natural result of the evolution of the relationship between the public and private sectors in the UK. The public-private partnership system is considered to be a key factor for the government to provide modern and high-quality public services and to enhance the national competitiveness strategy, and it is the cornerstone of the government's modernization process. This evolution process roughly experienced the following three stages: Privatization, Compulsory Competitive Tendering, and Private Finance Initiative (HM Treasury, 2008)

The first stage: The Privatization Stage

Privatization refers to the transfer of ownership and management rights of the entire enterprise to the private sector. Beginning in the early 1980s, the Thatcher government sold state-owned enterprises on a large scale, and the privatization movement began (Parker 1990).

The second stage: The Compulsory Competitive Tendering Stage

In the 1980s and 1990s, the United Kingdom passed legislation to force local governments to contract many public service contracts through competitive tendering to the private sector that has a high level of capability assessment and can efficiently provide the required services. These public services include garbage collection, street cleaning, school hygiene and catering services, computer services, legal services, personnel services, and housing management. From an objective point of view, this method can effectively reduce the cost of auxiliary services. However, because the contracted public services rarely achieved the expected results and were strongly resisted by consumers, the United Kingdom abolished mandatory contracting in 1997 (Parker 1990).

The third stage: Encourage Private Finance Initiative (PFI) stage

In 1989, the UK abolished strict restrictions on the introduction of private capacity to invest in public assets. In order to encourage private capacity to enter the health and local government sectors, in 1992, the United Kingdom first proposed the concept of encouraging private investment actions. Under this approach, the public sector and the private sector supplier signed a long-term service contract. The contracts generally indicate the asset requirements and therefore require the investment of private sector capacity. The advantage of encouraging private investment is that it can obtain the management technology advantages and financial support of the private sector, but the core services are still provided by the public sector.

Encourage private investment actions to pay more attention to services and financial benefits, which is in sharp contrast with the strong price-oriented contracting in the previous stage (Pollitt, 2002)

As the participation of the private sector continues to increase, its participation methods are constantly changing and innovating. From privatization to compulsory competitive bidding, and outsourcing public services to encouraging private investment actions, public sector theorists and practitioners are constantly practising the concepts and methods of using private participation to reshape the public utility sector and even the entire government sector. The concepts and theories of public-private partnerships were born and developed under this background. Since the concept of public-private partnership was first proposed in the United Kingdom, it has received widespread responses in major western countries such as the United States, Canada, France, Germany, Australia, New Zealand, and Japan. At the same time, Non-Governmental Organizations (NGOs) and academia have also played an active role in promoting the development of public-private partnerships. International organizations such as the European Union, the United Nations, the Organization for Economic Cooperation and Development, and the World Bank have also promoted the development of public-private partnerships (World Bank, 2017). The concept and experience of the company have been promoted globally. So far, many developing countries, including China, India, Brazil, and Mexico, have begun to learn and experiment with public-private partnerships. However, there are still some differences in the theoretical understanding and practical progress of public-private partnerships.

2. Modern Public-Private Partnership Models

Public-private partnership is a new type of project emerging in the current society. It can be realized in various forms, but the main body is jointly completed by the public sector and the private sector. The public-private model is not an activity arranged by the project sponsor to raise funds. The public-private partnership model is determined by the benefits of the project, the size of the assets, the specific methods and the strength of government assistance measures. It is supported by the strength of the government, owns the assets of the company and the commitment of the government (Rosenau,1992)

The modern public-private partnership model gathers more private capacity, opens up new financing channels, and greatly improves efficiency. Through agreements, the government and private enterprises clearly define rights and obligations, jointly take responsibility for the operation and management of the project, and effectively reduce the risk of responsibility. The rules and regulations of the modern public-private partnership model allow private companies to participate in the construction of the city, fully analyze the feasible plans, and use advanced design concepts to better build the city. This not only improves the security of

private enterprise funds, but also can introduce good management solutions and other key technologies of private enterprises into the project, so as to better serve the project, and the value generated is immeasurable (Brooks et al, 1984).

The goal of an enterprise is to achieve profitability. If it is "unprofitable," I believe that no private enterprise will participate in it. Enterprises need to find a goal to ensure the security of capacity, and at the same time, the invested capacity can also get due benefits. Based on this principle, the modern public-private partnership model came into being. First of all, if private enterprises invest in this project developed by the government, as compensation, the government can allow enterprises to get better preferential measures in other aspects. For example, certain tax concessions are given to enterprises, conditions can be appropriately relaxed when enterprises take out loans, and enterprises have more convenient rights when participating in other competitive projects, etc. Through the implementation of the above measures, private capacity can be greatly mobilized to participate in the projects developed by the government, and mutual benefit and win-win are realized (Bennet & Grohmann, 2009). The modern public-private cooperation model realizes the real-time management and control of project construction, which is conducive to the transformation of government functions, and also effectively relieves the government's financial pressure, enhances the service concept of the public sector, and significantly improves the quality of services. In this context, private enterprises are responsible for raising the capacity needed for construction. The significant advantage is that the channels for financing are improved, and the required capacity can be raised more effectively and faster, thereby reducing the asset-liability ratio (Erlander& Xiang Long,2013). Private enterprises jointly manage the project construction and realize the best operation mode, which not only reduces the responsibility of the government, but also has a reasonable risk-sharing mechanism, and more effectively achieves mutual benefit and win-win cooperation (Lane 2012). Its ultimate goal is to better serve the people and better safeguard the interests of the country and enterprises.

2.2 Public-Private Partnership Models in Western Countries

Since the 1970s, some western countries with developed economies and markets began to privatize public services, relying heavily on the power of private units to meet the demands of the people. When these countries build infrastructure, a large number of public-private partnership models are implemented, which can not only help the government to transform its functions, but also improve the quality of services, and also allow the government to control those public sectors that are closely related to people's livelihood. Beginning in 1980, the United Kingdom and the United States began the process of privatization (HM Treasury 2008). Under the influence of the United Kingdom, many western countries have gradually moved towards privatization, and at the same time, many developing countries have also begun this

process.

The governance model of public-private partnership is not new in recent years. The concept has been around since the 19th century. In recent years, with more research and more frequent practice, the connotation of this definition has also changed. In 1996, at the Second United Nations Conference on Human Settlements, Habitat II, participants at the meeting reiterated the definition of partnership and believed that having the public sector and the private sector work together as partners is a key to effective city governance. Based on this, Prof. Erlander, an expert from Sweden, summed up three meanings of partnership: First, in general, partnerships can help private capacity maintain a preference in the governance of cities. In this way, private capacity occupies a major position in the partnership system. Second, the partnership system is that the government provides opportunities for private capacity to fully occupy the field and play the role of private capacity. This implication sees the partnership as a means of public policy, rather than cooperation between the interests of the participants. Third, the masses can influence decision-making through partnerships. In this sense, national interests and public interests are all subordinates (Ingemar Elander,2002)

In 2000, the UK Treasury explained public-private partnerships: Penetrate the ownership of private units in state-owned enterprises; promote private investment, according to which the public sector purchases goods in accordance with the contractual agreement, using the advantages of private sector management, and at the same time, benefiting from the financial resources of the private sector to strengthen public programs; Government departments should expand the scope of services, and then use the technical and financial resources of the private sector to develop the commercial potential of the government (HM Treasury 2000).

The U.S. Council on Public-Private Partnerships and the European Union share the same view, both of which believe that public-private partnerships are a local and for-profit public-private engagement. According to this agreement, both the public and private sectors can enjoy technology and services. In addition to these shared resources, there are certain risks and associated benefits (The U.S. National Council 2013). American industry experts divide the public-private partnership model into three levels. First, in a broad sense, both the public and private sectors are involved; second, PPP is a complex and privatized infrastructure project. Finally, it refers to a cooperation model between private enterprises and local governments to make the city more beautiful (The U.S. National Council 2013).

In April 2004, The European Commission defined public-private partnership as follows: "Public-private partnership is a form of cooperation between public institutions and the commercial community to ensure the financing, construction, renovation, management and maintenance of infrastructure or the provision of services." (Commission of The European Communities 2014)

There are many explanations for the public-private partnership model because its connotation is different due to the influence of culture and economy. Through the above analysis, it can be seen that the interpretations are different, but they have some common characteristics, such as the common pursuit of the partners and the responsibility for providing public services together; the need for both parties to achieve mutual benefit and win-win; common enjoyment of rights; the best way to strengthen risks distribution, and provide certain services to taxpayers, etc.

2.3 Research on the Effectiveness of Public-Private Partnership

Regardless of the theoretical and practical circles, the effectiveness of public-private partnerships is the subject of key research and discussion. According to the views of scholars, it can support the public-private partnership school; the public-private partnership school and the neutral school.

From a supporting point of view, supportive scholars believe that the current trend of changes in the world is to reduce dependence on the government and establish more social institutions, and for large and developing governments on a global scale, the public-private partnership can bring higher production efficiency and better Economic performance to meet diverse public needs. As a representative of the support group, Savas (1999) once stated in his representative book "Privatization and Public-Private Partnerships" that outsourcing public services to private providers through contracts and other methods can promote the development of private enterprises and ease Government management pressure. Guy Peters (1998) also spoke highly of the value of government public service outsourcing. He believed that if the government wants to improve administrative efficiency and reduce fiscal expenditures, the only way is to add market competition mechanisms to the supply of public services and contract the supply of social public services in the form of intergovernmental contracts or agreements. In addition, Luisa Perotti, Vincent Wright, Philip Cooper (2007) and others also support the public-private partnership. Supporting scholars not only believe that public-private partnerships can improve economic efficiency, but also emphasize that maintaining private ownership, ensuring competition, and maintaining the market are necessary conditions for achieving economic efficiency. The government's functions must be restricted by law.

From a neutral point of view, the centrists who hold a neutral view are mainly pragmatic public administrators and politicians. The representatives of the centrist are Ted Gabler and David Osborne (1993). They proposed a market-oriented government, steering instead of paddling. The ten principles of government reform that play a catalytic role are highly consistent with privatization, especially in public service outsourcing. The centrist believes that the government can provide better and more efficient public services through the cautious and selective use of outsourcing, but the premise is that there must be government department

managers, a certain degree of market competitiveness, and the status of rule-makers (Gabler & Osborne 1993).

From an opposition view, with the deepening of research on public service outsourcing in academia, more and more scholars have discovered the problems and disadvantages of public service outsourcing. The academia's attitude towards the effectiveness of outsourcing has become more and more rational, and many doubts and criticisms have even emerged. The opposition, represented by K. H.Schaeffer, Elliott D.Sclar and Robert Brandwein (1989), questioned the validity and rationality of the methods used by private providers to improve the efficiency of public services and believed that it is impossible to rely on the market as the sole measure of efficiency. Because marketization based on economic analysis may bring about a series of potential social impacts such as frequent corruption, a decline in the quality of public services, and a rise in outsourcing transaction costs, which may even have an impact on democratic procedures in severe cases. In addition, Milward and Provan (2000) also pointed out that relying too much on social forces to maintain public services will lead to the "hollowing" of the country and weaken the credibility and authority of the government.

