

MARKET ANALYSIS AND BUSINESS
OPPORTUNITY EVALUATION OF
ENTERING CHINESE MEDICAL WASTE
TREATMENT INDUSTRY

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ABSTRACT

China's ever-growing population and the rapid increased economy have created the medical waste crisis. Chinese government has promulgated many regulations and policies to limit people's negative actions of dealing with medical waste and to encourage the development of business in medical waste treatment industry. This is mainly because the money shortage and the relevant technology backward in China. However, due to the fact that medical waste treatment project requires a long-term operation and a relevant stable payback during the contract period, Finnish investors who are able to provide from start-to-end disposal solutions can meet this new-starting business opportunity.

This study provides a market analysis of entering Chinese medical waste treatment industry for Finnish investors. Background information of medical waste crisis in China is introduced. The competitive advantages of Finnish company are discussed following the introduction of medical waste management model respectively in China and Finland. Conceptual discussion helps readers identifying the key factors, which can significantly influence the market. Associating with the described concepts, the analysis of relevant stakeholders in Chinese medical waste treatment market is explored, which helps readers with recognizing the entry barriers and market challenges. Based on those analyses, this study recommends Finnish investors establishing a joint venture company with a local player, and the relevant business model is proposed in the last chapter. However, this study only illustrates the pre-actions for Finnish investors, therefore, further research is necessary for Finnish investors building up a steady business in China.

Key words: Medical waste management, Waste treatment and disposal, Chinese government, Incineration, Macro environment analysis, research approach

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Abbreviation :

MW	Medical waste
MSW	Municipal Solid Waste
EFCC	Environmental Cluster for China
MOH	Ministry of Health of the People's Republic of China
MEP	Ministry of Environmental Protection of the People's Republic of China
WHO	World Health Organization
WRI	World Resources Institute
MEP	The Ministry of Environmental Protection
BOT	Build-Operate-Transfer
OECD	Organization for Economic Co-Operation and Development
IPR	Intellectual Property rights

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1 INTRODUCTION

1.1 Background

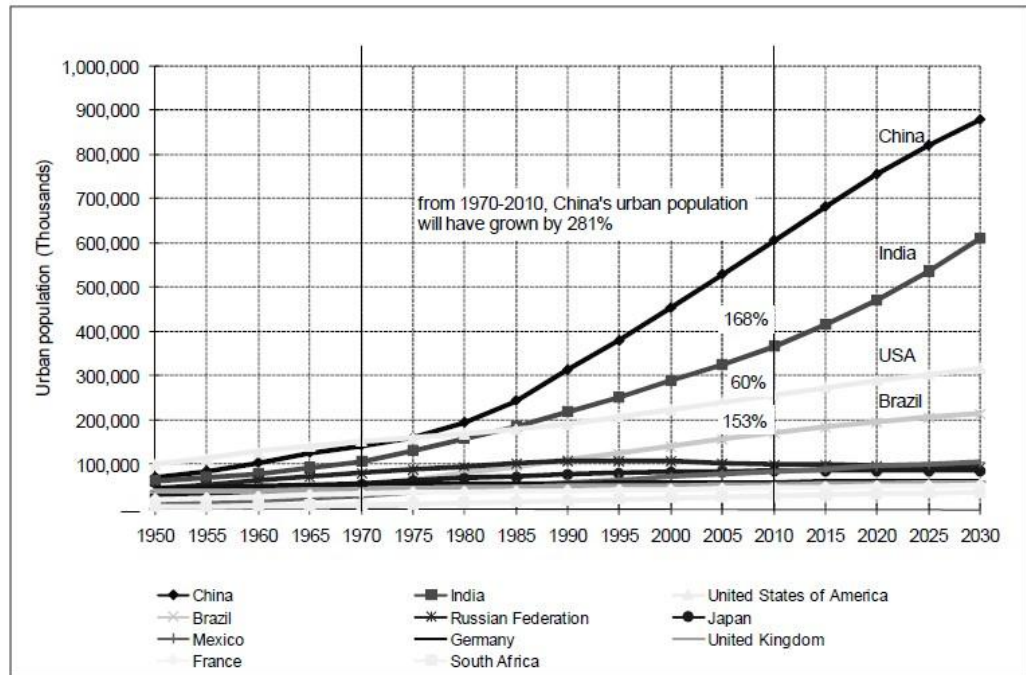


Figure 1: Urban population, 1950-2030(Source: OECD, 2010)

China has the largest population in the world, with 1.3 billion inhabitants and 600,000 urban residents. With the rapid growth in economy, Chinese people pursue better lifestyles. Medical waste (MW) as the most polluted objective, which people can inevitably face in their daily lives, is the biggest threat to people's health. Its generation sites are healthcare sectors, like hospitals, healthcare centers and related education and research institutions. This eventually explains MW, for instance, infectious and toxic waste, including infectious, genotoxic, chemical wastes and pressurized containers are not environment-friendly. What's more, if managed improperly, MW may significantly cause threat to human health; for example, some untreated medical materials like used needles can transmit serious diseases, such as HIV and hepatitis. Therefore, MW is internationally recognized as hazardous waste.

According to the Chinese Journal of Process Engineering, China generates around 650000 tons of medical waste per annum, ca. 2% of Municipal Solid waste (MSW), and this figure appears to be growing at about 19%~25% per year. Meanwhile, the overall treatment capacity in 2007 had increased to 94 million tons from 63 million tons in 1997, at an average rate of 5% per annum. The treatment rate in 2007 was 62%. The potential investment in this sector during this period is evident as the GDP growth for the same period was around 10% annually (POYRY a). MSW has been only collected regularly in urban areas, which accounts for about 25% of the Chinese population and only half of this waste is treated properly. So, sorting MW is the first and important step of managing medical waste.

However, there are tremendous problems in the field of Medical Waste Management (MWM) in China. First, relevant laws and regulations lag behind current situation of MWM. Even though “Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste” stipulates the requirements on hazardous waste collection, transportation, storage and disposal, lacking of the specific legislatives on responsible people causes the unequal enforcement of laws and regulations.

Second, an unreasonable and incomprehensive MWM system causes risks that people in the procedure of processing MW without monitoring and the pollutants from the origin to be without control.

Third, the operation mechanism is unreasonable. Government supervision on MW requires the coordination of all levels of relevant departments from laws formulators to environmental protection bureaus. However, the blurry realization of responsibilities and the shortage of well-trained supervisors make MWM inefficient.

Fourth, MW classification and collection are incomprehensive. This is the first and the vital step of non-hazardous sanitary MW. But in the majority of Chinese hospitals, especially the hospitals from small and remote areas, MW are normally mixed with household waste. Even in big cities, MWM is in the starting stage.

Fifth, unsanitary places for storing MW put negative impact on environment. Contract is applied in the process of centralized transportation and storage. But

unsealed transportation and non-sterilized storage increase environmental pollution.

Sixth, backward disposal facilities cause secondary pollution. Government stipulates MW must be incinerated in a centralized way, still many hospitals combust MW privately by using simple stoves. It is obvious that would generate exhaust gas and harm for people's lives as well as the environment.

Seventh, the public awareness of environmental sanitation needs to be improved. Unlike in Finland, where people really care about the environment and are involved in practice of sorting waste in a proper way; Chinese people receive few education of and have lower knowledge of the threat of MW. Being attracted by private income, hospital staffs make dealing with informal MW collectors, who sell them to leather or commodities manufacturers with higher prices. But the threat for the whole society is uncountable. Based on the current China market, an informal collecting system (the waste collectors) has widely existed in the process of MSW, including medical waste. Waste collectors pick used Cotton Tipped Applicators, plastic injections, gloves from bins or directly sold by medical staffs. The existence of this large informal collecting system has put a profound impact on China's medical waste management business. This situation is completely different from European countries, the reasons for which are: firstly, both the people and administrators perceive that waste is valuable; secondly, the informal sector employs more than 2 million people in waste management and provides their livelihood; thirdly, the composition of waste is different, as some waste is suitable for combustion in incinerators and some for composing purpose. Therefore, the technical solutions for treating this kind of waste are purely based on the experience of foreign companies (POYRY b).

Eighth, the shortage of investment on developing technology and enhancing training system restricts the development of Chinese MWM industry.

The problems listed above are in need of reasonable solutions. With promulgating national relevant laws and regulations, Chinese government makes a great effort to attract foreign investment in the field of MWM industry. But due to the market integration strategy, foreign investors who are able to provide integrated solutions in the procedure of processing MW will be encouraged. What's more, the hi-techs applied in the ultimate disposal are urgently needed in the current Chinese MW treatment market.

By comparing three main waste treatment approaches: composting, landfill and incineration, and associating with Chinese MW market situation, incineration turns out to be the most popular method, which is encouraged by Chinese central government. This is mainly because of the shortage of land resource and because the continually increased land cost in megalopolis, like Beijing, Shanghai, Guangzhou, has required on optimal land utilization. Besides, with the economic development and the progress of urbanization, power generation from waste incineration can provide higher resource utilization.

In order to ensure that MW has been treated entirely and in an environment-friendly way, The State Environmental Protection Administration of China (SEPA) or now called Ministry of Environmental Protection (MEP) is responsible for collecting, transporting and treating MW in a formal way. Along with MEP, the national and local governments have taken action to improve MWM. Chinese government aims to make a qualified living condition for generations. By controlling the waste management publically and establishing a licensing system for all players in the value chain, the illegal and environmentally harmful practices are better controlled then before.

During the 11th five- year plan period, the government's total investment in MSW safe treatment infrastructure is about CNY86 billion, i.e.17 billion Yuan annually. By the end of 2008, Chinese government distributed CNY 4 trillion to stimulate its ailing economy, with a focus on public works projects including environmental infrastructure construction. It is estimated that the investment in the field of waste management will be around CNY 140 billion annually in 2009 and 2010 (POYRY c).

During the 12th five-year plan period, construction of waste treatment facility is becoming the major national project. The planning institute of MEP has predicted that government will invest 3.1 trillion Yuan into environmental protection industry, MSW industry can account for 800 billion Yuan of the total investment, which doubled that of the investment from government in the 11th five- year plan period (Stock 2011).

Nowadays, Chinese MWM has a positive change. With the involvement of international environmental protection organizations and the publicity of mass media, people's senses of environmental sanitation have been significantly im-

proved. Change always brings opportunities; therefore, by analyzing Chinese current MW treatment market, the author will provide potential Finnish investors with business opportunity in the field of MW treatment industry in China.

1.2 Research questions, objectives and scope

Main research questions:

- What are the characteristics of the Chinese medical waste processing market?
- How can Finnish investors do business in processing medical waste in China?

Theoretical research sub-questions:

- What are the medical wastes and its characteristics and classifications?
- What are the differences between Finnish and Chinese MWM model?
- What are the main concerning issues for doing international business?

Empirical research sub-questions:

- How much (average) medical waste is generated in hospitals in China?
- Who are the main players in medical waste processing sector?
- What's the process of the medical waste collection and disposal by hospital?
How can the medical waste be transported? And the delivery channel?
- What's the government response and incentives to medical waste collected and treated? And the requirement?
- What's the relationship between this business and local communities? Who are the stakeholders? And the local networks?

Research objectives

Main objectives:

- Evaluate the business opportunity for Finnish companies processing medical waste in China
- Make a conclusion on business potentials and risks as well as investment return

- Based on the evaluation results, a business model and an applicable business entry strategy will be proposed for Finnish investors

Scope:

- Only focus on the mainland of China due to the same law, policy and regulation conducted from the Chinese government as well as the size and potential of this market
- This study only illustrates the pre-actions for Finnish investors, does not expound on the concrete steps of establishing a business in China.

1.3 Structure of the research report

Chapter one provides the brief information about the issues of medical waste in China, and the research strategy, which aligns with relevant research questions. Then, the structure of this study will be explained at the end of this chapter.

Chapter two aims to introduce the basic concepts and classifications of medical waste, identify the technologies utilized in the whole process of managing medical waste, from collecting, transporting to proposing, and compare the different managerial ways of treating medical waste between companies from Finland and China. It helps Finnish investors recognize their advantages in the Chinese medical waste management market.

Chapter three shapes a view on how to manage an international business and what are the key issues of concern in marketing process. At the end of this chapter, the reason why those concepts are introduced and what contributions of them are going to be discussed as the conclusion of this part.

Chapter four introduces the approach and methodologies utilized to prepare for the empirical research. Besides, it also includes the data analysis and the limitations of the study. Finally, some cases are introduced in this chapter mainly for supporting the facts of the empirical research.

Chapter five presents the Chinese market analysis of processing medical waste followed with the empirical research, such as administrative introduction and tendering process, which can assist the entry modes' discussion and help to give the conclusion of business opportunity for Finnish investors.

Chapter six analyzes the conclusion of business opportunity for Finnish investors, proposes the marketing strategy in China and a suitable business model, summarizes the distribution of this study, and discusses the areas for further research.

2 DOING BUSINESS IN MEDIAL WASTE SECTOR

After introducing the medical waste issues in China, the research will dig into medical waste sectors by providing basic conceptions and classification of medical waste, by describing the management approach, how to collect, transport and dispose medical waste and the requirements for technologies, and by introducing the MWM model respectively in China and Finland. It will help Finnish investors recognizing their advantages to do medical waste management business in China.

2.1 Medical waste definition and classification

Medical waste (MW) is normally recognized as the waste generated from hospitals, medical centers with severs polluted components. The World Health Organization (WHO) defined it as “Waste generated by health care activities including a broad range of materials, from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices and radioactive materials”. It’s obvious that medical waste needs to be well managed and treated, because it’s a potential threat to people’s lives with countless infections. How to manage it? Can all kinds of medical waste be thrown into one plastic package? Is there any conducted standard to classify the medical waste? To answer those questions, the first step is to find out the classification of medical waste. Because every country has slight difference in classifying the medical waste, in order to guide Finnish investors, here only list Chinese classification standard, which effected by Ministry of Health of the People’s Republic of China (MOH) and Ministry of Environmental Protection of the People’s Republic of China (MEP) or called The State Environmental Protection Administration (SEPA) in 2003. (Details see Appendix 1: Medical waste categories according to EU Waste Catalogue, WHO and China (2003)):

Infectious waste

Pathological waste

Sharps

Medicaments

Chemical waste

2.2 Medical waste management

Medical waste management (MWM) is the process that consists of people, regulations and technologies, and people who are involved in this sector, from the hospitals' staffs, to MW collectors and practitioners. Regulations refer to laws, policies, standards and plans affected by governments and direct departments. Technologies are widely used in MWM, especially the high-tech tools applied to collect, transport and treat the infectious waste. They are the know-how to help practitioners dealing with MW environment-friendly. Thus, in this part, the main discussion issues are identifying the process of MW from generation to disposal; then, following three sub-titles, readers are going to gain deep knowledge about MW sorted technical requirements during the management process.