2.4 A Brief Introduction of PPP MSW Management PPP in India

India, a developing country along with China, is one of the growing markets for public-private partnership (PPP) infrastructure projects. MSW management projects have been approached with some success using the public-private partnership model over the past two decades, in India.

The success factors of PPP MSW projects in India can be roughly summarized as follows. Firstly, good government governance is crucial throughout the project process. The Indian local government has simplified the approval process for PPP MSW projects to avoid cost and time overruns. Local governments are efficient, knowledgeable, and willing to share power and coordinate with private parties (Hazra & Goel, 2009). The government has carried out effective garbage classification and popularization of PPP project knowledge to residents, acting as a mediator between contractors and residents, overcoming residents' objections. Good governance reduces logistics costs and expands PPP MSW projects to more areas of the city. Secondly, " adequate financing " is also one of the success factors for PPP MSW projects. As a developing country, many local governments in India lack sufficient financing, which is one of the main difficulties in effective MSW management. In PPP projects financed by the private sector, The private sector allows flexible use of financial instruments such as equity, securities, and credit for financing. In addition, preferential policies such as tax rebates and subsidies are provided by the government to make up for the financial gap in financing to ensure the economic feasibility of PPP MSW projects (Zhang 2015). Thirdly, a reliable private sector party with advanced technical and management capabilities is crucial to the success of a PPP project.

In MSW PPP projects in India, different companies are often operated together to form a consortium. With strong financial capabilities and advanced technology, rich experience and management capabilities to undertake project design and development, optimize capital expenditures and efficient process management to ensure the success of the project (Chan et al, 2010). Last, but not least, raising public awareness is also one of the factors for the success of PPP MSW projects in India. In India, the public sector plays a leading role in the development of MSW projects, and with the assistance of many non-governmental organizations, through various media, citizens can understand the impact of MSW on the environment and health, so as to improve residents' public awareness of waste classification. Several studies in India have emphasized the importance of citizen support for the positive effects of PPP MSW projects (Devkar,2009). The participation and support rate of the public have an important impact on all stages of the MSW project

As seen from the above literature review and foreign successful cases, the advantages of PPP outweigh the disadvantages. PPP has now become a popular means for the government to build public facilities and provide public services, which is inseparable from its unique model advantages. Firstly, using the PPP model can alleviate the government's financial pressure, and the government will transform from a provider to a regulator so that it has more energy to do its own work well. It can also take advantage of the private capacity to reduce project costs Secondly, the PPP mode diversifies the investment subjects, maximizes the use of the private sector's capacity and technical advantages, and improves the project operation effect. Finally, the PPP mode allows the risks of the project to be allocated reasonably. The private sector and the public sector share project risks, which reduces the financing difficulty of the project and makes the project a higher success rate.

At present, the effect of MSW management in Wuhan, China is not ideal, and the risks faced by the industry are mainly reflected in the government's financial constraints leading to insufficient investment in the MSW management industry, the incompleteness of relevant laws and regulations, and the low degree of marketization have also constrained MSW management industry development. The introduction of the PPP model in the MSW industry can meet the public demand for waste disposal, protect the health of the public, and take advantage of the private capacity to improve project operation effects and benefits. The government can focus on its own work, while private enterprises can also get preferential policies or subsidies to expand their industrial scale and reduce operational risks. Using the PPP model, a unified recycling system and a sound waste disposal resource industry can be established.

3. Theoretical Framework

3.1 The Concept of the Municipal Solid Waste

"Abandoned useless or dirty and tattered things" is the dictionary definition of garbage. In China " The municipal solid waste management and Pollution Prevention Technology Policy" stipulates that municipal solid waste is: solid waste generated from daily life or service activities for daily life and solid waste that is regarded as domestic waste by laws and administrative regulations. Therefore, in a strict sense, urban construction waste, hazardous waste, medical waste, and discarded electrical and electronic products do not belong to the category of "municipal living garbage" (Ministry of Ecology and Environment of People's Republic of China 2010). Therefore, the municipal living garbage studied in this paper is only solid waste generated in daily life or activities that provide services for daily life and its various processing links and does not contain other contents otherwise stipulated by laws and regulations

As a kind of solid waste, in a broad sense, municipal solid waste includes toxic and hazardous waste, such as waste batteries and waste lamps from residents, as well as food waste. On the one hand, municipal solid waste that has not undergone reasonable disposal has a great harm. It not only pollutes the environment, but also affects the city's appearance, spreads diseases, increases the burden on sewage treatment plants, and occupies a lot of land. And it will produce some toxic and harmful substances, pollute the air and water sources, and cause great harm to people's health. On the other hand, municipal solid waste is a resource with great potential. Food waste, which is an important part of municipal living garbage, can be made into biodiesel to expand the source of resources, and it can also become a major raw material for industrial oils and fats. Recyclable waste such as wastepaper and empty bottles in municipal solid waste is a major source of resource reuse.

In addition, MSW management involves multiple links such as generation, cleaning, recycling, transportation to end treatment, and the lack of management of which link will cause the effectiveness of waste treatment to be greatly reduced. This means that if the municipal living garbage is not properly handled, it will become a major disaster in the new era, but if it can be used reasonably and turned into resources, it will be a huge wealth. How to deal with the increasing amount of MSW and recycling of municipal living garbage has become the focus of attention in recent years.

3.2 The Concept of Public-Private Partnership (PPP)

At present, the application of public-private partnerships in the world has become a trend, and it is a fairly broad concept. In addition to the differences in cultural background, ideology, economic development, and application environment, so far, there is no unified understanding of the concept of PPP in all countries in the world. German scholar Norbert Portz (2003) believes that "trying to summarize what PPP is or should be is almost meaningless. It has no fixed definition, and it is difficult to verify the origin of this vague English word. The exact meaning of PPP should be determined according to different cases." Even so, the different interpretations of PPP by scholars and research institutions are helpful to understand the connotation of PPP.

Professor Savas(2002), known as the "Master of Privatization", classifies the concept of PPP into three levels: First, in a broad sense, it refers to any arrangement in which the public and private sectors participate in the production and provision of goods and services; second, it refers to some complex, multi-participated and privatized infrastructure projects; Third, it refers to formal cooperation between enterprises, social organizations and local governments to improve urban conditions.

The United Nations Institute for Training and Research (2000) believes that the definition of PPP has two meanings: the first is to meet the needs of public products and establish various cooperative relationships between public and private advocates, and the second is to meet the needs of public products. Establish partnerships with the private sector to implement large-scale public projects.

The U.S. National Council for Public-Private Partnerships (2002) defines PPP as an agreement between a public agency (federal, state, and local) and a for-profit company. Through the agreement, the public and private sectors share each other's technology and assets to provide services and facilities to the public. In addition to sharing resources, they also have to jointly assume the risks in the provision of services and facilities and share the benefits brought by the services and facilities.

"The Public-Private Partnerships: The Government's Approach" issued by the British Ministry of Finance explains PPP from three aspects: "Introducing private sector ownership in state-owned industries; encouraging private investment behaviours. According to this plan, the public sector purchases products or services for a long period of time through contracts, takes advantage of the management technology of the private sector, and at the same time benefits from private financial support to consolidate public projects; expand the scope of sales of government services, thereby leveraging the expertise and financial resources of the private sector to develop the commercial potential of government assets." (HM Treasury 2008)

Based on the interpretation of the definition of PPP by the above-mentioned scholars and

institutions, a general description can be given: Public-private partnership refers to a long-term cooperative relationship established by the public sector and the private sector to provide public products or services by signing a formal agreement.

Under this partnership, the public and private sectors play their respective advantages to provide public products or services and share risks and benefits together. The narrow PPP model can be understood as a general term for a series of project financing models, including specific models such as BOT (Build-Operate-Transfer), TOT (Transfer-Operate-Transfer), DBFO (Design-Build-Finance-Operate) (Wang Hao 2005).

3.3 Application of PPP Theory in Wuhan MSW Management PPP Mode

1. Variable Selection

This paper takes the success or failure of the PPP mode of domestic waste treatment in Wuhan as the dependent variable. When analyzing the influencing factors of the PPP mode of urban domestic waste treatment, according to the theory of public goods, market failure theory, and market economy theory, combined with the existing literature review and PPP projects. interview survey, From the production process and municipal solid waste treatment PPP project structure, the main influencing factors are divided into four project background factors: environmental factors, government factors, project factors, and market structure factors.

①Environment Factor:

In the past, municipal solid waste disposal services in China have always been regarded as public welfare undertakings, which belong to public goods and should be provided by the government. However, economist Christine Kessides'(1993) research on the MSW management industry found that the waste treatment industry has certain competitiveness in terms of supply, and even has strong competitiveness and exclusivity in terms of waste transportation and recycling. This is not consistent with the properties of pure public goods. The characteristics of certain private goods in MSW services indicate that introducing a certain degree of market mechanism will be a more efficient choice. According to the principle of survival of the fittest in the market economy, the higher the level of local economic development, the better it can provide capacity and manpower, and operation experience for the MSW PPP project. Residents in developed regions have a high awareness of environmental protection and a high degree of understanding and acceptance of PPP.

The project background environment mainly examines the impact of external factors on the success or failure of the project. Specifically, the analysis mainly takes into account four factors: the economic development level of the project location, the natural ecological environment of the project location, the project operation experience, and the attitude of surrounding

residents towards the project.

The higher the economic development level of the project location, the higher the level and quality of services provided for project development in terms of finance, law, human resources, more project operation experience, and residents' education level, which will have a positive impact on the PPP MSW project.

②Government Factor:

The theory of "market failure" was first proposed by American economist Barto in "Anatomy of Market Failure" in 1958. In short, market failure is due to market information asymmetry, externalities, monopoly and other inevitable defects that lead to "failures" in the allocation of resources, resulting in the waste of resources. When the market is difficult to effectively allocate resources, in order to make up for the market failure, the government needs to intervene and play its economic functions. Therefore, when the MSW management problem cannot be solved solely by the market mechanism, government intervention is required. Strong government intervention is an effective measure for social management, and it is also an inevitable choice under market economy conditions.

As the initiator and regulator of PPP projects, the role of the government in PPP projects is self-evident. The management level of the government mainly refers to whether the government departments can effectively cooperate with each other in the management of the PPP project, and whether they have prior management experience for the project. In general, the stronger the management ability of the government, the more likely the PPP project will be successful. The public sector factors are mainly to analyze the government supervision capabilities and experience, the government's financial capacity, the project administrative risks, the policy input & the cross-administrative levels

The government's financial capacity and proportion of investment refer to the level of capacity given by the government in PPP projects, and whether it has certain financial controllability in the face of possible risks. During the implementation of PPP projects, the government's financial capacity reflects whether it can provide certain financial guarantees following the contract and whether it has long-term financial guarantee capabilities. The stronger the government's financial capacity, the more economic guarantee it can provide for the success of PPP projects.

The administrative risk of the government refers to whether there is a change of leadership during the implementation of the PPP project, which may delay the progress of the project or even cause the project to die prematurely.

Policy input means whether the government gives preferential policies and support in the process of project implementation, which reflects the government's investment. If the

government can give as many concessions and support as possible to the project, the probability of the project's success is higher

Cross-administrative level refers to whether the implementation of PPP projects involves the collaboration of different administrative levels. The more cross-administrative levels the more likely to delay the progress of the project and inefficiency.

③Project Factor:

Public-private partnership is a public infrastructure project construction mode in which the public sector and the private sector form a good partnership. This kind of contract relationship is interpreted as a principal-agent relationship in economics, so as to absorb social capacity, introduce market competition mechanism, effectively relieve government financial pressure, reduce project cost, and not only ensure the social benefits of public products, but also improve the efficiency of project operation and management (HM Treasury 2008).

The characteristics of the project itself also have a certain impact on the success or failure of the project which is mainly to analyze the adjustability of the project contract, the technical complexity and difficulty of operation and maintenance, the profitability of the project and the advanced level of project technology.

Whether the contract is adjustable refers to whether the contract can be adjusted in time according to market changes during the project implementation process. According to the characteristics of PPP projects, the flexibility of the contract has a positive impact on the success or failure of the project. The more flexible the contract is in line with market changes, the more it can attract private investment, and the more it can give full play to the management skills and innovation incentives of the private sector and make the provision of public services more efficient. Whether the project is profitable is one of the important factors that can attract the private sector to participate in the PPP project and stimulate the enthusiasm of the private sector to join the MSW management field.

The technical complexity and operation and maintenance difficulty of the project also affects the success or failure of the project. Both public and private parties will consider the cost and risk of project operation. Project cost and risk have a negative impact on the success of the project.

The technological advancement of the project refers to the degree of technological progress of the project in related fields. Whether the project technology is innovative and sustainable has a positive impact on the success of the project. Government departments are more inclined to technological innovation projects.

④Market structure Factor:

Public-private partnership projects absorb social capacity and introduce a market competition mechanism. The competition mechanism is one of the contents of the market mechanism, and it is the means and method for the survival of the fittest in commodity economic activities. It can form the vitality and development momentum of enterprises, promote production, and enable consumers to obtain greater benefits (Adam Smith 2010). As the private sector is a participant in the PPP project, the strength of the private sector will have a certain impact on the success rate of the project. The strength of the private sector can be judged by the leadership of the private company in the market, its financial capability, and the reputation of the private company in the relevant industry. According to the market competition mechanism, the stronger the strength of private enterprises, the higher the probability of success of PPP projects.

4. Research Design

4.1 Research Method

This study takes the PPP MSW project in Wuhan, China as a case study. In order to reach the research purpose, this study adds a successful MSW PPP project of the Tongxin Waste Treatment Plant in Chongqing city as a comparative case for interview analysis. The main research method is a comparative case study by interviewing the projects' leaders. Thematic analysis will be used to analyze my interview data. Techniques such as comparative analysis, description of information, data analysis and interview evaluation are added to the design and enrichment of qualitative research.

Based on the existing PPP literature, two interviews will be conducted, intervieweeI is the Chongqing MSW project leader from the private enterprise WTT (Waste Treatment Technologies), and interviewee II is the Wuhan MSW project leader from the government. Through interviews, data collection and data analysis, Thematic analysis will be used to filter out the six variables most relevant to the research question, namely, the local economic development level, residents' acceptance, government regulatory and financial capabilities, government administrative risks, and private enterprise financial and technical capabilities. Then compare the success and failure factors of the PPP model application between Chongqing and Wuhan cities.

I will also discuss the establishment of institutional and legal systems in related industries, and the utilization of waste resources. Some opinions and relevant suggestions are put forward for the sustainable development of the municipal solid waste disposal industry.

4.2 Research Setting

This study takes the PPP MSW project in Wuhan, China as a case study and also adds a successful PPP MSW project of the Tongxin MSW in Chongqing city as a comparative case study. The Wuhan municipal government has some problems in the outsourcing of MSW management and is seeking a series of changes regarding the introduction of the PPP model into the MSW management industry. At present, MSW management in the main urban area of Wuhan is monopolized by Wuhan Sanitation Group, which is a semi-state enterprise. On the one hand, the rapid growth of Wuhan's population has led to an increase in the demand for sanitation facilities and the cost of operation and maintenance, which has placed a huge financial burden on the government. What's worse is that because of covid-19, the government has allocated part of the capacity to fight the epidemic, resulting in a huge financing gap for the government in MSW. On the other hand, the popularization rate of waste sorting knowledge in Wuhan is low, and residents are not actively cooperating. Because the citizens do not sort the garbage well, the role of the Wuhan garbage treatment plant has not been fully utilized. Finally, the construction and operation of sanitation facilities in Wuhan lack an effective supervision and management mechanism, which makes the MSW in an inefficient operation state, causing double losses of the environment and funds.

The reason for choosing Chongqing Tongxin Waste Incineration Power Plant as a comparative case is that Wuhan and Chongqing have a similar geographical location, similar natural environment and climate, similar customs and habits, and similar city size and population. They are both Chinese megacities and financial centres in China inland.
The Chongqing Tongxin Waste Incineration Power Plant PPP project started as early as 2010. It is the first large-scale waste incineration power plant in the Midwest and the first PPP project in the field of MSW management in Chongqing. It's mostly successful, but not perfect. Through information collection and interviews with the project leader, the analysis of the success and existing problems of this project has important reference significance for promoting the application of PPP in MSW management in Wuhan.

4.3 Data Collection

This subchapter will further clarify the method of data collection, introduction of interviewees, interview reasons, and interview questions.

This study uses qualitative research and focuses on interviews as a data collection technique. Two experts are invited to conduct interviews. intervieweeI is the Chongqing MSW project leader from the private enterprise WTT, and intervieweeII is the Wuhan MSW project leader from the government. I had a one-on-one conversation with them on the topic of MSW management in Wuhan and Chongqing. The reason for choosing the interview is that on the one hand, from the perspective of government officials, we can understand the deficiencies of government internal management and how to carry out improved policies. On the other hand, from the perspective of private enterprises, we can understand the cooperation attitude and purpose of enterprises The in-depth interviews with the experts allowed me to better understand the background of the PPP MSW project, the potential motivations, attitudes and purposes of cooperation between the two parties on MSW public-private cooperation issues. The interview is divided into the following four parts, environmental factor, government factor, project factor and market structure factor. The question will also revolve around the above four factors. Taking the success or failure of the PPP project as the dependent variable, Thematic analysis will be used to analyze my interview data. Finally, screen out the six variables that most affect the success or failure of PPP projects.

Interviewer	Position	Time &Location	Reason
Interview I	Managing Director of China, WTT Waster Treatment Technologies Company & Chongqing Tongxin PPP project leader	Online interview 19th, August 2022	*As the head of WTT in China, he has rich experience in PPP projects. He will share the successful experience of the MSW Tongxin Project from the perspective of private enterprises. *He also knows about the Wuhan MSW PPP project, but WTT did not participate in the bidding, which is one of the reasons why I want to interview him.

Interview II	Wuhan Municipal officer Wuhan MSW PPP project government leader	Online interview 16th, September 2022	As the municipal government leader of the Wuhan MSW PPP project, he will share the successful experience and shortcomings of the Wuhan Project from the perspective of the municipal government *He will also express his views and opinions on the MSW PPP project in Wuhan

4.4 Data Analysis

Thematic analysis will be used to analyze my interview data. Thematic analysis refers to summarizing the collected text content (such as interview content) to extract some themes (Bryman 2012). After one-on-one interviews, data were analyzed following the guidelines of Braun and Clarke (2006). This analysis has an overarching theme: "What are the Success Factors of Municipal Solid Waste (MSW) Management?", and four interpretive themes. I examined the codes, some of which clearly grouped into a theme. For example, the following four codes can be summarized into “The Project Background Environment” theme.

•The economic development level of the project location

• The natural ecological environment of the project location

• The project operation experience

• The attitude of surrounding residents

A list of the themes and codes is shown in table 4.1 below

What are the Success Factors of Municipal Solid Waste (MSW) Management?	
Interpretive Theme	Codes
The Project Background Environment	• The economic development level of the project location • The natural ecological environment of the project location • The project operation experience • The attitude of surrounding residents
Government	• The government's regulatory capabilities & experience • The government's financial capacity • The project's administrative risks • The policy input & the cross-administrative levels
Project Characteristics	• The adjustability of the project contract • The technical complexity and difficulty of the operation • The profitability of the project • The advanced level of project technology
Market Structure	• The private company's leadership in the market • The private company's financial capacity • The private company's industry reputation

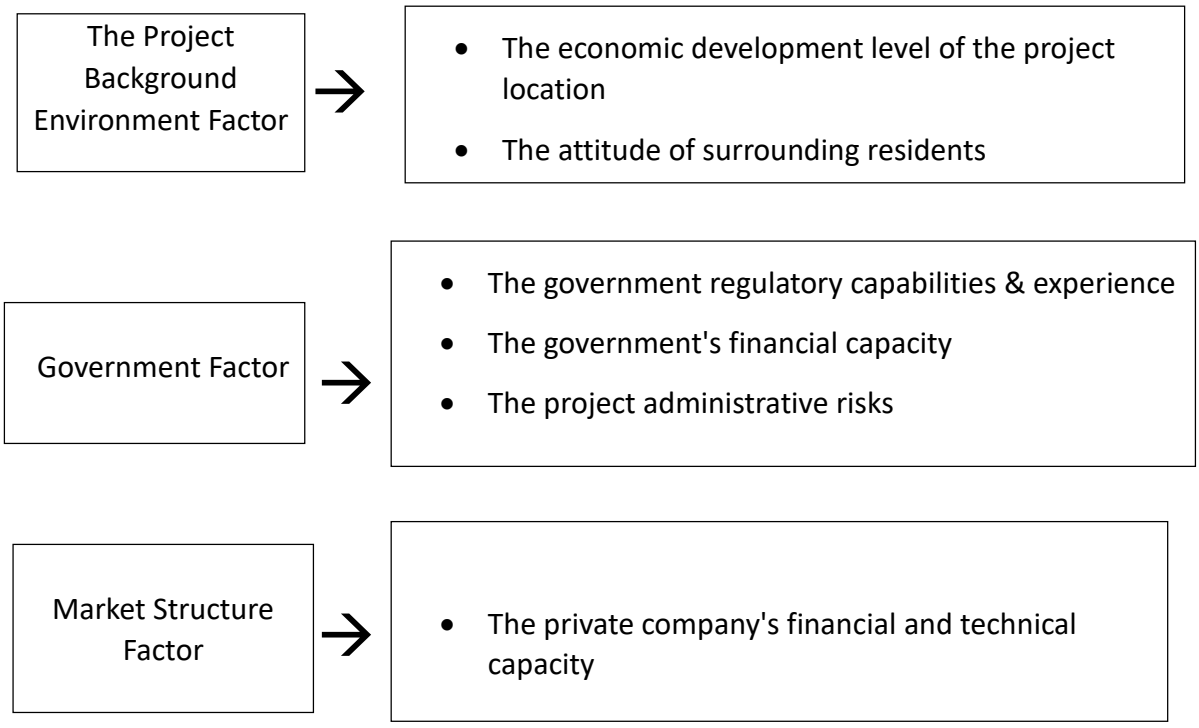
4.5 Data Operationalization

Although the above variables (codes) in Table 4.1 all have an impact on the four factors (Themes). But I reviewed and researched each transcript, then modified and developed the preliminary themes. I found that the preliminary theme “Project Characteristics” doesn't really work in this case. There isn't much data to support it and it overlaps with coding "Private Companys' Financial and Technical Capabilities" in the theme "Market Structure". The reason is the interviewers believe that if the company can successfully bid, it proves that the company has the financial and technical capabilities to undertake the project, and the difficulty of the project itself is not a problem. Coding "The adjustability of the project contract" can be integrated into the coding of “The Government Regulatory Capabilities & Experience in the theme "Government".