The MWM flow chart will be shown as below:



Figure 2: MWM flow chart

Collection is the first step for every hospital dealing with MW. MW generated from all medical departments, e.g. Wards, Surgery, Laboratories, Haemodialysis facilities and so on. Then, segregating all the collected MW based on national MW classification list is the vital important work for trained staffs. Also, before MW has been transported to disposal plant, trained staffs must store them in a certain place in a proper way.

According to the actual circumstance, transportation in some hospitals should be divided into on-site transportation and off-site transportation. On-site trans-

portation is that hospitals centralize stored MW by using specific vehicles. Off-site transportation is that the MW formal collectors transport MW directly from hospitals to disposal plant. Both on-site and off-site transportations request trained staffs using well sealed containers transporting MW by special vehicles. Disposal is the last circle for dealing MW. Even some developed countries appeal that the internationally popular methods of treating MW, say, incineration and landfill, should be stopped, because the emissions as poisoned gas may put negative effect on the local environment. But in the terms of the local economic and technology, the best methods for China to treat MW is incineration, which is the most suitable way to dispose specific infectious wastes.

See methods and technologies involving each of the three steps for MW management in following sections.

2.2.1 Collection

Collection is the most essential step for reducing pollutants by systematic segregation. How to segregate MW, what containers or packages should be used and which kinds of knowledge should be applied in this step. The method and technology shown in tables below will provide the answers.

Table 1: MW technical guideline (Source from: Mohd Nasir Hassan, PhD, Environmental Engineer of WHO)

Type of Wastes	Colour of Container and Markings	Type of Container
Infectious wastes, pathological wastes	Yellow, marked "INFECTIOUS"	Strong, leak-proof plastic bag, or container capable of being autoclaved
Sharps	Yellow, marked "SHARPS"	Puncture-proof container

Chemical and pharmaceutical wastes	Brown, marked “HAZARDOUS’	Plastic bag or container
Wastes with High Content of Heavy Metals	Brown, marked with the specific heavy metal content and “HAZARDOUS’	Puncture and corrosive proof container, separate containers for different heavy metal contents.
Radioactive and Genotoxic wastes	Red, marked with “RADIOACTIVE SYMBOL”	Lead box, labeled with radioactive symbol
Pressurised containers	Black	Plastic bag; could mix with the general wastes
General Waste	Black	Plastic bag

Regular education and training is necessary for hospital workers for improving and enhancing their knowledge about body protection. When hospital workers dealing with the medical equipment, they are “at greatest risk from exposure to the potentially infectious wastes and chemical hazardous wastes”(Basel Action Network (BAN), April 12-14, 1999). Staffs that collect and transport the waste among a hospital should have protective gear or special protective equipment, because of the exposure risks.

“Proper education and training must be offered to all workers from doctors to ward boys, to laborers and rag pickers to ensure an understanding of the risks that wastes pose, how to protect themselves, and how to manage wastes (especially how to properly segregate)” (Basel Action Network, April 12-14, 1999). This will change the workers’s behavior and also provide them with a positive understanding of the importance of reducing the amount and volume of wastes for the ultimate disposal.

2.2.2 Transportation

In order to prevent the environment from large- scale and secondary pollution, there must be secure on-site and off-site transportation systems for dealing with MW. This paper is not going to describe a world-wide transportation system to readers due to the different circumstances of each country, especially in China, there is no strict MW transportation system for practitioners, and only the transportation requirements exist. For example, “The Regulations of Shanghai Municipality on Disposal of Medical Waste and Protection and Control of Environmental Pollution” (see details in Appendix 2) identifies the transportation requirements and the “Technical Requirements of Vehicles Conveying Medical Waste”.

2.2.3 Treatment and disposal

In MSW treatment industry, the main methods of treating and disposing MSW are named as: composting, landfills and incineration. Composting aims to deal with household waste. Most of it (**75-90%**) is similar to domestic waste. This fraction referred to as healthcare general waste (HCGW) is made of paper, plastic packaging, food preparation, etc. that haven't been in contact with patients. (WHO X, 9. SEP 2011)

A smaller proportion (**10-25%**) is infectious/ hazardous waste that requires special treatment. This fraction referred to as healthcare risk waste (HCRW) is the one that WHO focuses on due to the risks that it poses both to human health and the environment (WHO X, 9. SEP 2011).

2.3 Medical waste management model in China

Collection

MW collection in hospitals and health centers in China is not as good as government requires. In large public hospitals, responsible staffs can classify MW and collect them by using different color packages and labeling. But MW classification is not strict and only two different packages for storing hazardous MW (yellow package) and household MW (Black package). Because lacking of monitoring, small-size hospitals and health centers, or which in remote areas treat MW without classification, even drop MW randomly.



Figure 3: Collection and on-site transportation in Chinese hospitals

Transportation

Hospitals and health centers in China are spread in a large area. Because MW should have centralized treatment in China, local governments normally appoint one or two hospitals as the MW transportation center in a certain area, or in the big cities, a specific transportation center can be established. In that case, other

hospitals and health centers should transport MW by themselves and ship MW to the transportation center. Thus, transportation on-site requires a special vehicle for preventing pollution. However, when conducted the field research, some hospital just uses unsecured tricycle as picture shows for on-site transportation.

Disposal

Although there are three kinds of disposal approaches for MSW, the hazardous nature of MW requires specific treatment. The table below shows the advantages and disadvantages of those three different technologies. By comparing them in terms of processing rate, operation fee, and environment consequences and so on, then analyzing the trends of each technology based on the local environment, finally, the approach Chinese MW treatment companies have been applying in disposal and the reasons why they choose it will be exposure.

Table 2: Comparison of composting, landfill and incineration

	Composting	Landfill	Incineration
Processing Rate	9-45days	Totally Decomposed in one hundred year	1-2 days
Secondary Pollution	peculiar smell, leachate is the high concentration	Heavy Oder, high concentration of heavy metal ion from landfill leachate, cause various Viruses	Peculiar smell emission in the pre-treatment stage, dioxin released in the process of combustion
Residual Liquid	Highly polluted	Highly polluted	Heavy mental is rich in the remainder
Protection Distance	500M from dwelling district	500M from dwelling district	500M from dwelling district
Floor Space (500t/Day)	More than 41.7Acre	More than 83 Acre	More than33.3 Acre
End Product	Inefficient fertilizer contains	No	Heat/ electricity power

	large quantity of heavy metal, recycling		
Capacity Cost Per Ton	1.5-2.2 million	1.5-2 million	3.5-5million
Operation Fee (Beijing)	More than 125Yuan/ton	More than 108 Yuan/ton	More than 165Yuan/ton
Economic Benefit	Fertilizer out of market, depends on government' subsidy, without value for recycling, cause financial loss	Pay for environmental pollution fee, simply depends on government' subsidy, without benefit	High consumption of coal and oil, break even operation, more than 12 years payback period
Automatically Degree	Semi automatic	Manual work plus machinery work	Fully automatic

(Source: adapted from the information of Beijing Zhouji Huanfa Renewable resources technical development company,

<http://solidwaste.chinaep-tech.com/zhoujihuanfa/40883.htm>)

Based on the comparison, the advantages of incineration in China are obvious. Incineration has much faster rate for treating MW, requires less land for operation than composting and landfill and is fully automatic, which can improve productivity. The very important benefit of incinerating MW is the can-be-sustainable used end product; still it has the problems of secondary pollution and high cost in the process of operation. Incineration is encouraged by Chinese government in recent years, and has developed rapidly. However, sanitary landfill has a very small increase due to the government's strict requirement of construction standards and low benefit. Composting cannot be considered as a way to treat MW, because it has low fertilizer efficiency and is rich of heavy metal in the final end. What's more, landfill and composting MW are bad for environment, and are forbidden by Chinese government. Therefore, MW treatment companies are encouraged to incinerate MW as the optimal approach.

2.4 Medical waste management model in Finland

In environmental matters Finland is often considered as a “pace setter” or “leader”. There are a number of reasons for explaining why. First, environmental protection has constitutional status. It states that environmental matters need to be taken into account in decision-making and Finns learn to argue for environmental aspects already on the national level. Second, there is some political pressure to promote green movement was mobilized into a political party in the 1980’s. The green league has been in the government and the Ministry of Environment has been from that party. The popularity of the party has kept environmental matters on the political agenda and also made other parties “turn green”. All major international environmental NGOs have branches in Finland and there are many domestic ones like Suomen Luontoliitto (SLL) that has been very active. Third, there is a strong institutional capacity to address environmental problems and this has been the case for some time. The Ministry of Environment was established in 1983. Fourth, the Finnish pace setting stand is congruent with underlying environmental attitudes and behaviors. For example, Finns generate 85 kilos of packaging waste per capital whereas the EU average is 170 kilos per capital. The difference of those numbers can be explained by the efficient re-circulation of bottles and other packaging waste. And the last important reason is, people care. (Jussi Kinnunen, Multilevel governance, the burning issue of waste in Finland, 2002) Thus, Medical waste management model in Finland will be addressed in this section by applying interviews of Ekokem Group and the Central Hospital of Lahti, which assists with explanation of how it can affect Chinese medical waste industry.

Collection

Each type of MW has a corresponding responsible staff, for example, an infections specialist is responsible for infectious waste. Hospital staff has normal hospital outfits and working gloves for keeping hands clean and the waste is handled responsibly and packed for moving. No open wastes lying around outside working points. Each type of waste bin is marked with certain color and all the waste is sorted. These colors and different waste handling routes are all explained in the waste handling diagram that is available for hospital workers.

For example waste containing any patient information is put to secured bin which can only be opened when it's emptied in the proper disposal facility. There has not been any contagious waste in 15 years but there are procedures on how to handle them if there would be such waste. The hospital has detailed instructions for the staff for the waste handling.



Figure 4: Classification standard, storage and on-site transportation route for robot in Central hospital in Lahti

Transportation

Hospitals have competitive bidding for the transportation companies (that have proper licenses). Taking central hospital in Lahti as an example, it utilizes three different waste disposal companies according to the different types of waste plus then the transportation company. The waste is picked up from the hospital regularly once a week or once per two weeks and for some types of waste transportation is ordered separately. The competitive bidding is done every 3-5 years. The transportation fee is only about 1/4th of the whole waste handling price. For on-site transportation, central hospital has a robot to handle with MW, which can reduce the harm to MW responsible staffs.

Disposal

Taking Ekokem as an example, Ekokem is one of the biggest companies in Finland, which has about 1/3 of turnover which comes from hazardous waste treatment. The majority of MW generated in Finland is disposed of by Ekokem, which is a part of their hazardous waste turnover. It provides customers with environmentally sound solutions, for example, hazardous waste treatment; environmental management operations from treatment of contaminated soils, through constructions of landfills to many kinds of waste treatment solutions (Ekokem 2011a).its customers are from private sector, like industrial companies as well as from the public sector.

Ekokem can take over the entire chain from start to finish, including appropriate packing of the waste, filing for any required licences, and finally, processing the waste and submitting a disposal certificate to the customer. It also carries out training courses in handling, packaging and labeling of hazardous waste for foreign customers. (Ekokem 2011b)

Ekokem also thinks incineration is the safest and most secure way to treat hazardous organic chemical waste. Ekokem's treatment facility is among the most advanced in the world. Its modern treatment facility recycles and renders harmless more than 100,000 tonnes of different types of hazardous waste each year. Ekokem uses four kilns. Two of them are high temperature kilns for incineration of chemical waste and other materials that are hazardous due to organic compounds. The energy produced by the incineration process is recovered and utilized for district heating and electricity. The flue gases are always purified using the optimal available technology. (Ekokem 2011c)

Ekokem Pricing waste treatment fee based on the characteristics of MW, for instance, the basic price of solvent MW is 1.910 Yuan/t, whereas that of pasty MW is 5800 Yuan/t. what's more, there is the extra cost of package.

3 INTERNATIONAL BUSINESS MANAGEMENT

Globalization challenges firms to develop their business sustainably and financially for surviving in facing of the changeable economic environment. Therefore, cost-effective and practical management with customers, products, brands, governments, local environment and other relevant stakeholders plays essential roles in firms' strategy for long-term development. Searching markets for lower cost, more customers and sustainable business network is the most important strategical point for firms, and it always will be. Marketing turns to be the key word for financial success. Because there is no accident strategy for good marketing, "but a result of careful planning and execution using state-of-the-art tools and techniques (P.Kotler, Marketing Management, P25)", the basic concepts of international marketing and the fundamental indicators, which can influence market analysis and marketing strategy related to Chinese market will be addressed in this chapter.

According to the idea of "international marketing, an SME perspective" (L. Brown, 2004, P5) International marketing, "is the process of planning and undertaking transactions across national boundaries that involve exchange." Thus, in section 3.1 the process of international marketing will be presented, in 3.2 market analysis, the national boundaries in China will be identified for Finnish investors.

3.1 International marketing process

According to Isobel Doole and Robin Lowe's theory, the process of international marketing can be seen as the figure 5 shows below:

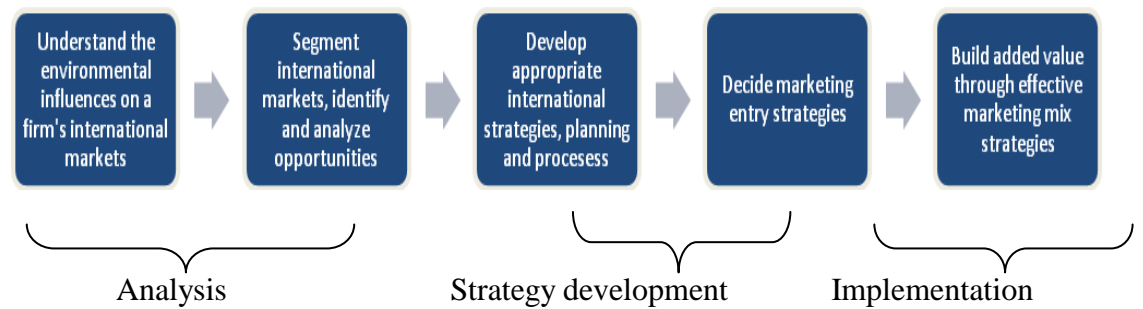


Figure 5: The process of International Marketing

These five steps consist of three parts, analysis part (includes first and second steps), strategy development part (includes third and fourth steps), and the implementation part (the fifth step).

In the analysis part, the internal environmental factors, which negatively impact on Chinese MWM, have been identified in chapter two. This reflects the managerial advantages of Finnish companies' MWM approaches. In the following section, external environmental factors which can intensively influence Chinese MW treatment industry will be introduced.

3.2 Market analysis

Prior to making a suitable plan on potential market, it's definitely necessary to understand the marketplace environment, relative business stakeholders, customer needs and wants, competitors, as well as the payback period. Thus, analysis related to these factors is the most vital part within this chapter. In order to widely cover the important factors and to effectively discuss the threats Finnish investors might face in the external environment, a useful and typical analysis tool, like PESTLE, will be applied in 3.2.1 Macro environment analysis.

3.2.1 Macro environment analysis

Kotler divides marketplace into macro environment and micro environment. Macro environment as external environment has numerous unpredictable issues,

which can intensively impact on MW treatment companies' performance and business activities. Therefore, PESTLE is used to analyze these issues.



Figure 6: PESTEL analysis

3.2.2 Micro environment analysis

Micro environment is defined by Kotler as, the actors close to the company that affect its ability to serve its customers-the company, suppliers, marketing intermediaries, customer markets, competitors, and public. Marketing is aiming to create value and relationship with final customers, but one company cannot do this alone. Because there are too many influencing factors, which can affect the marketing success (positive or negative) in the business involvement. Isolation is impossible. Tying up the relationship with other firms and local people to build a harmonic environment combines all the local resources to enhance the value delivery network, a company can be competitive. Micro environment analysis aims to identify the relationship among each actor, and how they work together to affect the value delivery network. The following figure 7 shows the actors in the Micro environment.



Figure 7: Actors in Micro Environment

The company

The company's mission, vision and objectives can fundamentally influence its marketing strategy. All of its ideas are in conjunction with the products provision and customer service.

Suppliers

In MW treatment industry, MW treatment companies' suppliers are equipment manufacturers, hospitals and other health centers; equipment manufacturing companies' suppliers are parts manufacturers.

Marketing Intermediaries

Marketing intermediaries can help a company to promote and sell products. They create direct relationship with end-users. In MW treatment industry, marketing intermediaries are marketing research companies, advertising companies, marketing consulting companies, banks, insurance companies, etc.

Competitors

Competitors are those who provide the same or similar products or services with a company. Therefore, identifying competitors' marketing strategies, their weaknesses and strengths is important for a company to compete with them and share more market.

Publics

The public is not directly involved in one industry, but pay more attention to the behaviors of companies. They inspect and monitor a company's business performance which can put negative impact on, say, environment, health or communities' benefits. The public can be NGOs, local communities or mass media.

Customers

Customers are the group a company sells products or service to. According to different characteristics of various customers, a company can segment them into several groups. The classification of customers can be divided into age, gender, income, geography, hobby, etc.

Actors of Micro environment can be well known by stakeholder analysis.

3.2.3 Stakeholder analysis

A “stakeholder” can be defined as: any individual, group, or institution that has a vested interest in the natural resources of the project area and/or who potentially will be affected by project activities and have something to gain or lose if conditions change or stay the same. (Bronwen Golder, 2005)

When Finnish investors are involve in Chinese market, their businesses are not only for meeting the interest of internal group, like staffs, shareholders, etc, but also are relying on the external groups, especially the local ones, for example, Chinese government, local communities, medias. Therefore, stakeholder analysis needs to be used to identify all the relevant stakeholders of companies in MW treatment industry and to explain the stakeholders’ prioritization in order to help Finnish investors making a communication and negotiation plan. The detailed analysis can be seen in chapter five, 5.1.5 stakeholders analysis.

3.2.4 Competitor analysis

Competitor analysis aims to preview Chinese counterparts for Finnish investors. The competitors’ behaviors also reveal current Chinese MW treatment industry, by introducing four main players in section 5.1.3, in terms of their business

performances and risks, Finnish investors can know more about Chinese market barriers and challenges, which can be help of making marketing strategy to react.

3.2.5 Competition analysis

The purpose of competition analysis is to identify competitive level of Chinese MW treatment market, search the weaknesses and strengths of this industry and finally exploit business opportunity from the market. Utilizing Porter's Five Forces to analyze Chinese MW treatment market and the relevant competitors can help potential entrants better knowing current market. Figure below shows the five forces of industrial competition, they are: the competition from new entrants, the competition from existing rivals, the threat of substitutes, the bargaining power of suppliers and the bargaining power of buyers.

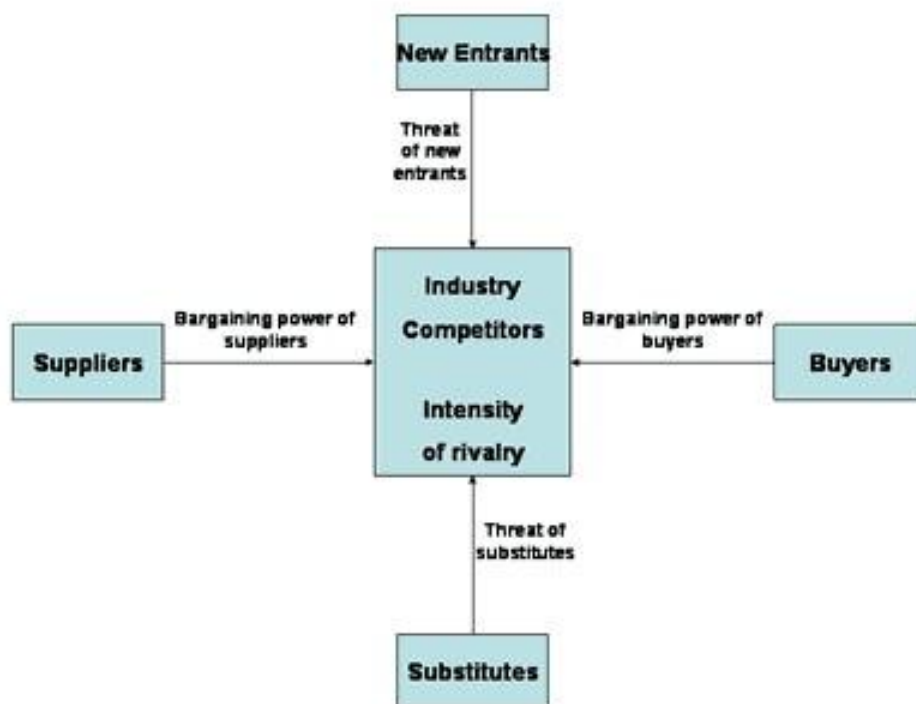


Figure 8: Porter's Five Forces (Porter. M.E , 1980)

3.2.6 Payback period

Due to there being only two ways for a MW treatment company to obtain financial income, one is by selling the power to the grid and getting the payment from local power grid company (or power bureau), another is by getting MW treatment fee from the local government, the best method used to analyze a MW treatment company's revenue model is payback period calculation.

The payback period means the length of time required to recover the cost of an investment (Investopedia 2011) calculated as:

$$= \frac{\text{cost of project}}{\text{annual cash inflows}}$$

Although payback period calculation ignores the time value of money, for long-term projects, it's the easiest way to measure the investment value.

3.3 Business entry modes

Prior to entering into Chinese market, Finnish investors need to choose the best and most appropriate mode of entry for them to maximize the profit and avoid potential risks. According to P.Kotler, three options are offered: exporting, joint venture, and direct investment.

The main contents of these three modes of entry can be seen clearly in the following chart.

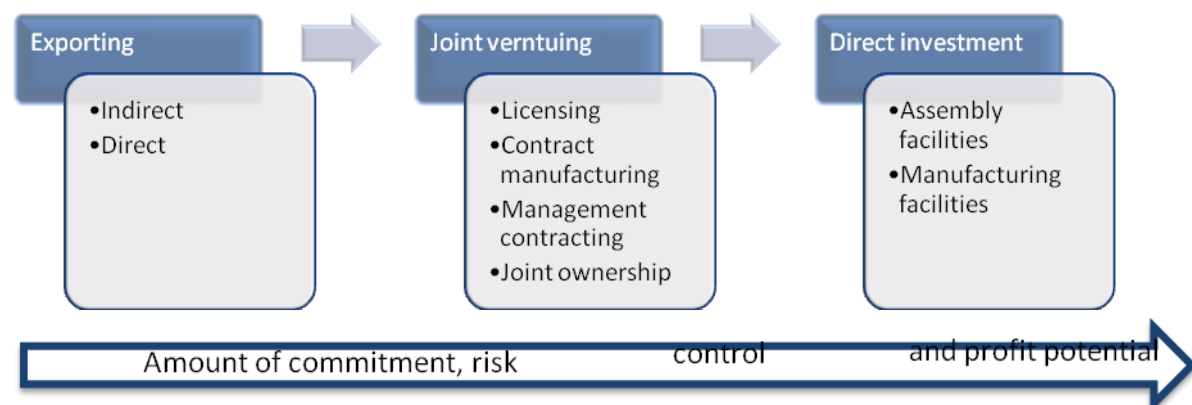


Figure 9: Market entry modes (source: P.Kotler, P590)

There is a comparison of those three entry modes in the table below, in respects of conditions favoring this mode, advantages and disadvantages, to assist Finnish investors making planning decision.

Table 3: Comparison of Foreign Market Entry Modes

Mode	Conditions Favoring this Mode	Advantages	Disadvantages
Exporting	limited sales potential in target market, little production adaption required, distribution channels close to plants, high target country production costs, liberal import policies, high political risk	minimizes risk and investment, speed of entry, maximizes scale, uses existing facilities	trade barriers and tariffs add to costs, transport costs, limits access to local information, company viewed as an outsider
Joint Venture	import barriers, large cultural distance, assets cannot be fairly priced, high sales potential, some political risk, government restrictions on foreign ownership, local company can provide skills, resources, distribution network, brand name, etc.	overcomes ownership restrictions and cultural distance, combines resources of 2 companies, potential for learning, viewed as insider, less investment required	difficult to manage, dilution of control, greater risk than exporting, knowledge spillovers, partner may become a competitor.

Direct Investment	import barriers, small cultural distance, assets cannot be fairly priced, high sales potential, Low political risk.	greater knowledge of local market, can better apply specialized skills, minimizes knowledge spillover, Can be viewed as an insider.	high risk than other modes, requires more resources and commitment, Maybe difficult to manage the local resources.
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(Source: <http://www.quickmba.com/strategy/global/marketentry/> 15.Sep.2011)

3.4 Supplying and distribution channel

P.Kotler provides a “whole channel view” to identify the entire global supply chain and marketing channel. Whole-channel view is designing international channels that take into account the entire global supply chain and marketing channel, forging an effective value delivery network.

Figure shows the whole-channel concept for international marketing



Global value delivery network

Figure 10: The global Delivery Network

International MW treatment companies establish the channels between sellers and buyers and companies should pay more attention about the business networks that deliver the companies' value.

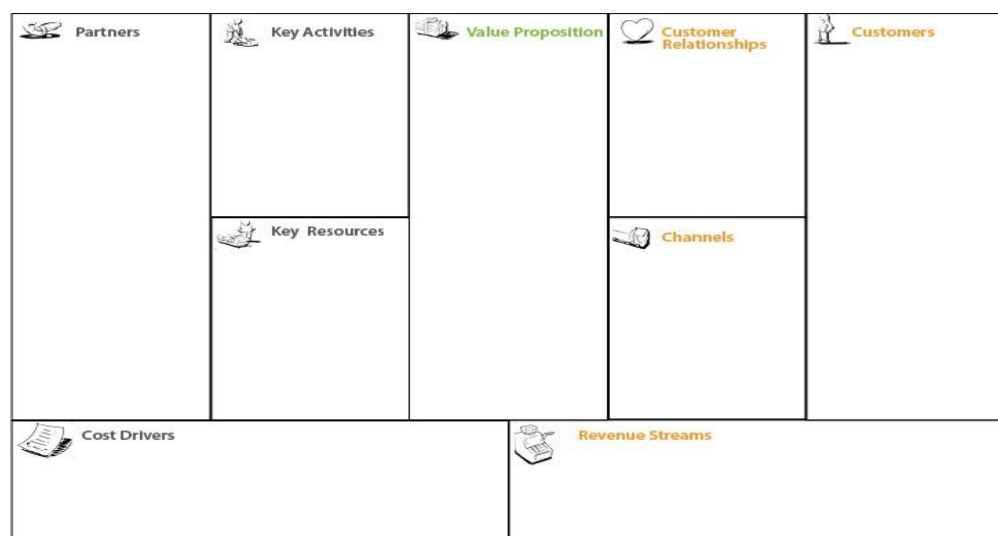
3.5 Business networks

Networks are more than just relationships that govern the diffusion of innovation and norms, or explain the variability of access to information across competing

firms. Because they are the outcome of generative rules of coordination, networks constitute capabilities that augment the value of firms (Kogut, 2000). Chinese market requires a strong business network between players and government due to the MW treatment companies obtaining incomes mainly from local governments. And the MW treatment industry in China closely depends on government's policies and regulations. "Networks require time and commitment to succeed and this needs to be supported both in cash and in-kind by the network participants and others." (Inter trade Ireland, report, 2005, P5) In China, extensive networking with all level of governments even with the competitors and business partners means the more business opportunities in future. Thus, the best entry way for Finnish investors is establishing personal and social networks with local people or local players to create further business networks. This networking may be inter-organizational, which can also include other businesses, or be facilitated by trade associations, chambers of commerce, professional institutions and public sector agencies.

3.6 Business model

Business model is used to help start-ups identifying their business performance and setting up the business map to make money. Using Canvas business model, which shown below can easily identify the relevant factors, which are needed to describe nine essential components.



(Source: Business solutions INC.)

3.7 Summary of the conceptual discussion

The relevant concepts of market analysis are introduced in this chapter, which helps readers to basically understand the major influential factors in Chinese MW treatment market, highlights the potential risks for decision-making, frames the field research, and associates with the eventual recommendations for Finnish investors.

4 RESEARCH METHODS AND CONTEXT

Research methods are used to help with collecting useful data. The data can generally be obtained from secondary research and primary research. When conducting the primary research, author found that some difficulties have been restraining the availability of data. For example, hospital employees would not tell the truths about how they deal with the medical waste, because they consider any information relevant to their working environment as official secrets. Thus, several questions should be reasonably answered long before using the data to practical analysis. The questions are how to do the research? Which approach or approaches should be applied to obtain useful data? (Explained in section 4.1) And how to analyze the obtained data in order to ensure that meet the paper needs? (See section 4.2 data analysis)

4.1 Research approach, methodologies and empirical materials

The research approaches applied in this study are qualitative method and comparative method. Qualitative method is widely used in the desk study while the comparative method is employed in writing period.