So I made some changes in this stage:

- I eliminated the “Project Characteristics” theme.
- I integrated coding “The adjustability of the project contract" into the coding of “The Government Regulatory Capabilities & Experience in the "Government" theme.
- I integrated the three preliminary codes into one code "The private company's financial and technical capacity" in the “Market structure” theme

Eventually, I filtered out the 3 themes and 6 codes that are most relevant or specifically address my research question "Factors that most influence the success or failure of the Wuhan MSW PPP project". (A list of the themes and codes is shown in table 4.2 below)



4.6 Reliability and Limitation

Reliability and Validation

This study mainly uses one-to-one interviews, two interviews will be conducted, interviewee I is the Chongqing MSW project leader from the private enterprise WTT, and interviewee II is the Wuhan MSW project leader from the government. First of all, the identities of the interviewees are the leaders in charge of the project, and their answers are professional and authoritative. interviewee I, as the leader of a private enterprise project, shared his work experience and opinions on the government. Interviewee II, as the government of the project leader, shared the contradictions and difficulties in the cooperation between the government and private enterprises, as well as improved policies. Their answers can provide an effective reference value for future PPP projects. Secondly, the interview method can obtain more real information. I use online interviews to communicate with the interviewees face-to-face so that they can have appropriate guidance and opportunities for further questioning and can explore some in-depth issues. In addition, I can observe the interviewee's facial expressions, movements, and other physical behaviours to understand the interviewee's state of mind at that time. The interview method can more directly understand the attitudes, opinions, and motivations of both public and private parties. Finally, Thematic analysis will be used to analyze my interview data. Thematic analysis can help me classify useful data in a large amount of interview data, and then filter out more accurate ones that can be used to explain and understand my research topics.

Limitation

This research, however, is subject to several limitations. First, the sample size of this study is relatively small, and only two project leaders were interviewed. Although the authenticity of the interviews is high, due to the small sample size, it is challenging to find significant connections in the data. Wuhan and Chongqing are adjacent to each other and have the similar natural environment and cultural and economic conditions, so the research results can be shared to a certain extent. However, if the research results are applied to other cities in China, there are certain limitations. Second, due to the limitations of sample features: the Chongqing Tongxin PPP project started ten years ago and has already had ten years of successful operation experience. The Wuhan PPP project happened to start a year before COVID-19. COVID-19 can be a disruption item, COVID-19 has led to the Chinese government's reaction, economic and political situation, legal and labour policy changes. These will affect the fairness of the data Third, the interviewer bias, interviewers come from two parties, leaders of government departments and leaders of private enterprises. Due to their different identities, their statements may not be neutral. They will be biased against certain phenomena, and the

published content is not objective enough, thus affecting the credibility of the data.

Nevertheless, the results of this study still can be generalized to similar MSW PPP projects. This study applies the theory of "PPP" to the field of urban sanitation, providing an empirical opportunity to promote the marketization of MSW management and the sustainable development of the pollution control industry, which will provide effective decision-making reference for the Chinese public sector to formulate special PPP regulations and related policies.

5. Research Findings and Analysis

1. The Environment Factor: The Local Economic Development Level

MSW PPP projects are affected to a certain extent by the local economic development level of the project. If the local economic development level of the project is high, the project is easy to succeed and has a positive impact. Generally speaking, the higher the level of economic development where the project is located, the more robust the service market for PPP projects will be.

IntervieweeII is the government leader, he mentioned that one of the important reasons why the Tongxin PPP project can be carried out smoothly is that "*Chongqing is at the forefront of urban development in China. The advantage is that the city has many foreign-funded enterprises and private enterprises with strong strength and capacity and equipment. The government also encourages the development of the private economy.*"

For example, in terms of financial services, in more developed cities, asset liquidity is stronger, and financial management and financing channels are also stronger than in underdeveloped cities, which relatively reduces financing risks for the operation of PPP projects.

IntervieweeI is a Managing Director of China from WTT Waster Treatment Technologies Company. He is in charge of the private enterprise of the Tongxin PPP project. He said, *"If the local government has enough capacity, they will cooperate with foreign-funded enterprises with first-class technology and equipment, such as WTT. In areas with better local economic development, the development of PPP will be smoother because of government funding and support. The government will have good subsidies and tax rebate policies to attract private companies to invest in waste recycling projects"*

In terms of legal services, interviewee I said "*We mainly provide technical equipment and operational knowledge. We usually find a third-party company as an agent to complete the government approval and legal procedures. It is easy to find an agent in a big city like Chongqing and they are efficient. But if it is a remote city, we have to deal with the approval and legal formalities ourselves, which we don't want to take the time to do*". As we can see

that the developed cities quickly implement relevant laws and regulations in the field of waste disposal and can provide more legal advisors and consultations. In remote cities, the legal construction and legal service market are relatively weak.

In terms of human resource services, large cities have a large population and relatively more concentrated talents, which can provide more labour and management and technical talents in related fields for the development of PPP projects. As interviewee II said, *"Chongqing has a population of 32 million, has sufficient labour supply, and is enjoying a demographic dividend"* And in terms of the particularity of the waste treatment field, first of all, the developed cities have a relatively large population and a relatively high demand for domestic waste treatment. This provides a good operating environment and market for the development of PPP projects. Secondly, developed cities have an earlier treatment of waste than underdeveloped cities. Relatively speaking, the technology and management level of domestic waste treatment is also higher. In addition, from the geographical distribution of MSW PPP projects, it can be clearly seen that there are far more PPP projects in developed cities than in underdeveloped cities.

Cities	GDP in 2020 (trillion yuan)
Shanghai	3.870
Beijing	3.610
Shenzhen	2.767
Guangzhou	2.502
Chongqing	**2.500**
Suzhou	2.017
Chengdu	1.772
Hangzhou	1.611
Wuhan	1.562
Nanjing	1.482
Tianjin	1.408
Ningbo	1.241
Qingdao	1.240
Wuxi	1.237
Changsha	1.214
Zhengzhou	1.200
Foshan	1.082
Quanzhou	1.016
Jinan	1.014
Hefei	1.005
Nantong	1.004
Xi'an	1.002
Fuzhou	1.002

Data excludes Hong Kong SAR, Macao SAR and Taiwan.
1 trillion yuan is about $145 billion.
Source: Local bureaus of statistics

CGTN **Source: CGTN China Global Television Network**

The economic development level of the project location has a positive impact on the PPP project. Although it cannot be said that PPP projects must be invested in economically developed areas in order to be successful, however, the above interviews show that the higher the economic development level of the project location, the sounder market and favourable environment provided for the operation and development of the MSW treatment PPP project,

the more conductive to the success of the PPP project. This proves that the higher the economic development level of the project location, the more vigorous the service market of the PPP project, and the easier it is for a PPP project to succeed and have a positive impact.

The Project Background Environment		
	Chongqing	Wuhan
The economic development level of the project location	High (Top5 in China)	High (Top 10 in China) Lower than Chongqing

2. The Environment Factor: The Attitude of Surrounding Residents

The intervieweeI *told us that the garbage recycling stations are generally located in very remote places, to avoid disputes with residents to the greatest extent. Because once residents complain, this project will be suspended, and the government needs to come forward to coordinate management. The most extreme situation is that we may have to change places to build factories. This is something we don't want to see, because the previous efforts will be in vain, and time and money will be in vain.*

The project government leader interviewee II also mentioned that there are many cases of project failure or delay due to public opposition in Wuhan. *"In 2019, several days of street protests against the waste incineration plant project broke out in Wuhan, China. The demonstrations brought thousands of people to the streets, and the local government was forced to reassure residents that there were no immediate plans to build the facility. While authorities in Wuhan blocked further protests, the local government was trying to reassure residents that their voices would be heard"*

As we can see that if the residents are satisfied with the acceptance, the project is easy to succeed, which has a positive impact on the success of the PPP project. If there is no advanced technology in waste treatment, especially in waste incineration power plants, "dioxins" may be produced, which will pollute the surrounding environment and cause problems for the surrounding residents. Therefore, the site selection of the waste treatment plant must take into account the interests and wishes of the residents.

In addition, as one beneficiary of the garbage disposal service, residents also need to pay a certain amount of garbage disposal fees. If the surrounding residents have a supportive attitude towards the implementation of the garbage charging system, then the PPP project is more likely to be profitable, which will have a certain role in promoting the PPP project.

MSW PPP projects are greatly affected by residents' acceptance. The higher the residents' acceptance and satisfaction with MSW management and charging system, the easier it is for PPP projects to succeed.

The Project Background Environment		
	Chongqing	Wuhan
The Attitude of Surrounding Residents	High support rate	Some residents objected, leading to delays in the project

3. Government Factor: The Government's Regulatory Capacity

The intervieweeI states that *"The Tongxin PPP project had a special team from the Chongqing government to participate in the project evaluation. The government is not involved in the design, but the government is involved in project approval and supervision. The enterprises will be given autonomy, the premise is that they comply with laws and regulations. For example, in the early stage of the project, environmental impact assessment, risk assessment, planning permit, and business permit will be carried out. In the later stage of the project, wastewater, waste gas, solid waste, hazardous chemical discharge, production safety, and tax payment will be supervised."* It can be seen that the Chongqing government does not participate in the profit distribution of the project, but the Chongqing government has a series of complete supervision plans to ensure the normal development of the project. Private enterprises operate independently and are responsible for their own profits and losses.

The intervieweeII agreed *that Municipal waste treatment should be a low-profit business. If the government participates in profit sharing, it will affect the enthusiasm of enterprises to* participate. He also *emphasized that "Government regulations is very important, but due to the outbreak of Covid-19 in 2019, the Wuhan government had to re-allocate some manpower, material and financial resources to fight the epidemic. As a result, there were not enough funds to support the development of the MSW project, and not enough human resources to supervise the follow-up development of the project, so Wuhan's MSW project is very slow and inefficient."*

The government's responsibilities in PPP projects are more of a regulator, and there are still many loopholes in the MSW industry that require mandatory government management. If the government can formulate relatively complete laws and regulations for PPP projects, and each department performs its own duties and responsibilities clearly, it can do a good job of regulation while not overstepping management and interfering too much with private enterprises. Even better, if the relevant government departments have certain operating experience in domestic waste PPP projects, they will provide an effective internal management mechanism for the development of PPP projects.