According to Michael D. Myers, research is defined as an original investigation undertaken in order to contribute to knowledge and understanding in a particular field. Although there are many types of research approach, the one popularly conducted in business and management is called qualitative method, which is used to study social and cultural phenomena in depth, with a focus on text (Michael D. Myers, *Qualitative research in Business and Management*, 2009, P260). It is good for exploratory research, when the particular topic is new and there is not much previously published research on that topic. It is also ideal for studying the social, culture, political aspects of people and organizations (2009, P9). “In addition, according to Michael D. Myers, all research in business and management focuses on a topic that is of relevance to one or more of the business and management disciplines. And research in business and management should be able to deal with “complex, unquantifiable issues that are the reality of business”. And this is where the value of qualitative research lies (2009, P6-P14). He also suggests that qualitative research is perhaps the best way for research in business and management, because it allows scholarship and practice come together. This argument is highly consistent with the content of this paper. Thus, qualitative method will be applied in this study in aspects of obtaining both primary data and secondary data within desk study and filed study.

By applying the qualitative method, the useful information and data can be obtained. In order to obtain the information and data thoroughly, primary data and secondary data should be included during the study. Prior to the field study, secondary data should be searched for research preparation. The gateways to gather this kind of data are internet and libraries. The main idea and the research orientation of this thesis are formed in this period. In addition, the primary data is obtained both in the desk study and field work. According to the conceptual parts,

local companies, local government and local NGOs in Finland are the important roles should be visited before the field study. What's more, in the field study period, the valuable primary data could be obtained by observation and interview. On the one hand, the way the medical waste gathered and transported by organizations can be observed; on the other hand, interviewing the counterparts in China market by face to face interview and telephone interview can ensure the data more credible.

The comparative method is often used in the early stages of the development of a branch of science. It can help the researcher to ascend from the initial level of exploratory case studies to a more advanced level of general theoretical models, invariance, such as causality or evolution. The goal of comparative method is to find out why the cases are different: to reveal the general underlying structure which generates or allows such a variation. (Pentti. Routio, Comparative study, 2007)

The comparative method is mainly applied in the analysis period when comparing the business performances between main players to find out the problems and risks in current target market. In that case, a feasible recommendation of business model and entry mode can be proposed for foreign investors.

4.2 Data analysis

Collected data need to be analyzed when selecting to help with describing the typical value, for example, the data gathered in section 5.1.2 supply forecast, to illustrate the government investment in China's 12th Five Year Plan; they also can assist with finding difference between various numbers, for instance, in section 5.1.1 demand forecast, data of MSW output in different regions of China are used to compare and are help of geographic distribution recommendation. All the data in this study are collected from interview responses, observations and some are also from secondary findings, such as previous papers, official web sites or journals, and so on. Organizing the data in a graph, chart or table for analysis is easy for readers to select objective information rather than go through all information.

4.3 Limitations of the study

Because of this study's scope, there are some limitations, which are listed as below:

- Hong Kong, Macao and Taiwan are excluded in this study, because of their social system, under the principle of "one country two systems", is differed from that utilized in the mainland of China, mainly on the political system and economic structure.
- Only focus on the MW treatment industry, especially the incineration treatment company, who can provide from start-to-end solutions of suitable technology and operate MW incineration plant to generate electricity power. This mainly because of the government's encouragement and requirement fostering the incineration treatment development in China.

4.4 Cases

As Harvey Maylor and Kate Blackmon say "the case study method is not a 'pure' research method, because you will normally collect your data from multiple sources and using several methods such as surveying, interviewing, participant observation and archival research"(2005, P243), so the explanation for cases is separated from 4.1 Research approach, methodologies and empirical material. What's more, the cases are more utilized for analysis rather than gathering data. "Case study research is applicable at any stage of the research on a particular topic" to answer the question "what", "the 'what' are contemporary real-life situation", and to help researcher know "how" and "why" questions, how and why a particular business decision was made, or how and why a business process works the way it does (Michael D. Myers, 2009, P73). In this paper, the case study involved in section 2.3 and section 2.4 MWM model management respective in China and Finland is used to explain what the current medical waste management approaches applied by Chinese companies and hospitals, and Finnish companies and hospitals. Finally, the results of introduction, which is relevant to the empirical findings from real organizations, lead to the definite competitive advantages of Finnish companies' approaches of medical waste

treatment and provide Finnish investors a feasible business model to better sell their solutions .

However, there are typical standards and criteria for selecting cases. Based on the study objects, the cases are areas selection, hospitals selection and MW treatment companies' selection.

For areas selection, the local climates, populations and the development level of economics, which can strongly influence the operation and pricing of MW treatment technology and equipments as well as the project scale determination. Moreover, the cities should stand for typical samples of variety classes in this field.

For hospitals selection, the scale and business with MW treatment companies should be typical in the local areas.

For MW treatment companies' selection, companies involved in MW treatment industry for a long period, up to five years, have different business modes and face various business problems.

Therefore, the selected areas, hospitals and MW treatment companies listed in the table below are:

Area	Country	hospital	Company/ project
Chengdu	China	West China Hospital	Chengdu Sheng qi li
		The Third People's Hospital of Chengdu	Industry and Trade Co.,Ltd
		Chengdu Sunshine Gynecology Hospital	Chengdu Luodai MW treatment facility
Suzhou		Changjiang hospital	Wujiang Lvyi solid
		The First Affiliated Hospital of Soochow University	waste recycling treatment company
Shanghai		Ruijin Hospital (Shanghai Jiaotong University School Of Medicine)	Shanghai Solid waste treatment facility
		Huashan hospital HuaMei hospital (Aesthctic)	
Lahti	Finland	Lahti central hospital	Ekokem

Along with the cases, some important stakeholders of which are selected to interview:

Government	Chengdu sanitation and anti-epidemic stations Chengdu Municipal Environment and Protection Bureau Wujiang Bureau of Investment Promotion
Local community	Local citizens, who live near waste treatment project facility
Media	Journalists from Sichuan Daily Newspaper and Tianfu Moring Newspaper

5 DOING BUSINESS IN MEDICAL WASTE TREATMENT INDUSTRY IN CHINA

5.1 Market analysis

With the purpose of strengthening the safe treatment of hazardous waste and MW and of protecting national environment, “the plans of constructing national hazardous waste and medical waste treatment facilities” (hereinafter called “Plans”)” got the approval of the State Council for implementation in December, 2003. In the 11th Five Year Plan period, projects construction in “Plans” is included in the most important ten projects of national environmental protection, which identified the importance of constructing hazardous waste and MW centralized treatment facilities, aimed to safely store and treat hazardous waste, MW and radioactive materials. Meanwhile, in order to ease the financial burden on the central government and along with accelerating marketization progress in municipal public industry, the State has promulgated “Methods of managing hazardous waste operation license” (included MW operation) in July, 2004.

Prior to operating a hazardous waste or MW treatment facility, every operator shall apply an operation license. This “Methods” indicates the BOT mode has been utilized in MW treatment management.

Until 2010, MEP associated with 31 municipal governments of environmental protection promulgated around 1500 “hazardous waste operation licenses”.

According to MEP’s statistics, the licensed enterprises have disposed hazardous waste (included MW) totally more than 8 million tons in 2010. But until 2010, the total number of pure MW treatment facilities is only 184 in China. Compared with the constantly increasing number of national population and the development of urbanization, there is a huge gap between future market demand and current MW treatment capacity. Along with the formulation of 12th Five Year Plan, Construction of Waste treatment facility is regarded as the priority project in the next five years. Therefore, the market of MW treatment industry will meet an explosive growth. In this chapter, Chinese macro environment will be introduced first, then, Chinese MW treatment market will be analyzed primarily based on government policies of the 12th Five Year Plan. Current four main players in MW treatment market will be introduced for the purpose of identifying their business mode and their methods of solving business risks, which somehow shows the current competition in MW treatment industry in connection with analysis of Porter’s Five Forces. The other renowned players will be addressed in Appendix for reference. Administrative framework is separated from stakeholders’ analysis due to government policies in China having strong power to influence the business performance. Finally, MW treatment market barriers and risks will be summarized as well as the whole practical chapter.

5.1.1 Chinese Macro environment-PESTEL analysis

Political factors

Political environment can be affected by people’s attitudes, government policies. It also can put a huge impact on business performance and social activities.

Relevant political factors in Chinese MW treatment industry mainly refer to tax policy, trade restrictions and tariffs, and other government policies.

Foreign companies' marketing strategies have faced a tremendous effect with Chinese government's policies and industrial regulations. First, MW treatment projects require the operational approval from Chinese government. Due to its long-term operational period and the profit model, MW treatment companies have to negotiate with local government in a long run. Second, although Chinese government's policy of marketing MW treatment industry has encouraged both international and domestic investors, the intangible support for domestic companies is inevitable, especially in the process of tendering, domestic technology or products are always a selection priority. Third, foreign investment, however, is welcomed by Chinese government owing to the requirement of marketing economics and the local demand for hi-techs. Therefore, Chinese government has promulgated laws and policies to attract foreign investment. For example, hazardous waste treatment facilities are the fifteenth, in the "Industry guide lists of foreign investment" (2007) by NDRC. By encouraging companies entering public infrastructure construction, all level of governments has released tax preferential policies. For instance, Shanghai tax department has published "tax free or discount for industries", companies involved in waste treatment projects or technology development of emission reduction can enjoy "three years' taxes free" policy and "taxes 50% discount" policy after first obtaining operational income. However, local government's policies consistent with central requirement still have different details, especially in preferential policies due to the interest of different groups. Finnish companies can go through this as further research.

Economic factors

China's economy has rapidly increased in recent years and still shows a strong development in the future. In 2010 China became the world's largest exporter. In recent years, China has renewed its support for state-owned enterprises in sectors it deems "economic security," explicitly looking to foster global competition sector leaders. China in 2010 stood as the second-largest economy in the world after the US, having surpassed Japan in 2001. Even in the global economic downturn due to the financial crisis in 2009, China rebounded quickly, outper-

forming all other major economies in 2010 with GDP growth around 10%. The economy appears set to remain on a strong growth trajectory in 2011. In the 12th Five-Year Plan, Chinese government continually reforms the economy and emphasizes the need to increase domestic consumption in order to make the economy less dependent on exports for GDP growth in the future. (CIA 2011) World Bank classifies China as to be an “Upper middle” economy in 2011 that differed from the classification as a “Lower middle” one last year. (World Bank, Classification, 2011) However, China’s per capita income is below the world average and the domestic economic development is unbalanced with further progression in coastal provinces than in the interior.

Furthermore, three major economic factors, which can greatly vary business income, should be taken into consideration for Finnish investors. First, Chinese government implements fixed exchange rate. Facing international pressure, mainly from the US, it is still varied. This somehow affects the foreign investment in China, especially the import-export trade. Second, currency inflation is another problem foreign investors could face in China. In late 2010, it surpassed the government's target of 3% (CIA 2011). This mainly affects the investment in manufacturing, which requires large amount of raw materials from local market. Third, the corruption and other economic crimes are involved in business operation. For example, bribes sometimes are expected from individuals who are illegal in both Finland and China, still widely exist in China. This asks for a suitable action from marketing managers.

Social factors

Chinese people’s raised awareness of environmental protection fosters the development of environmental sanitation industry in China. People pay a great attention to MW sanitary treatment mainly due to the health consciousness. Residents in eastern and developed cities like Beijing, Shanghai, Guangzhou have higher requirement on living conditions and public infrastructures, this because of more education they have gained from daily lives and institutions. This also explains the large number of hospitals and health centers existing in those relatively developed cities.

Technological factors

Developed cities in China have relatively stronger ability in terms of innovation and R&D, this mainly due to the large number of universities, institutions and professionals in those regions. For instance, until 2007, Shanghai has 96 higher education institutions only less than Beijing with 118 (DYGK 2010), and more than 300 foreign R&D centers, and one out of three is invested from the world top 500 companies. In 2000, technological transaction value rocketed up by 101.74%, reaching 7.39 billion Yuan, compared with 3.65 billion Yuan in 1999. Until 2005, Shanghai's technological transaction scale has reached 20 billion Yuan and keeps continually increasing in recent years (FZKJ 2007).

Universities in Shanghai, like Tongji University and Jiaotong University have very strong capacities in innovation and research. Based on Tongji University, Shanghai Boshigao Environmental Equipment and Engineering Company produce many products in aspect of all fields of environmental sanitation. However, many local small-size companies lack capacities of research, Finnish investors can take advantage of local research achievements or cooperate with local institutions and universities to compete with local players.

Legal factors

So far, there is no law directly related to MW in China, but Chinese government has released and promulgated many relevant regulations and standards (details in section 5.2.2) to standardize the MW treatment industry. Although local governments make regulations and standards stricter, there is still problem for foreign investors, like IPR. This is the huge risk for foreign products and services. Recommended solution for this risk can be seen in section 5.4.6.

Environmental factors

China is a country with large territory, but the majority is mountainous, which is not conducive for living. Nowadays, a large number of migrants are pouring into urban areas and looking for better jobs and better lives. Therefore, land is limited under urbanization, even in the developed cities, like Shanghai and Beijing; the price of land is ever higher than before. This situation explains the encouragement of incineration method in China rather than landfill or composting, and the MW treatment facility only can rent and use land for operation rather than own it. Local governments' intervention in environment varies and reflects in the enforcement of regulations and laws. Generally, local governments in developed

regions are more concerned about environment; in contrast, municipalities in less developed areas under the pressure of economic development usually favor investment.

5.1.2 Demand forecast

China annually generates around 650 000 tons of MW, which accounts for 2% of MSW. And this figure continually grows by 19%-25% per year. (Li Run-dong, 2006, Vol.6 No.2) According to “the First National Pollution Source Research Bulletin” released by MEP in 2010, total output of MW is 450,200t, innocent treatment output is 394,200t, and innocent treatment rate is: 87.6%. But lacking of the exact statistic data of MW output forecast from Chinese government, and without a common model to calculate the MW output, figure only shows the estimated data of MW output based on Mr Li’s statistics.

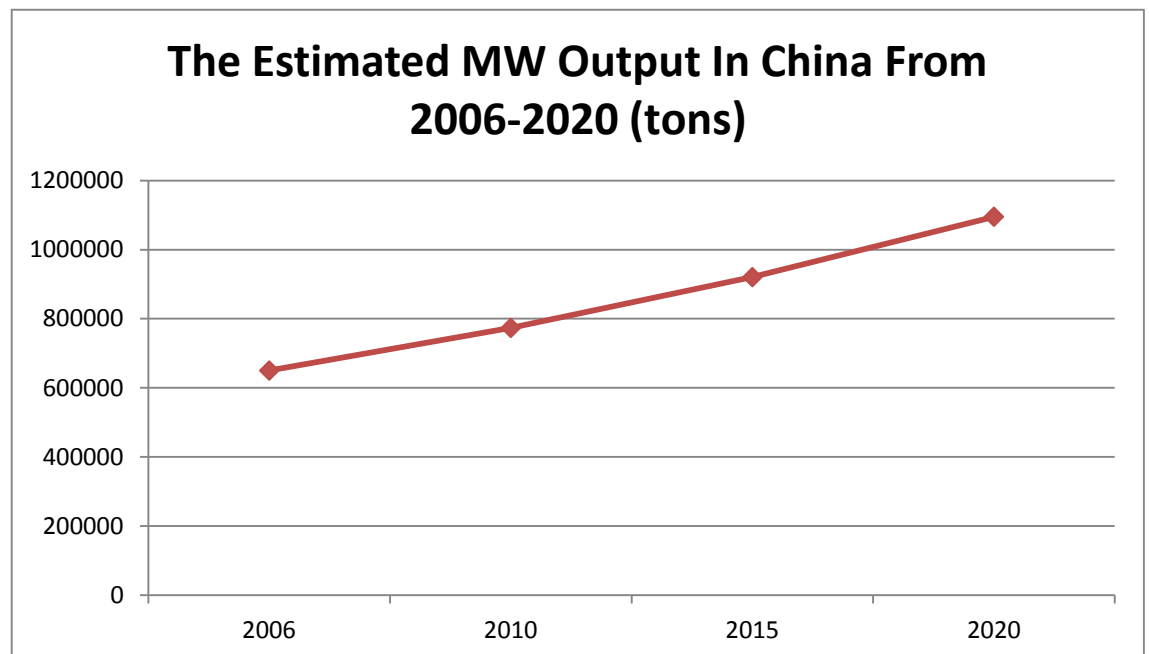


Figure 11: The estimated MW output in China from 2006-2020

Nevertheless, MW, as mentioned before, belongs to MSW. Therefore, the factors, for example, the economic development level and the dwellers’ living quality, which put a huge impact on the output of MSW also, can affect that of

MW. According to Pöyry's finding from the World Bank, the MSW output quantity is predicted to be 350 million tons in 2013, which is raised by 25% from that generated in 2011.

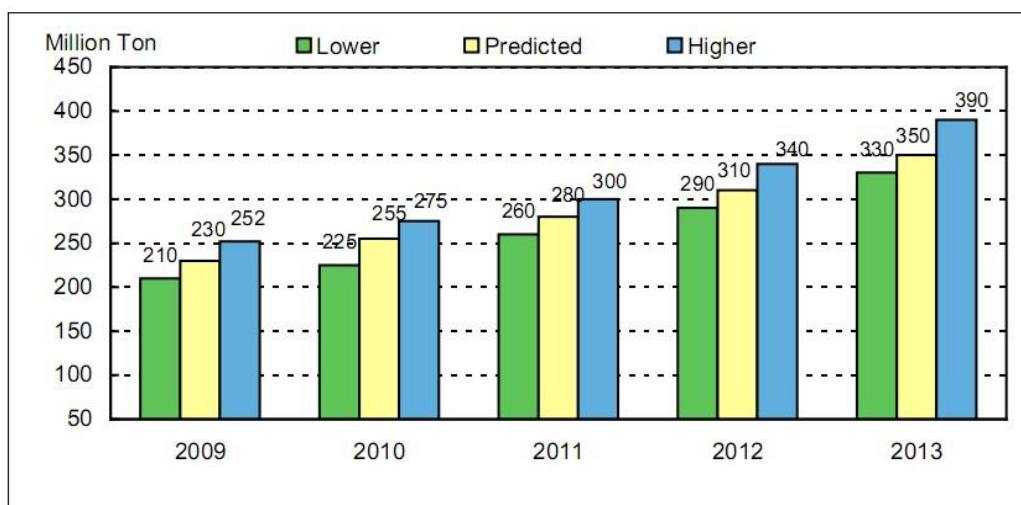


Figure 12: MSW output forecast in nationwide from 2009–2013

According to a study “A Research on the Outputs Prediction of Medical Wastes”, researchers present that the output of MSW generated in China is directly proportional to Chinese GDP. Additionally, the developed regions can produce more MW than cities with lower GDP and with poor living conditions. This is mainly because people's requirements for advanced medical equipments, medical technology and medical service have arisen by the sustainably rapid economic growth and by the increasing income.

World Bank classifies China as to be an “Upper middle” economy in 2011 that differed from the classification as a “Lower middle” one last year. (World Bank, Classification, 2011) Nationally, generally speaking, eastern regions account for the highest GDP of China, whereas western areas show less competence in GDP, and the middle ones are in the “middle level”. According to China Financial Daily and 21 City.org, 12 out of 15 cities ranked in 2010 and 2011 Top 15 in GDP are eastern cities, whereas three from Middle West (Wuhan, Chengdu and Chongqing) in the rank show the most significant increases in GDP. (Details See Appendix: table 2010 TOP 15 Chinese cities Rank in GDP and table 2011 TOP 15 Chinese cities Rank in GDP) This atmosphere indicates the geographic distribution to the amount of MW output in China. The figure shows the amount of MSW output from eastern regions is near twice than that from middle areas and

three or four times than that from western areas annually. This roughly indicates the researchers' analysis.

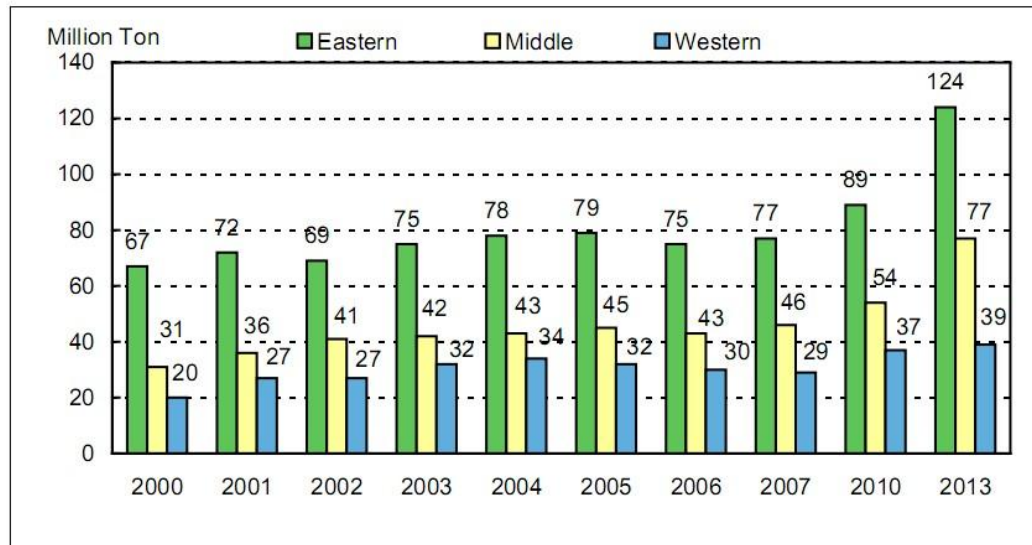


Figure 13: MSW output quantity in China's urban areas between 2000 and 2013 (Source: Pöyry)

According to an investment report of China's waste treatment industry (hereafter as Investment report 2011), with increasing development of urbanization, China's MSW output is predicted to be 323 million tons, which is twice that generated in 2010. This fact in 2010 is 167 million tons, which is relatively similar with the predicted data from the World Bank (see figure 13 above).

Table 4: MSW output in urban China from 2010-2020

YEAR	2010	2015	2020
Quantity (million tons)	167	260	323

(Source: Investment Analysis Report on China's Waste Treatment Industry by Reviewing 11th Five Year Plan and Predicting 12th Five Year Plan, 2011)

However, being special institutions for offering services to everyone, hospitals or other healthcare centers have inherent factors of influencing outputs of MW. For instance, the number of beds, the utilization rate of beds, patients, etc. Mr. Zhuang Yu Ting, the chairman of Pu Hua Kang Jian Environmental Protection Company, said taking a municipality with 2 million populations as an example, there would be 8000-10000 hospital beds in the city, usually the MW treatment fee is varied from 2 to 2.5 Yuan per bed, the total payback for companies will

over 7 million Yuan annually. If a city with population less than 2 million, the requirement for the number of hospital beds is fluctuant from 5000 to 8000, therefore, a company can obtain payback from 3 million Yuan to 7 million Yuan. Based on China Economic Herald's investigation, until 2009, China generated at least 1.07 million tons' MW from total 0.9 million hospitals. The potential profit of MW treatment market has reached 3.1 billion Yuan. According to MEP's first national pollution source research, until 2010, there are only 184 MW treatment facilities in China. Put it another way, over 80% of overall cities are without centralized MW treatment facilities or lack MW treatment equipment. Some hospitals and health care centers stealthily treat MW by themselves without special equipment and trained staffs. Until now, less than 200 companies have been involved in China's MW treatment industry. If taking particular account of the legal requirement, only 1/4 of the total MW treatment companies has professional qualification and can reach the national standards.

In recent years, with Chinese government's emphasis on environmental sanitation, a lot of private capital began entering into Chinese MW treatment industry by direct investment or mergers and acquisition. But as far as current market is concerned, splintering is the primary issue for MW treatment industry. The major operator has only 5% share of the whole market. Therefore, China's MW treatment market has great potential to be profitable to investors and equipment suppliers due to its ever increasing market and improving policies and regulations.

5.1.3 Supply forecast

Due to the unique characteristic of MW, the Chinese government's requirement is centralized treatment and gas sanitation. According to the "regulations of Medical Waste Management" (2003), MW centralized treatment facility should be established in each area above the rural-area level; remote and under developed regions can be invested by government. However, the number of established MW treatment facilities is only 184 until 2010, which is significantly

unbalanced when comparing with the number of areas above rural-area level in China. Stimulated by international climate conferences and agreements, and improved awareness of environmental sanitation, Chinese government has done a great effort to develop MW treatment industry in China. Supply forecast will put emphasis on the subsidies and investment from Chinese government, which constantly provides potential investors with preferential policies either on business operation or on technology development, aims to attract more potential investors into MW treatment industry.

According to Pöyry's finding, Chinese government has invested CNY 4 trillion to stimulate domestic demand and to promote economic growth. "during the 11th Five-Year Plan period, the gross investment on the pure waste treatment facilities is CNY 58.9billion." Additionally, "the plans of constructing national hazardous waste and medical waste treatment facility" (hereafter called "Plans") got the official approval of the State Council for implementation in 2003. "Plans" was integrated into ten priority projects in 11th Five-Year Plan and obtained 3.8 billion Yuan from the central government. What's more, the 12th Five-Year Plan that has been released this year emphasizes the prominent position of climate change, environmental issues, and energy. As WRI' Principle Advisor Deborah Seligsohn said, "this is the first Five-Year Plan that mentions climate change, and it's mentioned at the top of the environmental section."

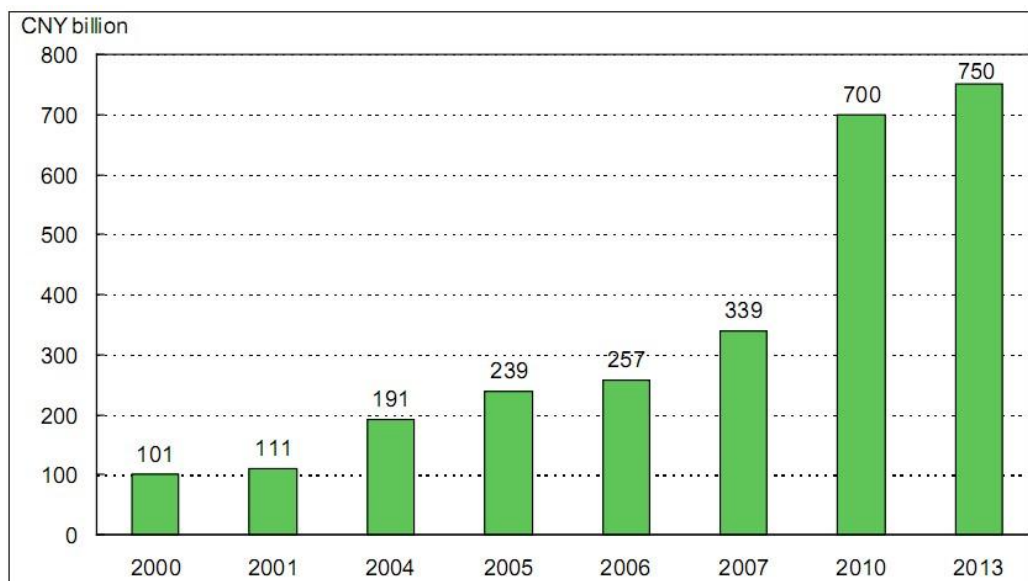


Figure 14: Investment in Anti-pollution Projects between 2000 and 2013 (¥ billion)

Since 2009, government's awareness of environmental sanitation is unparalleled strong. This mainly because the international pressures and the forces from environmental protection organizations. For examples, United Nations Framework Convention on Climate Change (UNFCCC), 1992; Kyoto Protocol, 1997; Bali Road Map, 2007; Copenhagen Agreements, 2009. As a developing country, China has made a great effort to reduce environmental pollution with developed countries. Typically, "Energy conservation and pollution reduction" (ECPR) has turned to be the supreme duty for Chinese government. In 2009, "accelerating the development of environmental protection industry" has been one of the eight most important duty for ECPR; in 12th Five Year Plan period, "Plans of ECPR industry development" will be promulgated separately. Thus, after analyzing the development trend of environmental protection industry in China, Investment report (2011) predicted Chinese government will invest 3.46 trillion Yuan for protecting environment.

Constant comprehensiveness of government's policies and regulations on environmental sanitation has simultaneously encouraged the development of waste treatment industry. Investment report (2011) estimates, in 12th Five Year Plan period, the annual investment in waste treatment industry would be 70.2 billion Yuan; in 13th Five Year Plan period, the annual investment in waste treatment industry would be increasing to 91.3 billion Yuan. From 2010 to 2020, the compound increase rate of investment in waste treatment industry would be reached 10%. From 2010 to 2015, the annual market scale for domestic waste incinerator manufacturers would be gross to 2.3 billion Yuan, whereas that would come up to 3.77 billion Yuan during a decade from 2010. That means domestic incinerators will have an opportunity to occupy more market share in the future waste market industry.

MEP also has estimated in this year that the State intends to invest 2 billion Yuan into the field of solid waste protection and chemical management during 12th Five Year Plan period. The purpose of this investment is to develop large-scale whole set equipment with proprietary IPR, to research the manufacture technology of large-scale furnaces and control incineration technology, to advance integrated treatment technology of wastes, and furthermore to develop essential technology and facility of organism anaerobics to produce methane, and to sys-

temically study the non-incineration technology of fly ash sanitation and of persistent organic pollutants (POPs) treatment. Government's investment in scientific technology will certainly encourage a tremendous development of Chinese waste treatment industry.