As we can see that the MSW PPP projects are greatly affected by the government's regulatory ability. The stronger the government's regulatory ability, the easier it is for the project to succeed, which has a positive impact on the success of the PPP project

Government Factor:		
	Chongqing	Wuhan
The Government's Regulatory Capacity	Sufficient	Insufficient

4. Government Factor: Government Administrative risks

Both the interviewees I and II state that "*the complicated administrative bureaucratic procedures will indeed delay the progress of the project. The garbage recycling project requires a lot of cross-administrative approvals, and many documents need to be signed. This will affect the progress, but it is also necessary. These procedures may take a year to complete. In case of a lack of materials, there will be resubmission for review risk, the efficiency is definitely not high Changes in the leadership will definitely affect the progress of the project. If the leadership changes, different leaders have different opinions, and there is a risk of re-approval, which will delay the development of the project*"

IntervieweeI states *that the approval process of the SMW project in Chongqing was very smooth, and all procedures were completed on time, so the project can be carried out smoothly on time.* IntervieweeII states *that the administrative bureaucratic procedures in Wuhan are a bit complicated, and the approval process is a bit slow, which really delayed the development of the project. Fortunately, the final procedures have been passed, and everything is slowly on the right track.*

Since the general contract period of MSW PPP projects is relatively long term, when the government administrative risk is relatively high, such as when there is a change of leadership during the project implementation process, the relevant policies of the PPP project may also change, and the relevant personnel in charge may change. It may bring obstacles to the implementation of the project, or the relevant policies and contracts are not stable enough, and the phenomenon of rapid changes will lead to a decrease in the credibility of the government, and it will not be easy to attract private enterprises to cooperate, resulting in the failure of the project.

MSW PPP projects are greatly affected by government administrative risks. The greater the administrative and financial risk of the government, the more likely the PPP project will fail, showing a negative effect.

Government Factor		
	Chongqing	Wuhan
Government Administrative risks	Sufficient	Insufficient

5. Government Factor: The Government's Financial Capacity

Fiscal risk, that is, whether the government can grant relevant capacity to the private sector in accordance with the contract is an important factor in the success of PPP. The difficulty for private enterprises is the financial pressure. The government may default on garbage subsidies and tax rebates.

Both interviewee I and II state that *"The Chongqing government has very good preferential policies in terms of tax rebates and subsidies. Many tax rebates can be obtained in terms of environmental protection. This is called the environmental regeneration tax rebate. High-tech enterprises will also have preferential policies and tax-free policies. There is also a subsidy for garbage recycling."*

As far as China's garbage disposal industry is concerned, due to its strong public welfare and the concept of garbage payment has not been fully promoted, completely leaving the waste treatment to the market for development may lead to an unbalanced service supply or a lack of service supply due to poor profitability. Therefore, the government's support, such as the government's investment in the early stage of the project, the government's preferential tax policy for private enterprises during the project operation, and the subsidy policy for urban low-income residents are all important factors for the success of PPP projects.

Interviewee I mentioned that *they have PPP projects in other cities. A government with poor financial resources may default on waste subsidies and tax rebates. For example, according to the plan, the subsidy was given to 1000RMB, Per ton, but only 800RMB, Per ton was given. It should be paid once a month, but it turned out to be paid every three months. This will lead to the collapse of the capital chain of private enterprises. In addition, bureaucratic procedures are very time and money-consuming. If the government can provide long-term financial guarantees and implement more preferential policies, it will attract more high-quality enterprises. Moreover, the waste treatment industry is still in the initial stage of marketization. If the government cannot guarantee financial support, the possibility of project failure is high.* He also explained that *WTT did not participate in the bidding for the MSW project in Wuhan because it considered the financial situation of the local government. "We are worried that*

during the Covid-19 epidemic, the Wuhan government cannot guarantee long-term financial support, and there is no attractive tax rebate policy and subsidy. So we did not participate in the bidding for the Wuhan MSW project."

MSW PPP projects are greatly affected by the government's financial affordability and financial risk control ability. If the government has a strong financial capacity, the project is easily succeeded. The government's financial capacity here mainly refers to the capacity that the government has invested in the development and operation of PPP projects and the capacity that can be invested. The stronger the government's financial capacity, the greater the chance of a project's relative success.

Government Factor		
	Chongqing	Wuhan
The Government's Financial Capacity	Sufficient	Insufficient

6. Market Structure Factor: The Strength of Private Enterprises

Interview I state "WTT is a global leader in MSW technology and solutions. We have completed nearly 130 projects around the world and achieved good results. We are among the top three in the world in terms of urban waste recycling and processing technology. Our equipment is imported from the Netherlands or Germany. We also have advanced technology and services. We have strong capacity and market competitiveness, which makes the Chongqing government more inclined to cooperate with us as a high-tech enterprise."

As one of the project participants, a private enterprise, when it has large capacity strength, is in a leading position in the industry and possesses advanced technology and management level, is of great help to the operation of PPP projects. A competitive private enterprise, relying on its sensitivity and familiarity with the market, can better participate in the PPP project to market waste industrialization. Especially in the franchise mode of waste treatment plants, the management and operation mode of private enterprises will affect the success or failure of the project company and whether it can provide high-quality services to meet the needs of the public.

MSW PPP projects are affected by the strength of private enterprises. The stronger the strength of private enterprises, the easier the project is to succeed.

Market Structure Factor		
	Chongqing	Wuhan
The Strength of Private Enterprises	Foreign-funded & high-tech enterprises, the global leader	Chinese private enterprises with medium capacity and technology

Through interviews and case analysis, 6 significant variables were finally screened out: **(1)** The level of local economic development of the project, **(2)** Resident acceptance, **(3)** Government regulatory ability and experience, **(4)** Government Administrative risk, **(5)** Government financial tolerance and financial risk Control ability, **(6)** strengths of private enterprise.

These 6 variables will have a significant impact on the success or failure of China's MSW management PPP projects. An MSW PPP project with a high level of local economic development, low administrative risk, strong financial tolerance, strong financial risk control capability, strong government management capability, satisfactory residents' acceptance, and strong private enterprise strength is easy to succeed; otherwise, it is easy to fail.

6. Discussion and Conclusion

This paper is to study what are the success factors of using the PPP model to manage municipal solid waste in China. The purpose is to help the Chinese government successfully cooperate with the private sector in waste outsourcing projects. This study takes the PPP MSW project in Wuhan, China as a case study and adds a successful MSW PPP project of the Tongxin Waste Treatment Plant in Chongqing city as a comparative case for interview analysis. It is based on the public product theory, market failure theory, and market economy theory, combined with existing literature reviews and interviews on PPP projects. The main research method is a comparative case study by interviewing the projects' leaders. Thematic analysis will be used to analyze my interview data. Through interviews and case analysis, 6 significant variables were finally screened out. An MSW PPP project with a high level of local economic development, low administrative risk, strong financial tolerance, strong financial risk control capability, strong government management capability, satisfactory residents' acceptance, and strong private enterprise strength is easy to succeed; otherwise, it is easy to fail.

This chapter discusses the establishment of institutional and legal systems for related industries, as well as the utilization and management of waste resources. Put forward some

opinions and relevant suggestions for the sustainable development of the MSW management industry.

6.1 Recommendation

1. Improve laws, regulations and incentive mechanisms, and strengthen government management

At present, due to the immature development of China's market economy, Chinese PPP projects generally still need proper guidance from the government. MSW is a public utility that is closely related to people's lives. There will be market failures if it is completely dependent on the market. The government's regulatory capacity plays an important role in the healthy development of PPP in MSW management. Without strong government control, the private sector will likely expand its own benefits at the expense of the public interest.

On one hand, China currently lacks laws specifically applicable to PPP, which brings a lot of inconvenience to the government's management, reduces the enthusiasm of participants to participate, and causes certain obstacles to the promotion of PPP. Therefore, it is necessary to improve the content of relevant laws and regulations to allow the healthy development of MSW management. On the other hand, the current awareness of environmental protection among Chinese residents is not high. The government can increase the cost of waste generation through taxation and charges, and guide residents and producers to reduce waste discharge. The key is to establish a reasonable domestic waste charging mechanism. The affordability of the public should be taken into consideration, and a reasonable income should also be ensured. Especially for some low-income groups, the government can consider appropriately reducing or exempting their garbage disposal fees to avoid causing too much burden on their lives.

2. Improve government organizational structure and reduce administrative risks

Administrative risk is also a reason that cannot be ignored. This has a negative effect on attracting the entry of private enterprises and also has a negative impact on the advancement of the PPP project itself.

As for how to reduce government administrative risks, we can start with the relevant organizational structure of the government. First, a special agency should be set up to be responsible for the implementation of PPP projects, to prevent the occurrence of unclear responsibilities of multiple management. In view of the risks brought about by the change of government, the relevant supervision and discourse rights of specialized agencies can be reserved. In addition, the contract system can be used to guarantee it. These can reduce PPP project failures due to regulatory confusion.

3. Adopt reasonable subsidy methods to ensure the source of funds for PPP projects

Reliable funding sources for PPP projects are a major factor in ensuring the smooth progress of PPP projects.

First of all, when the government invests in PPP projects, it must have a reasonable and practical budget and evaluate the projects. Prevent project interruption due to insufficient financial capacity, or the shortage of funds caused by excessive project losses. Secondly, reasonable subsidies can be given to private enterprises participating in MSW management and more high-quality private enterprises can be attracted to join the PPP projects.

Due to the different local conditions of the MSW management PPP project, the government can also provide different subsidy methods accordingly. For projects with higher initial construction costs, the government can make some investments in auxiliary facilities, such as investment in technology and equipment for waste incineration power plants. For projects that require government support during the operation period, the government can promote project operation through high-priced recycling and low taxes and fees, such as high-priced recycling of waste incineration for power generation, resource utilization of kitchen waste, etc.

4. Strengthening the role of private enterprises in PPP projects

Private enterprises are important participants in the marketization of waste management. Firstly, the government can provide appropriate policy guidance to encourage more private enterprises to enter the field of waste management and provide support for advanced technologies of private enterprises in related fields. Secondly, in the process of bidding for private enterprises, the government should pay attention to the strength of participating enterprises to prevent low-quality private enterprises from winning bids by relying on price advantages. Thirdly, driven by market interests, private enterprises sometimes reduce service levels in order to maximize profits. At this time, the government should formulate standards for the quality of waste disposal by private enterprises, supervise according to the standards, and punish violators severely. The government can establish an assessment and evaluation system for private enterprises. This has a certain indication effect on private enterprises to achieve the expected effect of waste disposal. It can guide the behaviour of private enterprises more effectively, and also provides certain standards for government regulation.

5. Increase public acceptance of the MSW PPP project

First of all, the basic rights and interests of the people must be protected. When selecting a site for a waste treatment plant, full consideration should be given to its impact on residents' lives and health, and it is necessary to consider the project's public welfare while considering

the project's profitability. Secondly, in terms of cultivating residents' environmental awareness and habits, it is necessary for the government, schools, radio and television, newspapers, media, and communities to properly publicize the classification and disposal of domestic waste.

As an important part of social members, residents must be aware of the impact of their behaviour on the environment and should consciously make certain efforts for environmental protection.

6.2 Limitation

There may be some possible limitations in this research. Firstly, this study is limited to some time constraints. The data for this study were collected from August to December 2022, which coincides with the transition period of the market-oriented reform of environmental sanitation services by local governments in China, especially in the central and western regions (including Wuhan and Chongqing). There are no specially formed and standardized cities to learn from, and many imperfect places still need to be further optimized and improved. For MSW PPP projects, continuous research is needed, because there will always be new data and social issues, and the data limitations and new social issues will pose another challenge. Secondly, the interviews in this study have certain limitations. The sample size of this study is small, two project leaders were interviewed. Despite the high degree of authenticity of the interviews, finding significant connections in the data was limited due to the small sample size. Wuhan is adjacent to Chongqing, and the research results of small samples can be shared to a certain extent. However, if the research results are applied to other cities in China, there are certain limitations. In addition, due to the limitation of sample characteristics, the Chongqing Tongxin PPP project started ten years ago and has ten years of successful operation experience. The Wuhan PPP project started exactly one year before COVID-19. COVID-19 may have been a disruptive item. It has resulted in changes in the Chinese government's reaction, economic and political situation, laws and labour policies. These will affect the fairness of the data. Thirdly, the bias of the interviewers. The interviewers came from two parties, leaders of government departments and leaders of private enterprises. Due to their different identities, their speeches are inevitably more inclined to the positions they represent, and their speeches may not be neutral. They will be biased against certain phenomena, and the published content is not objective enough. The collected data is highly subjective, which will affect the accuracy and credibility of the data. Finally, due to the limitations of my professional knowledge and experience related to the MSW industry, some questions during the interview may not be professional enough, and I have not been able to dig deeper into the views of the interviewees. The interaction with the interviewees to get more ideas is limited. In addition, the data collected may be based on personal opinions, which has a certain degree of subjectivity and

affects the accuracy of the data. Future research can be carried out from these directions. The Chinese government is encouraging and promoting PPP projects to participate in local government infrastructure projects, and the market-oriented reform of sanitation services is developing. The popularization and development of MSW PPP can be used as a future research trend. This study is a qualitative study with comparative cases, which can be developed into a comprehensive quantitative study in the future. Future research can use questionnaires to collect data among citizens. Increasing the number of samples can eliminate people's prejudice and subjective consciousness to a certain extent. A sufficiently large sample can ensure statistical power and survey credibility. Besides the opinions of the government and contractors, the opinions of the third-party citizens can reflect in the results of the questionnaire which PPP projects generate good responses and which PPP projects lead to negative perceptions. Statistical tests can be used to quantify and analyze survey results and then make statistics and predictions. Citizens' opinions can also be used to understand the direction of improvement and expansion of MSW PPP in the future.

6.3 Conclusion

The market-oriented reform of environmental sanitation services by local governments in China is still in a transition period, and many imperfections still need to be further optimized and improved. The conclusions of this study are as follows: firstly, based on the theory of public goods, market failure, and market economy theory, MSW management has certain consumption exclusivity and competition. It is completely feasible and necessary to adopt the PPP model. PPP serves as a bridge connecting the public and private sectors, which can use the market economy to improve the operational efficiency of MSW projects while reducing the government's financial burden on the project. Secondly, the government still plays an important role in the PPP development of China's current MSW industry. The initial growth of PPP requires strong support from the government, which not only requires more funds and policy support from the government, but also requires the government to continuously improve management functions, improve credibility, reduce administrative risks, enhance the government's governance capabilities, and long-term financial security capabilities. Thirdly, private enterprises are important participants in the marketization of waste disposal. The strength and market reputation of private enterprises is very important. Private enterprises must enhance their professional capabilities and competitiveness, and they must also improve their credibility among citizens. Finally, as a public utility, MSW also needs to take into account public participation and support. As a public utility, MSW also needs to consider public participation and support. Increase publicity efforts to cultivate residents' environmental awareness and garbage sorting habits, and let residents participate in the management and supervision of garbage disposal.

MSW management is a typical public utility, and the leading role of the government is irreplaceable. The PPP model is an important and effective supplementary model. With the improvement of China's public utilities and sanitation systems and the improvement of citizens' quality, the public-private partnership model will be the future development direction of urban domestic waste management. Through public-private cooperation, make full use of the capital, technology, and management advantages of private enterprises, combined with government regulation and control, to achieve optimal allocation of resources and maximization of total social welfare. Encourage the public to actively participate and supervise, and realize the "reduction", "recycling" and "harmless" of MSW management to meet the public's ever-increasing living environment requirements and the sustainable development of the city.

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8. Appendices

8.1 Interview I

Interviewee: Mr Liang Jiayun, head of the PPP project of Chongqing Tongxin Waste Incineration Power Plant, and general manager of Waste Treatment Technologies(WTT) China
Time: 19th, August 2022
Location: Online Interview

Yulan: Good morning, Mr Liang, thank you very much for accepting my interview during your busy schedule. Our interview today is mainly about WTT undertaking a PPP urban waste recycling project in China. My purpose is to collect information on the success and failure factors of the PPP project. Before I start my question, can you briefly introduce yourself and the company Waste Treatment Technologies (WTT)?
Mr Liang: Good morning, my name is Jiayun Liang. I graduated from Erasmus University with MBA in 2017, and then joined Waste Treatment Technologies (WTT), a Dutch company. WTT is a multinational company headquartered in the Netherlands. WTT has advanced municipal waste recycling and processing equipment and technology. Our goal is to form a partnership with the local government and community to maximize the use of waste to recycle into fuel, reduce pollution to the surrounding environment, and support sustainable development. We have carried out more than 130 waste recycling projects around the world.
In 2017, WTT was participating in a bidding activity for a PPP waste recycling project located in Chongqing, China. I participated in the bidding activity for the entire project, helped the company get the project, and then participated in the contract negotiation and the pre-construction of the project. At that time, WTT also intends to set up a branch in China. I am from Shanghai, so at the end of 2017, I went back to Shanghai to help the company establish a branch in Shanghai China. At present, I'm the head of WTT China branch, responsible for WTT's entire business in China. The Chongqing Tongxin PPP project was the first project I participated in, and it was also the first PPP project I participated in after the establishment of the Chinese branch.
As a multinational company headquartered in the Netherlands, WTT set up a branch in Shanghai as its headquarters in China. Later, we also did a project in Shanghai, we also have projects in Chongqing in central of China and Hebei province in the north of China, and our business is slowly expanding to the whole of China. The main business is to convert municipal waste into green fuel.

Yulan: Could you please introduce your company's urban waste treatment business in China, is it compost bio-drying, renewable resources or thermal energy? Do you have your own equipment and workshop in Shanghai (if you can provide publicity materials about your business, please send an email to me).

Mr Liang: The main business of WTT is to convert municipal waste into green fuel. Our company mainly provides design, equipment, installation, commissioning and maintenance. After completing the above content, it will be delivered to the owner. The factory is owned by the owner, and finally, the equipment and technology are sold to the owner together. Most of the equipment and technology are imported from the Netherlands, we are a turnkey project.

Yulan: Next I have some questions about the Chongqing Tongxin Municipal Solid Waste Recycling PPP project. I will start with four project background modules: the government module, the environment module, the project module, and the market module. Let's start with the government section.

Government Modules:

Yulan: I'd like to know why the government decided to carry out this public-private partnership project?

Mr Liang: Because at that time, the Chinese central government encouraged first-tier and second-tier cities to develop domestic waste treatment projects. China's central government has the 13th Five-Year Plan, and each local municipal government also has a five-year plan, which includes a plan to develop green waste recycling projects. Chongqing is a municipality directly under the central government. According to the 13th Five-Year Plan of the Central Government, Chongqing, as a first-class city, must build its own waste treatment project, and establish and improve the project of urban waste recycling.

Local governments will cooperate with private enterprises in the form of bidding, which can be foreign-funded enterprises or state-owned enterprises. The technology and equipment of foreign-funded enterprises are advanced, but they are also relatively expensive. However, if the local government has average financial strength, they will choose State-owned enterprise cooperation. If the local government has enough funds, they will choose to cooperate with foreign companies with first-class technology and equipment, such as WTT.

In areas with better local economic development, the development of PPP will be smoother, because there is government funding support. But on the other hand, if the local economy is not very developed, the addition of social capacity can reduce the burden on the government, and actually give more opportunities for the development of social enterprises. Social capacity will 100% fund the management and operation of waste recycling projects and be responsible

for their own profits and losses.

Yulan: How did WTT compete for this government sanitation project? Is it through bidding? Is it a government franchise? Is this an outsourcing contract with the government? Long-term or short-term, how long does it usually take?

Mr Liang: WTT got to this project through bidding. The Chongqing Municipal Government attaches great importance to this project and has sufficient financial support. They hope to build an advanced green municipal waste recycling plant to support the sustainable development of the city. WTT's technology and equipment meet the requirements of Chongqing's development and finally won the project through bidding. This is a city government outsourcing project, and the time is 30 years.

Yulan: After WTT got the sanitation project of Tongxin municipal waste recycling, did the government provide financial support (investment)? Will the government share the project benefits (profits) and will the government share the risks?

Mr Liang: For example, the Tongxin project has a duration of 30 years. The construction period is two years, the operation right is 28 years, and it will be returned to the government after 30 years. The government contributed 10%, and WTT investors contributed 90%. Investors can be multiple companies, or they can be exclusive. The government can also not invest, so it requires 100% investment in social capacity. Profit distribution and investment risk are calculated according to the proportion of investment.

Yulan: Has the government participated in the design, planning, plant construction, equipment operation and maintenance of this sanitation project?

Mr Liang: The government generally does not participate in the design and planning of sanitation projects, but will evaluate the design, planning, and environment, and assess the feasibility of the PPP project.

Yulan: Does the government have a professional leadership team (or individuals) to participate in and support this project? Could you briefly introduce this government leadership team? Do they have the expertise to participate and have an opinion on the design plan, or do they just play an oversight role on behalf of the government?

Mr Liang: The Tongxin PPP project had a special team from the Chongqing government participate in the project evaluation. The government did not participate in the design, but the government participated in the project approval and supervision. Private enterprises need to submit various feasibility reports to the government when bidding, including technical

feasibility reports and economic feasibility reports such as sanitation design, planning, site selection, equipment reports, etc. In addition, there is an environmental assessment report. For example, the location of waste recycling sites is a more troublesome problem. The sites are generally located in the suburbs, and they need to be assessed by the Ecological Bureau and the Environmental Protection Bureau. Private enterprises need to make an environmental assessment report and submit it to the Environmental Protection Bureau. List various indicators, such as odour concentration sewage discharge, will it pollute the surrounding environment and affect the lives of residents. If all passed, then it will be publicized, the public announcement usually lasts for one or two weeks, mainly to see if there is any public protest. If the feasibility report, environmental assessment report, and public announcement are all passed, then the formal procedures can be followed, and the project can be carried out after the documents are approved

Yulan: I'd like to know the administrative risks of investing in this project at that time. For example, did the leadership change? Will the complicated administrative bureaucracy delay the project's progress? How did you overcome the administrative difficulties?
Mr Liang: This can be divided into two situations. When the project has been approved and the construction or operation is started, if the government does not contribute, but 100% of the capacity is contributed by the private entrepreneurs, then the private entrepreneurs will make independent profits and losses.
However, if there is government funding, such as 10%, there will be some administrative risks. For example, the budget is low. For example, the original budget of 50 million RMB is actually needed 70 million. This project needs to increase capacity, and then the shareholders have different opinions, If you are unwilling to increase capacity, the government needs to coordinate and let the project continue at this time.
Leadership changes will definitely affect the progress of the project. If the leadership changes, different leaders have different opinions, which will also delay the development of the project. Because the development or update of the project requires approval, the document approval requires the signature of the leader. If the project changes, it will need to be re-interpreted and approved. If the signature is not obtained, the project's progress will be delayed. If there is a change in the leadership, it will be more troublesome. Maybe some verbal commitments will be voided. Documents need to be submitted again for approval and signature. There is a risk of re-approval when the leadership changes. These are all uncertain factors.