5.1.4 Main players in medical waste treatment industry

With the rapid development of China's medical waste treatment industry, in the recent years, more and more foreign investments are extensively attracted to the local market. International corporations are booming under the stimulation of numerous profits. Those main players being involved in medical waste processing sector mostly can be divided into three categories: investment management companies, equipment manufacturers, technology consulting companies. The name lists of the main companies both international and local ones in each category and the major projects they operate can be seen in Appendix 3. Here, four representative companies investing in MW treatment industry are going to be introduced due to their different modes of entry and market strategy, especially the solutions they used to overcome business risks, which are main forces which can influence revenue. By analyzing three companies' performances, the common risks and relevant solutions can be drawn at the end of this section that indicate the trend of current Chinese MW treatment industry, and eventually support the recommendation of the last chapter.

Shanghai Chengtou Corporation (hereafter SCC)

Shanghai Chengtou Corporation was founded in July, 1992. With the authorization from Shanghai Municipal government, Shanghai Chengtou, as a professional industrial investment group company, engaged in the construction and operation of the city's infrastructure facilities. It has raised over 200 billion yuan during the last 15 years, has 1 listed company, 23 subsidiary companies, 26000 employees, invested in and built over 60 significant infrastructure facilities of road and bridge, tunnel, subway, environment, water supply and sewage, gas and housing for resettlement. (SCC) According to SCC's public announcement,

being a listed company, until 2008, SCC's total assets have increased by 150% from 7.6 billion Yuan to 19.6 billion Yuan; its net assets have risen by 40% from 7 billion Yuan to 9.7 billion Yuan; its total share capital ran up from 1.884 billion shares to 2.298 billion shares. After briefly introducing SCC, two subsidiary companies of SCC related to MW industry that significantly affect SCC's role in MW treatment industry will be stressed in the following section (finance 2008). The first one is Shanghai Environment Investment Company (hereafter SEI). SEI is an 80% state-owned investment management company; its main benefit is from long-term equity investments. SEI has shared 70% of total MSW treatment market in Shanghai. By operating five projects respectively in Chengdu, Shenzhen, Jiangyin, Taiyuan and Ningbo, and being keen on following up with over 50 projects around the market, SEI expects to be the NO.1 enterprise in China's waste management industry, and eagers to quick expand and obtain more profit and enlarge its business network in the nationwide. In March, 2010, SCC sold 40% of SEI's shares to Waste Management Inc, the giant waste treatment company in America. Thus, the joint venture company becomes the largest MSW treatment enterprise in China.

The second one is the Shanghai MSW treatment center (hereafter SMSWTC), which is operated by SCC for treating all the MW generated in Shanghai, but invested by Shanghai government. Its total assets are near 0.48 billion Yuan. SMSWTC is a hazardous waste and MW treatment facility combining landfill, incineration and comprehensive utilization located Jiading, Shanghai. By being built the third incineration line with the largest treatment scale of 72t/d and the advanced technology of rotary kiln incineration system in the country-wide, SMSWTC not only meet the national requirement of safely treating hazardous waste, but also have the capacity of dealing with the event of hazardous waste generated by accident (Solid waste2010). Its capacity of 72t/d can transform waste heat to 800kw/h electricity. This technology filled in the gaps in producing electricity by utilizing waste heat from MW incineration in China. Therefore, it becomes a national demonstration facility for all level of government from provincial on down. In the beginning of 2010, the facility was commissioned. At the same time, Mr. Wang Xingfang, the president of China Association of Environmental Protection Industry introduced SMSWTC in Chinese Environ-

mental Protection Industry Conference and, proposed to popularize SMSWTC's advanced technology and management method to every province (CAEPI 2010). Beijing Sound Environmental Protection Company (hereafter Sound)

Sound is a leading domestic company with its own hi-techs and patents in respect of treating urban waste-water, urban solid waste, urban sludge waste, industrial wastes, MW and electronic waste. With near 20 years' experience in environmental sanitation industry, Sound is able to provide clients with project consulting, technical design, product supply, and project construction and so on. Solid waste treatment is the core business for Sound to obtain income. In 2010, the benefit from solid waste treatment has reached 75.72% of the total income. (Eguard, 2011) Being a national hi-tech expertise, from 2009, Sound has a priority right of enjoying a preferential policy of reducing 15% income tax rate within a certain time period. Sound is master of systemic solid waste treatment techniques, especially in terms of high temperature-high pressure steam technique and thermal decomposition incineration technique in treating MW. In order to enhance company's profit, Sound set up a facility in Xianning, Hubei province, in May, 2008, for manufacturing environmental resource equipments (called Xianning Base for short), and officially operates from December, 2010. Xianning Base takes the responsibility of manufacturing the equipments for treating urban solid waste, urban sludge waste and producing the hazardous waste incineration equipment. When successfully operating, Xianning Base can totally produce solid waste treatment equipment for 35000t/y, and produce 162 other environmental protection pieces of equipment per year, including incineration equipment for hazardous waste treatment of 3000t/y, like rotary kiln, bag bust filter, dehydration equipment, drier, draft fan and MW treatment equipment for 2000t/y, like high temperature- high pressure steam system and thermal decomposition furnace. Xianning Base has increased the rate of domestically-produced equipment, and also provides the opportunity of exporting. According to Huatai Securities' prediction, Sound normally gains 0.638 billion Yuan income per year, and 0.126 billion Yuan profit as well. Because there are only 4-5 solid waste treatment equipment manufacturers in the domestic market and their products are mainly middle and low-end, high-end products need to be imported. Xianning Base comes with providing hi-tech products; meanwhile,

because of government encouraged policy on domestically-made products, Sound's waste treatment equipment can be the substitutes for foreign imported high-ends products.

Being a listed company, Sound has registered capital: 413,356,140 Yuan. Until 30.June, 2011, the total capital is 3,430,624,362.55 Yuan; its revenue is 633,464,276.31 Yuan from January to June, 2011. (Huatai Securities, 2011)

Sound acquired five BOT contracts of MW treatment projects. Table shows the investment, project scale of each project.

Table 5: Sound's Five BOT MW treatment projects

Project name	Investment (Yuan)	Scale (t/y)
Industrial and MW hazardous waste centralized treatment facility in Hubei province	0.13 billion	Total capacity: 26 thousand Waste incineration: 10000 (included MW 1000) Waste landfill: 15800 Waste physicochemical treatment: 7000 Curing process: 10000
Industrial and MW hazardous waste centralized treatment facility in Jilin province	0.16 billion	Total capacity: 35 thousand Waste comprehensive utilization: 2100 Waste incineration: 10000 (included MW 3600) Waste landfill: 20700 Waste physicochemical treatment: 8000 Curing process: 15000
Industrial and MW hazardous waste centralized treatment facility in Gansu province	0.12 billion	Total capacity: 26 thousand Waste comprehensive utilization: 6200 Waste incineration:

		4950(included MW 3140) Waste landfill: 18370 Waste physicochemical treatment: 15450
rial and MW hazardous waste centralized treatment facility in eastern of Inner Mongolia	0.1 billion	Total capacity: 21 thousand Waste incineration: 2550(included MW 1650) Waste landfill: 20000
Huainan MW treatment facility in Anhui province	–	Total capacity: 5t/d

Shanghai Boshigao Environmental Equipment and Engineering Co., Ltd (hereafter BSG)

BSG was established in 1998. Registered capital is 2.5 million Yuan. The business scope of BSG is environmental sanitation equipments investment, integrating operation of environmental sanitation projects, water and waste treatment, researching, developing and producing atmosphere control system, noise control system and boiler products, providing environmental sanitation projects with designing, monitoring and training services. Because the former chairman of BSG, Mr Gao Yan Yao was the principal of Tongji University, the company's platform for business development is based on the exchange and cooperation with Tongji University. With the high level of research ability in engineering, like environmental engineering, thermal engineering, mechanical engineering, chemical engineering and electric engineering, Tongji University has comprehensively provided BSG various professionals with specialty knowledge in aspect of all fields of environmental sanitation. But the most competitive strength of BSG is hi-tech hazardous waste treatment and industrial flue gas sanitation. Through technical exchange and cooperation with professional companies from Europe, Japan, Singapore and so on, BSG's expertise in techniques, equipments and projects operation has met the international level and has its own intellectual property on treatment system and treating equipments. Especially in terms of waste incineration, with a brilliant feat of engineering, BSG has a powerful competence competing with international coun-

terparts. In addition, BSG has a comprehensiveness of quality management system, which successfully meets the certification requirement of ISO9001. As a result, BSG is successful to be the turn-key techniques and equipments supplier for many international clients. Such as German Degussa (Shanghai) chemical industry company, BSG provides the service of industrial liquid waste and flue gas incinerator. (Boshigao 2011)

As far as medical waste is concerned, BSG developed the rotary kiln with treatment scale of 100t/d and 120t/d, and gas sanitation system promotion, solved the domestic difficulty of designing, producing and operating large scale of rotary kiln. However, there is an enormous difference for centralized treating hazardous waste service between industrial countries and China. Because most of the industrial companies in China are operating in small scale, but normally gathered together in one region, which directly causes the diversity of wastes varied easily, and asks for a high adaptability of treatment techniques and equipments to the hundreds of waste with different physic-chemical properties and combustion characteristics. In order to solve those problems, based on their practical experience on engineering operation and management, BSG has basically established the Chinese first database of industrial hazardous waste physic-chemical properties and combustion characteristics, and the manual of industrial hazardous waste storage, pretreatment and wastes ingredients. The database and manual not only solves their business problems, but also effectively helps with the national problems on systemic technique design and operation management of regional centralized treating hazardous waste. (Boshigao 2011)

Current intense competition pushes BSG ever-forward. In recent years, BSG has been expanding business from single projects service to investment and operation development, from single waste treatment to combination of waste treatment and comprehensive utilization. As a result, they established Shanghai Xingyue Environmental Protection Company with treatment capacity of 15000t/y for industrial hazardous waste; are jointly building Shanghai MW centralize treatment project with total investment of 90 million Yuan; is the chief constructor of Yiyang Medical Waste Centralized Treatment Project in Hunan Province (total investment is approximately 15 million Yuan); and also the chief

constructor of Panzhihua hazardous waste centralized treatment project in Sichuan province (total investment is approximately 20 million Yuan).

Table 6: BSG's seven MW treatment projects

Project name	Scale (t/d)
Jiuzhaigou Medical Waste Incineration Facility in Sichuan Province (Design)	3
Maerkang Medical Waste Incineration Facility in Sichuan Province (Design)	3
Jingdezhen Medical Waste Incineration Facility in Jiangxi Province (Technology Consulting)	3
Shanghai Medical Waste Centralized Treatment Facility (joint construction, Construction in process)	36
Kunshan Hazardous Waste (Includes Medical Waste) Incineration Plant in Jiangsu Province	24
Yiyang Medical Waste Centralized Treatment Project in Hunan Province (chief constructor, Construction in process)	8
Panzhihua hazardous waste centralized treatment project in Sichuan province (chief constructor, Construction in process)	-

Pu Hua Kang Jian Environmental Technology Company (hereafter PHKJ)

PHKJ is a foreign direct investment (FDI) company, established in 2003. It's the earliest company that has entered into China's MW treatment industry by providing non-incineration hi-tech and products. PHKJ is the Chinese agent of Hydroclave technology since getting approval from Canadian Hydroclave Company to sell and manufacture biologic waste treatment techniques, especially the sterilization furnace for MW treatment use. Due to the development of government policies on MW treatment and the improvement of people's awareness of environmental sanitation, PHKJ draws a positive trend of Chinese MW treatment industry. (Sino- manager, 2011)

As Mr. Zhuang, the chairman of PHKJ said, with health care reform and government's efforts on MW treatment industry, the market has become more ob-

viously active than before. In 2008, PHKJ sold more than ten units of equipment, whereas the number of sales rapidly doubled in 2009. MEP allocated 15 billion Yuan to support the construction of MW centralized treatment facility in more than 300 cities of the nationwide. And according to the MW regulations, MW must be sterilized for pre treatment rather than being recycled used. Therefore, PHKJ segments three target groups. First, the 500 cities with more than 2 million population, each city requires one MW centralized treatment facility; second, more than 1000 hospitals of infectious diseases, each hospital shall establish its own MW treatment facility; third, the 500 cities with less than 2 million population, their requirements on mobile-equipments for MW treatment. Thus, PHKJ has at least 2000 target customers, according to the industry estimated, MW treatment fee of one city with more than 2million population is normally 7 million Yuan, which means 4 billion Yuan potential value of MW treatment industry.(Chuang ye jia, 2010)

However, PHKJ aims not only to be a techniques supplier in this industry, but to pave a way for diversification and internationalization. Thus, PHKJ divides its market strategy into five steps: the first step is looking for potential market and developing products to suit the market; the second step is looking for cooperators for financing; the third step is purchasing small and scatted MW treatment facilities around China, making them to be the company's source of income; the fourth step is to be listed after being profitable; the fifth step is diversifying products and internationally expand business. (Sino- manager, 2011) Until now, PHKJ has succeeded in the first step. Their techniques with Hydroclave technology won some bids in Sichuan, Qinghai, Beijing and Jilin. When the Wenchuan earthquake occurred in 2008, PHKJ donated one on-vehicle mobile MW treatment technique with high-temperature sterilization system, which won the fame of "the first" technology in China, to the stricken area (Daifu, 2008). Moreover, cooperation with Goldman Sachs Group (GS) from last year makes PHKJ famous in the field of MW treatment industry as well as accelerates its step for being a listed. Thanks to GS's high reputation in terms of investment, PHKJ has gained significant social capital for itself. This will attract scatted MW treatment facilities initiatively being acquired.

Each above company has its own advantage competence, enters into the MW treatment market with different modes and specific business strategy, and aims to obtain a large number of cash flow by market segmentation. However, in every market, risks always come with business development. Companies' particular solutions to overcome business risks addressed in the table along with the business comparison can be used as reference for Finnish investors.

Table 7: Main players' business comparison and solutions for facing particular risks

Name	Company mode	Competitive advantage	Registered capital (Yuan)	Business scope	Distributing area (in terms of MSW treatment)	Average profit from projects
SCC	State-owned/have one listed subsidiary company/have one joint venture	Huge capital and government support	20.406 billion	Road and bridge building/water supply/environmental protection/real estate	Developed cities/large-scale treatment projects	Loss (due to construction of the municipal infrastructure is public welfare service)
<p>Risk : high degree of business dependence on the government of Shanghai/ applying for loans for project investments and construction from Chinese commercial banks</p> <p>Reasons:</p> <p>SCC is the most important operator for Shanghai's construction of infrastructure, has high degree of business dependence in aspect of project investments and debt payment on the government finances of Shanghai. If local government's finance income and subsidies on infrastructure reduced, SCC's cash flow would be influenced greatly. Applying for loans from commercial banks Company's finance will be negatively influenced by the increment of banks' RMB lending rate.</p> <p>Solution: direct finance.</p> <p>Until 2008, SCC has issued of 21 corporate bonds on an accumulative basis, raised 25.3billion Yuan in total. (hexun,2010)</p>						
Sound	Domestic listed company	High-ends equipment manufacture company	0.41335614 billion	treating urban wastewater, urban solid waste, urban sludge waste, industrial wastes, MW and electronic waste	Central area/Jiangsu and Zhejiang province/Beijing and Inner Mongolia	Profitable Gross profit rate increased by 1.84% from 2010 to the first half of 2011
<p>Risk: cost growth/ long-term payback period of waste treatment projects might influence cash flow/ new business in MSW techniques manufacture</p> <p>Reasons:</p> <p>Price rise in raw steel material, which is the primary material for manufacturing MSW techniques. Price change in raw</p>						

<p>material will directly affect the cost of production and business cash revenue.</p> <p>Increasing business requires the guarantee of cash flow</p> <p>Business in techniques manufacture have a relatively long process of producing and selling</p>						
<p>Solution:</p> <p>Strengthen cost control, improve ability to bargain</p> <p>Strengthen the good relationship with commercial banks, well manage cash flow period, enhance administrative process control management and avoid problems of cash flow</p> <p>Quickly build business channel, progress marketing strategy and enhance control ability of products quality (Finance 2011)</p>						
BSG	Domestic company	Technology development and quality management (certification of ISO9001)	2.5 million	environmental sanitation equipments investment/projects design, integration	Small-medium MW treatment incineration facilities	
<p>Risk:</p> <p>components of MW changed along with the urbanization and non-classification in source substitutes occurred</p> <p>intense competition</p>						
<p>Solution:</p> <p>Established the Chinese first database of industrial hazardous waste physic-chemical properties and combustion characteristics, and the manual of industrial hazardous waste storage, pretreatment and wastes ingredients</p> <p>Strengthen the exchange with domestic and international educational institutions, improve the research ability of technology development and increase the amount of proprietary IPR</p> <p>Expand business from single projects service to investment and operation development, from single waste treatment to combination of waste treatment and comprehensive utilization.</p>						
PHKJ	FDI	Hi-tech and social capital	10 million	non-incineration hi-tech supply and manufacture/ MW incineration projects investment, integration and operation	500 cities with more than 2 million population the 500 cities with less than 2 million population more than 1000 hospitals of infectious diseases	Loss from MW projects, due to number of projects is small/ the high investment on business operation for building good reputation/ single product; but

						obtained more than ten million dollar investment from GS
Risk: profit loss, single product						
Reason: looked on the market trend, government policies and reforms of MW treatment industry.						
Solution:						
Formulating specific market strategy and follow up, for instance, financing and to be listed.						

In conclusion, main players involved in MW treatment industry have generally faced two primary risks: shortage of cash flow and market-suited technology.

Main reasons are addressed below:

- Marketization accelerates competition in the field of MW treatment industry. Small and scattered companies and projects will be eliminated gradually. Companies only deal with MW collection or transportation will be easily replaced by that have an integrated system which combines collection, transportation, sanitation treatment, investment and management. Industry integration inevitably higher the entry requirements of capital investments as well as hi-techs with proprietary IPR.
- MW treatment project has a long-term payback period. With less and less investment on treatment fee from central government, enterprises have to ensure the health of internal fund-chain and the abundance of cash flow.
- Imported technology may not suitable for Chinese market due to the different characteristic of MW and collection methods. Therefore, enterprises shall pay more attention to technical development and products optimization.

By realizing those problems in the process of business operation, main players' solutions mainly are:

- Enlarge and extend the business chain, adjust market distribution, integrate all sorts of resources, seek chance for financing, further build own reputation in the field of MW treatment industry, be listed.
- Improve technology by operating with renowned international hi-techs suppliers, increase the number of technology with proprietary IPR, act for hi-techs with authority or acquire franchising.

5.1.5 Stakeholders' analysis

Stakeholders' analysis generates useful and accurate information about persons and organizations that are interested in MW treatment industry. This information can be used as input for analyzing local networks and for developing action plans on communication and negotiation. Because different types of business, here the internal stakeholders are excluded in analysis. Chinese governments as the most important stakeholder for marketing strategy and with full of power in MW treatment industry are introduced separately in section 5.2 Administrative framework. All the stakeholders listed in the table 8 below are external ones for a MW treatment company.

Table 8: Stakeholders list of MW treatment industry in China

Sector	Sub-sector	Reason chosen to MW incineration industry
Government	Ministry of Environmental Protection (MEP) and its relevant municipalities	All levels of Chinese government related to MW treatment industry have different but strong relationship with MW treatment companies. For example, MEP and MOHURD is primarily in charge of formulating relevant policies and regulations for environmental protection and giving official approval for MW treatment projects. The regulatory agency of government is mainly responsible for monitoring and supervising the construction
	Ministry of Housing and Urban-Rural Development (MOHURD) and its relevant municipalities	
	Regulatory agency of the government	

		and implementation of MW treatment projects.
Suppliers	Hospitals and health centers	MW is the source for MW treatment. MW output is directly associated with the scale requirement of MW treatment project and the project investment.
	Incinerators and MW treating equipments manufacturers	Incinerators and MW treating equipments are the fundamentals for well operating the MW treatment facilities.
Competitors	Incinerators and MW treating equipments manufacturers	Finnish companies 'advantage competence is advanced technology in aspects of incinerators and MW treating equipments. But due to the different environmental requirements, Finnish current available technology might not well adopt to Chinese market. Thus local manufacturers and other international players with mature market experience in Chinese market can be the potential competitors for Finnish investors. Additionally, the local competitors' low pricing strategy also the major threat to Finnish investors.
	MW treatment investment management companies	Along with the development of Chinese tendering mechanism, competition on MW treatment industry is booming. Both local investment management companies

		and international ones are hungry to share this large market. With Chinese government' strategy for encouraging the development of leading enterprises, integrating the small scale enterprises with low capacities, eliminating the operators who lacking of standardization and misprocessing, the investment management companies who exist in Chinese MW treatment market will be more powerful and more competitive.
	Informal MW recycling and treatment facilities	Due to the private interests and the inadequate awareness of MW, some hospital staffs and informal collectors reach an agreement on secret dealings. Especially in private health centers, the illegal behaviors intensively exist. This puts negative impact on legal MW treatment companies.
Media	Newspapers, TV, radio, journals, websites and so on	Various mass media can release relevant news and information or state's strategy and policies on environmental protection. From which, companies can obtain up-dated information for business promotion.
Customers	Power supply bureau	Power supply bureau is a big buyer for purchasing electricity from MW treatment power plants.

Environmental groups	Environmental protection organizations, NGOs, like WWF	Environmental protection organizations like supervisors who appeal environment-friendly actions and opposite pollution actions. They might not have any interest in doing industrial business with enterprises, but aim to stop pollution occurs.
Trades associations	Finnish Environmental Cluster for China (FECC)	Those trades associations are important for Finnish investors. Because they are more than business bridges between China and Finland. They can provide international business experience to new players who intend to enter Chinese market. They also can help Finnish investors with basic knowledge about the development trend of environmental sanitation in China by their earlier investigations.
	Clean tech	
	China Association of Environmental Protection Industry	
Lenders	Banks, e.g. World Bank Finnish government	Lenders here mainly refer to various banks or government agencies that provide loans or funds to establish projects. For example, under the fund support of Norway government, MEP and United Nations Industrial Development Organization (UNIDO) develop jointly Jiuzhaigou Medical Waste Treatment Facility in 2010.
Local community	Municipal District Office	Due to the MW can pose a potential threat to local community, the location chosen for establishing a
	Community Residen-	

	tial Committee	<p>MW treatment facility is important. For example, by fearing of the pollution threat, in 2007, Xiamen citizens expressed a vehement protest to PX project, which took Xiamen into account for establishing Chinese largest facility to produce p-xylene that is normally used to manufacture plastic, polyester and membrane. Finally, the project evacuated that area. Therefore, the power of local community should be taken into consideration by MW treatment enterprises.</p>
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Power interest grid is used to visually identify the priority of stakeholders. Figure 15 divides all the external stakeholders into four groups and shows the sectors which have more power to influence the MW treatment industry with high interest to involve in this business and which are opposite.

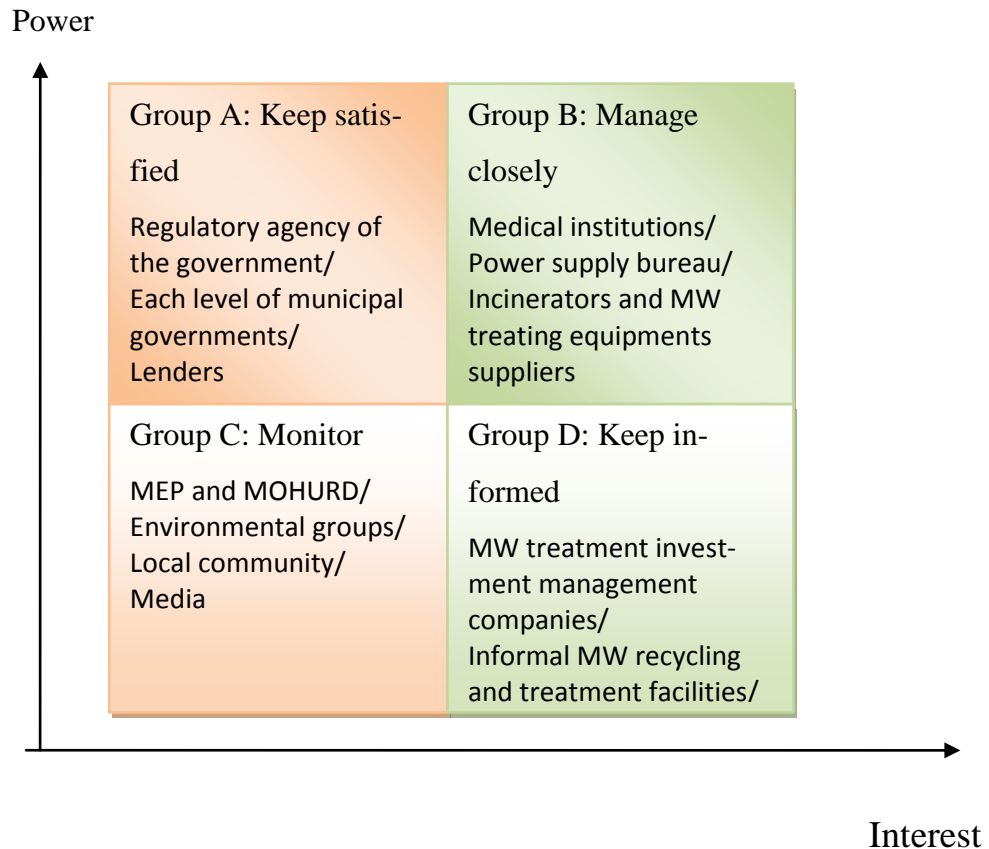


Figure 15: Power Interest Grid for Stakeholders

Group A includes the stakeholders with powerful influences on MW treatment industry but with low interest in doing business with MW treatment companies. Regulatory agency of the government aims to supervise the daily operation of MW treatment facilities. The duty of each level of municipal governments is formulating provincial development plan, giving projects operation licenses and investigating operators' qualifications. Lenders provide loans or funds normally according to reliable national organizations' feasible reports. Their purposes are to assist and support the development of underdeveloped regions. All in all, those stakeholders are not intended to participate directly in the construction of MW treatment projects, but have full power of decision on the establishment of a project.

Group B consists of MW suppliers and power customers. They are not only fully involved in MW treatment industry, but also the main factors to influence the business profit. So negotiation and communication with those stakeholders can significantly affect a MW treatment company's pricing strategy, technical promotion as well as the business outcome.

Groups C's function is to improve the performance of the whole MW treatment industry, to encourage the development and reform national policies in aspect of MW treatment, to enhance citizen's awareness of environmental sanitation.

They don't show any interest in MW treatment projects' construction, nor has willingness to obtain direct interest from this business.

Group D are direct and indirect competitors, who are full of interest in MW treatment sector, but with lower power to influence a counterpart's revenue.

Trades associations may involve many potential investors, who share the same information together, can be competitors to each other. On the contrary, every member in a same trades association might focus on different sectors within the same industry; in that case, they could be the business partners. Thus, keeping informed with those stakeholders is important for booming the whole industry with positive competition.

5.1.6 Porter's Five Forces

The market competition in MW incineration is rather fierce. This situation partly because of the marketization and industrialization strategy of Chinese government, by which many regulations and standards promulgated to a certain degree are successfully attractive to potential investors; it partly because the high requirement for professional equipments and the problem-solving skills in projects operation as well as the huge early investment, which cannot be provided directly by local government. Therefore, the threshold is widely opened for professional companies, which either have hi-techs for MW incineration or hold a huge sum of money and are interested in Chinese MW incineration treatment industry. Analyzing Chinese market competition power by Porter's Five Forces could be necessary for Finnish potential investors basically knowing the market

barriers and risks. However, different types of companies have different rivals, analysis of entrants, suppliers, buyers and substitutes should be aligned with companies' market strategies. The table presents the MW incineration industry competition analyzed by Porter's Five Forces.

Threat of new entrants

The high profitable payback is always the most attractive factor for investors. In the field of MW incineration, rates of return on profit primarily depend on government's policies, especially on preferential policy, such as treatment fee, electricity fee, subsidy, tax. As mentioned before, whatever the "Plans of ECPR industry development" has been emphasized in 12th Five Year Plan or the annual investment in waste treatment industry would be 70.2 billion Yuan in the following five years and even higher in the future, both of the signs embody Chinese government's a great effort on environmental sanitation, and also explore government's willingness of attracting more investors to the field of waste treatment industry. Until 2010, there are only 184 MW incineration facilities with approval operating in China, compared with the development of urbanization and the increasing population, the total number of projects doesn't meet the market demand. Therefore, MW incineration sector has more and more potential opportunity for new entrants.