Yulan: What policies did the local government (such as Chongqing Municipality) invest in supporting the project at that time? Did the project implement preferential policies, such as

subsidies for renewable energy? Could you tell us about the government's preferential policies?

Mr Liang: The project of garbage recycling is mainly tax concessions. Generally, there will be tax rebates at the end of the year, and many tax rebates can be obtained in terms of environmental protection. This is called the environmental regeneration tax rebate. High-tech enterprises will also have preferential policies and tax-free policies. There is also a subsidy for garbage recycling. For example, there will be a subsidy of 100RMB for processing one ton of garbage, but this is a very small part, and the main preference is still from tax rebates.

Regardless of whether the government has invested or not, private enterprises participating in PPP projects can receive subsidies and tax rebates from the government every year. Subsidies and tax rebates are the government's policy to encourage garbage recycling and will be given. However, as for whether private enterprises can recover their capacity and make profits in this PPP project, this needs to be calculated by private enterprises themselves. Most PPP projects are self-financing.

Yulan: May I ask if the Tongxin PPP project crosses government administrative levels, and does the implementation of the project involve collaboration between different administrative levels? Will cross-administrative levels affect the progress and efficiency of the project?

Mr Liang: Yes, there are a lot of cross-administrative approvals and documents that need to be signed on the municipal solid waste project. This will affect the progress more or less, but it is also necessary. For example, the technical review application needs to be reviewed by the Urban Management Bureau and the Housing and Urban-rural Development Department. The National Development and Reform Commission will review and approve the funds of foreign companies. The Environmental Protection Bureau will review the Environment Impact Assessment report, and the site selection will also need to be checked by the Environmental Protection Bureau and the Ecological Bureau. Different documents require different departments to review and approve, and these procedures may take one year to complete. Document work takes a lot of time, and it needs to be reviewed in different parts. In case of a lack of materials, there is a risk of resubmission for review. This efficiency is sure not high.

Environment Modules:

Yulan: In your opinion, can the economic development level and urban civilization of Chongqing support the public-private partnership (PPP) project of municipal solid waste treatment? What are the advantages? What are the difficulties?

Mr Liang: PPPs are generally carried out when the local government has a financial burden. Because the government hopes to have the private capacity injection to reduce the government's financial burden. Chongqing is a big city with good economic development, but

there are many administrative regions in Chongqing, and the economic development of each administrative region is different. Some district governments will introduce PPP to reduce the government's economic burden when the economy is not very well-off.

The advantage is that PPP projects are decentralized to the administrative region and managed freely by the administrative region. For example, the administrative district of Tongxin needs to do the project of municipal solid waste project, but the district government's funds are not very abundant, so the PPP model makes this project possible, otherwise, it may be difficult for the government to complete this project without the injection of private capacity. The difficulty is the financial pressure, and the government may default on garbage subsidies and tax rebates. For example, according to the plan, the subsidy was given to 100RMB, but only 80RMB was given. It should be paid once a month, but it turned out to be paid every three months. This will lead to the collapse of the capacity chain of private enterprises. In addition, bureaucratic procedures are very time and money-consuming.

If the local government has enough capacity, they will cooperate with foreign-funded enterprises with first-class technology and equipment, such as WTT. In areas with better local economic development, the development of PPP will be smoother because of government funding and support. The government will have good subsidies and tax rebate policies to attract private companies to invest in waste recycling projects

Yulan: I'd like to know whether the project will damage the natural ecological environment of the location and whether the surrounding infrastructure is sufficient to support the project.

Mr Liang: This requires the approval of the Ecology Bureau and the Environmental Protection Bureau. Before the construction of the plant, the Ecology Bureau will tell you where the water source area and protected area are, and garbage recycling stations cannot be built. Then the Ecology Bureau circles the range on the map and tells you that you can build a factory within this range. Then you can choose a site to build a factory. Of course, you also need to check whether the surrounding soil foundation is suitable for the construction of this project. Then it depends on whether the address of the factory is far away from the surrounding residents. Because residents do not like to build a garbage recycling plant in their own living environment, it is best to keep a distance of 10-20 kilometres. These are all factors to be considered. In the end, government approval is still the main thing.

Yulan: WTT is a Dutch company and has a lot of experience in waste recycling in Europe. But after the company established a branch in China, does it have enough experience as an investment operator of the Tongxin project to carry out this project in China?

Mr Liang: We mainly provide technical equipment and operational knowledge. We have our

agency to complete the approval and procedures. We found a local third-party company as our agent to handle government formalities for us. It is easy to find an agent in a big city like Chongqing and they are efficient. But if it is a remote city, we have to deal with the approval and legal formalities ourselves, which we don't want to take the time to do. Our main task is to prepare the equipment and goods, install and debug, and then complete the construction, and then do the post-maintenance work. But what makes me feel difficult to do business in China in recent years is that it is difficult to predict cash flow. Because in foreign countries, the government or suppliers will pay on time according to the contract. However, there will be delays in payment in China. Doing so is bad for the company's cash

Yulan: What do the surrounding residents think about this project, do they understand this project, do they support and cooperate?

Mr Liang: Garbage recycling and disposal stations are generally located in very remote places, and disputes with residents have been avoided to the greatest extent. However, there are also a few cases where residents simply do not agree, thinking that garbage disposal is harmful to health. Once a resident complains, the project will be temporarily stopped, and the government needs to come forward to coordinate management. The most extreme situation is that it may be necessary to change the place to build a factory, which we do not want to see because the previous efforts will be wasted, and time and money will be wasted. The educational level of residents will indeed affect the development of waste recycling projects. Residents in areas with low educational levels and education are less willing to accept new things and are reluctant to accept new knowledge and suggestions

Yulan: Do you think the current knowledge of garbage classification in China is popular? Can residents do it? If residents can do a good job in garbage classification, will it be of great help to garbage recycling?

Mr Liang: Regarding the popularization of garbage classification, garbage classification in China is actually not good enough. Only big cities such as Shanghai, Beijing, and Shenzhen are popularizing the knowledge and importance of garbage classification. Because they are used as a demonstration city according to the requirements of the central government, the local residents of the city are still very cooperative, and the results are good.

However, the residents of many small towns do not do a good job in garbage classification and do not pay enough attention. On the other hand, China's garbage classification is not very reasonable. Residents lack knowledge of garbage classification, and sometimes they are not very cooperative. If the overall effect (from the perspective of the whole of China) is not very good. The effect we are talking about refers to the final waste recycling rate, and the degree of recycling is not very high. The main reason is that China is too big, the population is too

large, the development of each city is unbalanced, and the education level of the population is also different. These are all difficult to carry out garbage collection projects. Unreasonable garbage classification will lead to excessive use of incinerators, reduce the service life of incinerators, and increase the cost of garbage disposal. Moreover, the organic substances in garbage are not fully extracted, which is also waste.

Project Modules:

Yulan: Ok thank you. Next is the project module

Yulan: After signing the cooperation contract with the government, can the contract be adjusted? I mean can the contract be adjusted in time according to market changes during the project implementation process? Will the flexibility of the contract affect the success or failure of the project?

Mr Liang: Whether the contract can be adjusted mainly depends on whether there is this clause at the time of signing the contract. For example, when signing the contract, there is a price adjustment clause, which stipulates that the price can be adjusted every 3 years. The waste treatment subsidy was originally 70RMB, but after three years due to market changes, the 70RMB cannot cover my manpower and costs at all, and the subsidy needs to rise to 100RMB. The government will ask for a report to prove why 100RMB is needed now, and then there will be an approval process. Under normal circumstances, as long as there is this price adjustment clause in the contract, the government will not reject you. The government will promise to increase the subsidy, but not necessarily according to your request. The government may give you a subsidy of 90RMB. The government will negotiate this price adjustment with you.

Yulan: Could you please describe the technical complexity and difficulty of the operation and maintenance of the project?

Mr. Liang: Equipment and technology have a quality guarantee period. During the guarantee period, we will maintain and replace them free of charge. After the guarantee period, you will have to pay extra. In terms of technology, if there is foreign technology, then many equipment standards will be different, such as German standards and European standards, China also has its own standards, and the standards need to be unified. The method and communication may be different in handling events, so the communication cost will be higher. If foreign technology is introduced into China, it is necessary to spend time explaining the new technology to domestic technicians, providing instructions for installation skills, and conducting training to ensure that the quality of the project can be successfully accepted and that it can operate independently and safely in the future. These will also increase communication costs.

Yulan: I think profitability is one of the important factors to stimulate the enthusiasm of private or foreign enterprises to participate in the field of municipal waste management. Enterprises are aimed at realizing their own interests, while the public sector is aimed at realizing public welfare. WTT and the government have formed a public-private partnership (PPP) relationship in municipal waste management. Do you think the profits of this PPP project are sufficient to meet the interests of WTT? Will WTT continue to participate in similar PPP projects in the future? From a WTT perspective, what improvements do you think the government needs to make (does the government over-regulate? Is the government investment fund not in place)?
Mr Liang: We are the general contractor of the Tongxin garbage disposal project. In addition to providing equipment, we also provide services. When government funds are not in place, it involves our company's need to advance funds. This is under certain economic pressure, and the Chinese government often delays payments. We will face a lot of dunning situations from suppliers. So, we now, in most cases, we will cooperate with other private enterprises. For example, the general contractor is 100 million RMB, and our company only does the core part of 30 million RMB and provides the main equipment and technology. The main investors must meet my payment methods and requirements, authorization fees and profit margins. The remaining 70 million RMB can be purchased by the main contractors in China for other needs, and maybe the main contractors can handle it with only 50 million RMB. After the two parties work together, the cost can actually be reduced.

Yulan: Are the equipment and technology of WTT company imported from the Netherlands? Have you awarded the technology and equipment to China? Do you think that China has made progress in the field of municipal solid waste treatment in recent years?
Mr Liang: Yes, they are imported from the Netherlands or Germany. Our technology and equipment are sold to Chinese investors and belong to them. We will provide technical support and maintenance and repair during the warranty period.
China has always made progress in dealing with urban waste recycling, but because China is too big and has a large population, each city has different levels of economic development and different population education levels, it is difficult to carry out waste recycling projects. At present, only the megacities of Shanghai, Beijing, and Shenzhen have done a good job in recycling projects. Other small cities are not doing well. This has a lot to do with the popularity rate of local garbage classification knowledge and the degree of cooperation of residents, as well as the level of economic development and garbage recycling technology and equipment.

Market Structure Module:

Yulan: As WTT is a participant in the municipal waste treatment public-private partnership project, the market environment will also have a certain impact on the success rate of the project. Can you introduce WTT's leadership, funding capability, market reputation and influence in the municipal waste recycling market?

Mr.Liang: WTT is the world leader in technology and solutions. We have completed nearly 130 projects around the world and achieved good results. We are the world's top three in municipal waste recycling technology.

In terms of financial capacity, because of the instability of global development in recent years, such as Covid-19 and the Russian-Ukrainian war. We have assessed market risks, we will participate in low-risk projects, and we will not participate in medium and high-risk projects. . For example, a few years ago we planned to invest in projects in Lebanon, but the instability of the Lebanese government caused our projects to be suspended. We also participated in projects in Ukraine, but a sudden war caused our projects to be suspended. Although These projects are not our core areas, they have also caused our millions of projects to be stalled. Our core markets are still in Western Europe, China and Canada.

Yulan: Will Covid-19 affect your business in China?

Mr Liang: It definitely will. The Chinese government spends a lot of money on the COVID-19 clearance policy, and it will inevitably reduce funding for other projects. For example, we originally had a project in Shanghai that was delayed because of the COVID-19 clearance policy. The government does not have enough funds to participate in this project. The original budget of the government planned to invest in this project, but it was all used to fight the epidemic. As a result, the project had to be postponed. It is estimated that it will be postponed until 2023. Our equipment has been purchased. It's already in the warehouse, but government funds haven't come in yet.

8.2 Interview II

Interviewee: Mr Zhu: Wuhan MSW PPP project government leader
Time: 16th, September 2022
Location: Online Interview

Q1 I would like to know why the government decided to carry out this public-private partnership project?

The government decided to introduce the PPP model for garbage disposal, it will mainly be considered based on two aspects: one is the input-output ratio. Get the most results for the least amount of money. The public financial budget is limited every year, and there are many areas that require financial investment, such as education, medical care, infrastructure, public security, etc. If you increase investment in one area, you will inevitably invest less in other areas. If the PPP model can just achieve the purpose of reducing government investment and achieving good results, it is a good solution.

Second, professional people do professional things. After all, the government that carries out the waste treatment are not mainly for profit, and the proportion of waste professional and technical personnel, management personnel, and R&D personnel in the government is not high. In terms of personnel management, performance appraisal, cost control, etc., the government are definitely not as professional and experienced as companies that specialize in the garbage disposal.

Q2 How did private (foreign) companies compete for this government sanitation project? Is it through bidding? Is it a government franchise? Is this an outsourcing contract with the government? Long-term or short-term, how long is it generally?

In terms of business acquisition, there are roughly two ways, one is bidding. The government uses bidding to select partners for business outsourcing. There is no potential bidder in this way, and the company with the lowest cost or the closest to the government's requirements is selected as the successful bidder through bidding; the second is a business negotiation. Because there are many uncertain factors in determining the winning bidder through bidding, if the government needs to achieve some comprehensive goals and requirements, it can find some companies with strong comprehensive strength to conduct business negotiations, negotiate details that are in line with the interests of both parties, and determine specific cooperation plans. No matter which of the above models is chosen, the rights and obligations of both parties will be solidified in the form of contracts to ensure their reasonable demands. As for whether it is a short-term contract or a long-term contract, it depends on the specific goals, requirements and other details. Public utilities will be mainly franchised, such as

garbage disposal. The garbage output of a city is relatively stable, and there is no major fluctuation. The company's participation in the urban waste treatment business must be hoping to obtain a franchise operation to ensure that it can obtain a stable business volume and thus ensure its due profits.

Q3: Does the government provide financial support (investment) to private enterprises after obtaining this sanitation project? Has the government participated in the design, planning, plant construction, equipment operation and maintenance of this sanitation project? Does the government share the project benefits (profits) and does the government share the risks? Or is it a private company that takes care of its own profits and losses?

Whether there is support from government funds. This depends on the specific cooperation details and government requirements. If it is only to reduce government financial expenditure, it can appropriately subsidize part of the funds. For example, it turns out that the government needs to spend 1 million RMB every year to dispose of the garbage independently, and the public-private cooperation parties can invest 500,000 RMB each to complete the task. For the government, subsidizing 500,000 RMB can achieve the original goal of spending 1 million RMB, which is undoubtedly a good choice. If some companies use new technologies in the garbage disposal, they can make profits by recycling garbage and reusing them. Then the government can issue franchises without providing financial support at all.

The government will participate in the feasibility study of the project and carry out the statutory risk assessment, administrative approval, etc. For example, in the early stage of the project, environmental impact assessment, risk assessment, planning permit, business permit, etc. will be carried out. In the later stage of the project, wastewater, waste gas, solid waste, hazardous chemical discharge, production safety, tax payment, etc. will be supervised. For specific construction and equipment maintenance that have passed the approval of planning, environmental protection, etc., they will generally not participate, and enterprises will be given autonomy, the premise is that they comply with laws and regulations.

Whether the government participates in revenue sharing should depend on the profit of the project. Municipal waste treatment should be a low-profit business. If the government participates in profit sharing, it will affect the enthusiasm of enterprises to participate. Therefore, the government generally does not participate in profit distribution, and naturally

does not share risks. Enterprises operate independently and are responsible for their own profits and losses.

The government regulatory is very important, but due to the outbreak of Covid-19 in 2019, the Wuhan government had to re-allocate some manpower, material and financial resources to fight the epidemic. As a result, there was not enough funds to support the development of the MSW project, and not enough human resources to supervise the follow-up development of the project, so Wuhan's The MSW project is very slow and inefficient.

Q4: Does the government have a professional leadership team (or individuals) to participate in and support this project? Could you briefly introduce the government leadership team? Do they have the professional knowledge to participate and express opinions on design planning, or do They just represent the government and just play a supervisory role?

Urban construction is based on a solid urban plan, and all construction will be based on the overall urban plan and the regulatory details of specific units. The government has a planning management department that specializes in researching and formulating plans and conducting examination and approval business. For this kind of waste treatment PPP cooperation business, in the project design stage, the design department will design according to the planning conditions (such as floor area ratio, building density, plant and equipment scale restrictions, etc.), and submit the design scheme to the planning management department for review. At the same time, the enterprise should carry out the environmental impact assessment of the project, and the environmental protection department will also review the assessment. In the later stage of the project, the government will supervise wastewater, waste gas, solid waste, hazardous chemical discharge, safety production, tax payment, etc.

Q5: I'd like to know the administrative risks of investing in this project at that time? For example, did the leadership change? Will the complicated administrative bureaucracy delay the project's progress? How did you overcome the administrative difficulties?

Leadership changes are only likely to have an impact in the early stages of a project. For example, leader A advocated adopting the PPP model, however, when the project was in the

early stages of research, demonstration and investigation, leader B was replaced, and he opposed the PPP model, which may have affected the progress of the project, or even terminated. And once the project has signed a contract, it will rarely affect the progress of the project due to leadership changes. Unless the project is illegal, an easy overturn would result in liquidated damages. If the project is confirmed through research, there will be basically no complicated administrative procedures to delay the progress in China. In fact, domestic administrative efficiency is much higher than that of foreign countries. The uncontrolled and uncentralized democracy in Western countries has caused a good project to be suspended due to endless discussions due to disputes among parties and even games with each other so that progress cannot be carried out for a long time. The uncontrolled and uncentralized democracy in Western countries, on the contrary, because of disputes or even games of various factions, a good project is caught in endless discussions and cannot be advanced for a long time.

Q6: Can I ask whether this municipal waste recycling project crosses government administrative levels, and does the implementation of the project involve collaboration between different administrative levels? Will cross-administrative levels affect the progress and efficiency of the project?

The project will go through research, reporting, decision-making, implementation and other links, and it will involve cross-administrative levels. Generally, if it is determined by the decision-making administrative level, the lower-level administrative level will cooperate with and support the project. Approval takes time, but this is the time required for the normal process. As long as it is legal and compliant, it will not affect progress and efficiency.

Q7: In your opinion, can Chongqing and Wuhan's economic development level and urban civilization level support the public-private partnership (PPP) project of municipal solid waste treatment? What are the advantages? What are the difficulties?

Garbage disposal is a task faced by every city in the world. The PPP cooperation model is an option, but not the only option. Government investment, PPP cooperation, BT, BOT, etc. are all options, and specific issues should be dealt with in detail. Everything has its pros and cons. The actual situation in different regions and cities is different. It is most pragmatic to choose the most suitable model. Just like fitness, whether it is swimming, cycling, running, or ball games, the best items are suitable for your physical condition. Chongqing is at the forefront of urban development in China. The city has many foreign-funded enterprises and private enterprises with strong strength and capacity and equipment. The government also encourages the development of the private economy. The advantage is that the city has the advantages of capacity and equipment, and the government encourages preferential private

economic policy. The difficulty is that the city has a large population, and the recycling and utilization of garbage also need the cooperation of the general public. Citizens must do a good job in garbage classification. The overall civilized quality of the people is very important to the urban garbage recycling industry.

Urban civilization is also important, in 2019, several days of street protests against the waste incineration plant project broke out in Wuhan, China. The demonstrations brought thousands of people to the streets, and the local government was forced to reassure residents that there were no immediate plans to build the facility. While authorities in Wuhan blocked further protests, the local government was trying to reassure residents that their voices would be heard.

Q8. I'd like to know whether the project will damage the natural ecological environment of the location and whether the surrounding infrastructure is sufficient to support the project? Will the surrounding environment and infrastructure also affect the development of the project to a certain extent?

Before the implementation of all projects, an environmental impact assessment needs to be carried out, and the site selection and construction scale of the project should also follow the plan. The finalized project will have the least impact on the environment, or the impact on the environment can be reduced as much as possible through technical measures. The waste treatment project involves many aspects such as collection, classification, recycling, harmless or low-hazard treatment, etc., and needs to be supported by a complete infrastructure around it. The infrastructure level of Chongqing is very advanced, and there is no problem in carrying out projects.

Q9 In the process of urban domestic waste generation, the Wuhan Municipal Government has been working hard to popularize the knowledge of garbage classification for residents. Do you think the urban garbage classification is successful? Do you have any suggestions?

China's domestic waste classification started relatively late, and Chongqing has only implemented waste classification for two years. Garbage sorting is a trend that should be promoted and persisted. Because it has just started, the consciousness of residents' participation and the accuracy of residential garbage classification needs a time process to continuously improve and perfect. Enterprises are the main body of technological innovation. Enterprises can focus on technical research in a certain field or industry, make more technological breakthroughs through continuous accumulation, and continuously improve the

efficiency of waste treatment, recycling efficiency and benefits, the effect of harmless treatment, and continuously reduce the impact on the environment. These are the advantages of enterprises and the needs of the government and the public. If the company has strong technical strength, especially if it can achieve higher environmental protection standards, it will eliminate the public's concerns about the environmental pollution caused by garbage disposal and the reduction of whether it will produce harmful substances.