However, high requirement of huge investment and know-how stops many investors, this mainly because of the special characteristics of treating MW in China. First, the diversity of wastes varied easily, when much small scale industrial companies gather together with hospitals and without proper classification for MW, this asks for a high suitability of treatment techniques and equipment to the hundreds of waste types with different physic-chemical properties and combustion characteristics. Thus, companies with hi-techs and professional expertise for solving MW treatment problems are welcomed.

Another issue which should bring concern is the existence of illegal MW incineration projects. Those projects either operating without approval from government or just with small scale treatment capacity can't meet the local demand. Besides, some of them do not fulfill the emission standards. As a result, many projects have been eliminated by government. In recent years, with the interna-

tional awareness of environmental pollution, each level of Chinese municipals have set up certain system, which aligns with state's policies, to supervise and control MW incineration projects' pollution actions. For example, Gansu province will carry out a policy of certificating all the staffs related to hazardous waste management (including MW). Put it another way, whatever the administrative staffs from environmental protection department, or the directors and workers from hazardous waste generation enterprises should be trained twice per year, then a certification can be issued for working after passing a certain examination. The more and more severe the government policy is, the less and less illegal action will occur. Therefore, when threshold of MW incineration market is opened widely, the market is more standardized.

Many domestic companies take technology and cost into account, only acquire contracts to construct projects. But a few companies are involved in manufacturing the sophisticated equipment, this due to the technical requirement for contracting to construct being low. But with the cutthroat competition in the bidding process, the construction profit will be sharply shrunk.

All in all, the threat of new entrants for contracting a construct is high, whereas that for sophisticated equipment manufacturers is low.

Bargaining power of suppliers

The suppliers in the field of MW incineration industry, could be the local government, who plans projects and offers subsidy and investment preferential policies; could be the incinerators or other equipment manufacturers. The level of bargaining power of suppliers depends on the demand of suppliers. The analysis is following below.

MW incineration projects in China are planned and announced by government. Because of the increasing population and the development of Chinese living condition, people expect more comfortable and safe environment for living. Thus environmental sanitation turns to be a most important issue for Chinese government. What's more, by several international agreements on environment protection released, the national pollution control actions frequently reflect on the promulgation and implementation of official regulations and standards. Thus, the power of government on formulating and implementing policies is absolutely strong. However, lacking of know-how and adequate intellectual properties,

Chinese government, meanwhile, needs importing the hi-techs for improving national technology to meet the international standards. In that case, a number of preferential policies have been promulgated for foreign investors. And negotiation with government is somehow possible. Additionally, with the bidding process more and more transparent, and the progress of marketization, government's power on deciding the contractors is much lower than before.

From the incinerators and equipments' manufacturers' point of view, the local accessories suppliers have less power for bargaining, this mainly because there are many substitutes of accessories in China.

But for the MW incineration operation companies, the high technical standards for incinerators or other equipment require professional suppliers. In domestic market, a few suppliers are able to provide hi-techs. As mentioned before, until now, there are only 4-5 companies can manufacture solid waste treatment equipments, high-end services primarily depend on importing. In this case, the bargaining power of techniques and equipments' suppliers is strong.

The other main suppliers are hospitals and other health centers, who supply MW to MW incineration treatment facilities. According to Chinese regulation of MW treatment, except sanatoriums and mental hospitals, every hospitals and health centers must contract with MW treatment companies for collecting, transporting and disposing MW. Moreover, each level of municipals have promulgated regulations of MW centralized treatment, which point clearly that the MW treatment fee is concluded in the hospitals' medical service cost, besides, hospitals are not charged for disposing pollutants any more as well as the urban household waste treatment fee. In the past, MW treatment fee depends on the MW generated volume, which causes many hospitals and health centers disposing MW stealthily by themselves so that they could reduce the MW treatment fee. BY recognizing the drawback of the charge method, in recent years, local governments have started to set and guide prices in light of combining MW generated volume and the number of hospital beds. Generally speaking, each hospital pays 2Yuan/ day / bed for MW treatment fee. The fee is publicly announced by each level of price department, so the bargaining power of hospitals and health centers is low.

Bargaining power of buyers

Here buyers refer to incinerators or equipments manufacturers; MW incineration projects operators and government.

Incinerators or equipments manufacturers have a strong bargaining power for buying accessories from local suppliers; the reason is the same with that mentioned in bargaining power of suppliers.

However, high-end incinerators and equipment buyers have less power in buying, because the number of domestic suppliers who can provide high-end services is small. If importing the equipment, high transport fee and the cost for after-sale significantly run up the total cost.

Government here refers to the power supply bureau, who buys electricity from MW incineration facility. The electricity fee can be negotiated between local governments and operation companies. If the company has advantage competence on hi-techs or has large capacity for project operation, local governments usually can provide an attractive price for purchasing power. In this case, governments have a weak power for bargaining and vice versa. Thus, the government's bargaining power is medium.

Threat of substitutes

As far as MW incineration facility is concerned, the substitutes normally refer to the incinerators or other equipments. In Chinese market, there are only around 200 players involved in waste treatment industry, and near 100 incinerator suppliers. Most of domestic suppliers only provide service to low-mid-ends. Although by Chinese government's support and, the research and development of technology, there are a few local companies can provide high-end equipments and services due to lack of huge amount of money and the knowledge on know-how. Taking SOUND as an example, their Xianning Base, which established last year, aims to produce high-end products to replace the foreign hi-techs. But by knowing 40% of their products are self-use, it's uncertain that how to sell the rest of them. Therefore, if Finnish companies provide hi-tech incineration equipments which can fit to the local environment, the threat of substitutes is low.

5.2 Administrative framework

Administrative departments are playing an essential role in a large scale in MW treatment industry. Every market player needs to acquire qualification certificates from all different levels of relevant governments before starting business operations. Especially in China, those authorities govern all the constructions of municipal infrastructures. Some of them are even widely involved in the project constructions for leading market order. Therefore, those primary stakeholders from central to local should be introduced separated from other related business stakeholders. Moreover, the announced legislative laws, regulations and policies that are related closely to MW treatment industry presented in this section are going to illustrate the instructive guidance for market players.

5.2.1 Administrative structure of medical waste management in China

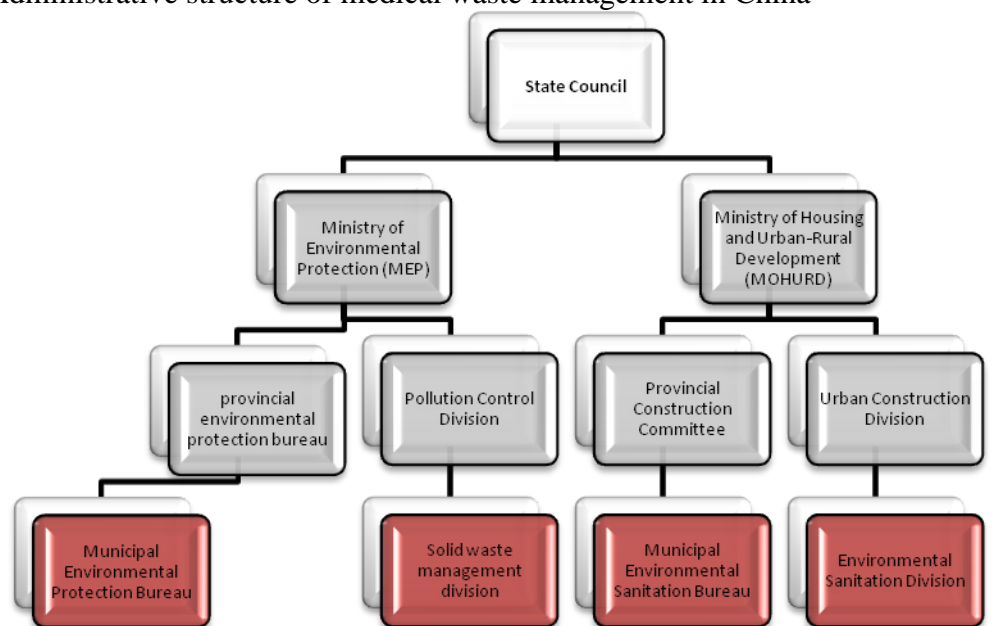


Figure 16: Administrative structure of MWM in China

Figure 16 shows the main departments that concern MWM in China. The State Council of the People's Republic of China, namely the Central People's Government, is the highest executive organ of State power, as well as the highest organ of State administration (GOV 2011). But it's not the direct government for inspecting or monitoring MW, only the relevant departments in gray panes will be introduced later as well as the ones in red panes which are important de-

partments with rights to investigate, monitor and punish practitioners in MW treatment (see table 9).

Ministry of Environmental Protection (MEP) is in charge of coordination, supervision and management of key environmental issues, taking responsibility for preventing environmental pollution and controlling damage from a source, in order to achieve national target on emission reduction. Putting forward recommendations on the scale and direction for fixed assets investment in the field of environmental protection and arrangement of national financial budget; review and check the fixed-asset investment projects under national plan and annual plan in accordance with its terms of reference identified by the State Council; cooperate with relevant departments to do well the implementation and supervision work. (MEP 2008)

Ministry of Housing and Urban-Rural Development (MOHURD) is charge of formulating regulations, laws and policies in terms of housing construction and housing reform and, implementing them. Monitor and standardize the markets for construction, real estate, and land exploitation.

Urban construction division is responsible for framing the development strategy and plan for urban construction and municipal public infrastructure. Its other duties are: supervising building urban wastewater treatment facility and the pipe network and, monitoring water and heat supply.

Provincial Environmental Protection Bureau is responsible for formulating relevant regulations, laws and policies for the whole province that based on the orientation of national environmental protection. And take some responsibility with MEP in behalf of the province.

Pollution control division is charge of environmental pollution and environmental situation analysis. Making initial drafts of regulations, policies, laws or standards to prevent environmental pollution related to atmosphere, urban land, light, MSW and so on. Checking and monitoring the registration of hazardous waste's operation license.

Provincial construction committee is fully engaged in building industry including the construction of municipal public infrastructure, for instance, supervising the construction of waste treatment plant. Design, plan, and supervise provincial

engineering construction in aspects of analyzing projects feasibility, pricing and so on.

Table 9: Directly relevant administrative departments and their responsibilities on MW treatment projects

Directly relevant administrative departments	Responsibilities related to MW treatment projects
Municipal Environmental Protection Bureau	Monitor waste water , gas emission and MW storage Environmental impact assessments Draw up regulations, policies, etc. on MW with other relevant departments gather statistics and survey data from MW projects approval
Solid waste management division	Draw up regulations, policies etc. on MW with other relevant departments Inspecting and monitoring MWM Projects approval
Municipal Environmental Sanitation Bureau	Training practitioners Monitor MW M Penalizing MW treatment enterprise according to <Medical Waste Management regulations> June, 2003
Environmental Sanitation division	Framing relevant regulations, policies and laws Training Monitor operation

In recent years, MW is generally considered as MWM for administrative legislations. There is no specific governmental department taking a special duty for monitoring or inspecting MW. Cross-authority exists in Chinese government for a long time. Thus, administrative departments usually have to collaborate with counterparts to against illegal MW treatment behaviors. Governors' slow reactions directly cause the lawless actions to last long.

5.2.2 Relevant legislations on medical waste

In order to solve the domestic waste problem fundamentally, Chinese government has made great efforts to formulate administrative legislations to limit environmental pollution. Due to different purposes, those legislations generally can be divided into three main categories: laws, regulations and policies, standards and codes. Their purposes and powers used to describe the characteristics and the powerful impacts on the development of MW treatment industry.

Table 10: Legislations of MW with different purposes and powers

Legislations	Purposes	Power
laws	Being Performance specification	Strong, most authoritative
Regulations and policies	Being orientation and guide to industries	strict
Standards and codes	Being Restriction norms for MW treatment facility construction, technique selection, and gas emission	Most specific

Although there is no specific law to restrict players' behaviors on MW treatment, until now, many regulations, standards and codes came into force for some specific purposes. Some legislative examples in table to simply illustrate current Chinese MW treatment market situation. (See more legislative documents list in Appendix 3)

Table 11: Main legislative documents on MW treatment industry

Documents	Issuing date	Main contents and functions
“Regulations of Medical Waste Management”	June, 2003	Defines the duties of MW treatment enterprises, employees and the rele-

		<p>vant municipal departments that have been involved in the process of MWM.</p> <p>Stimulates MW Innocent treatment and encourages MW treatment technology development.</p> <p>Stipulates MW treatment centralization.</p>
“Hazardous waste treatment license management methods”	May, 2004	<p>This document applies to every MW treatment facility. According to Article 3, “hazardous waste treatment license consists of two types of licenses, which are hazardous waste collection, storage and disposal integrating license and hazardous waste collection license.”</p> <p>And the former one “is valid for 5 years” whereas “hazardous waste collection license is valid for 3years”. Despite the MW treatment contracts at least would be valid for 20years; this regulation indicates the strong intervention of government.</p>
“Methods for Medical	June, 2004	This “methods” is in ac-

Waste Management administrative penalty ”		cordance with “Regulations of MWM”. It defines the penalty for each illegal behavior of MW treatment enterprise.
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As mentioned before, MW, in China, is regarded as one of MSW; so some Legislative forces on MSW treatment industry as impetus for market standardization and industrialization are also effective for players on MW treatment industry.

Table 12: Documents efforts towards waste treatment industry

Documents	Issuing date	Main contents and functions
“Notice On Implementation Of MSW Treatment Charging System to Promote Waste Treatment Industrialization”	June. 2002	Comprehensively promotes MSW treatment charging systems, puts forward that “waste treatment units shall separate government functions from enterprise management, introduce competitive mechanisms and adopt an open bidding method for carefully selecting qualified enterprises to assume MSW treatment “, meanwhile requiring that “urban construction (environmental sanitation) administrative departments shall establish a market

		admittance system” and this paves the way for waste treatment industrialization.
“Comments on accelerating marketization progress in municipal public industry”	December, 2002	Open municipal public utility industry markets (including waste treatment industry), establish municipal public industry franchising system, transit government management methods and promote marketization progress actively and steadily.
“Regulations for municipal public utility franchising”	May, 2004	Define the principles for implementing municipal public utility franchising, the selection procedures of the investors or operators as well as the respective responsibilities and obligations of government and enterprises.

(Adapted from Pöyry’s findings)

5.3 Tendering process

Medical waste treatment, in China, is the government’ duty and is placed under government’ control all the time. Especially Medical Waste treatment projects, due to the potential pollutions to environment and the special requirement for land use, Chinese government has been considered those as the basic municipal infrastructures, thus, tender, being a most important method, is applied in MW

treatment industry. All the relevant companies can obtain an operating contract by tendering in a public bidding. In order to make information transparent enough, government applies “public advertisement”, which opens the procurement information timely to all potential bidders in the official website.

Except a few tenders only offered to selective tenderers (those are always the state-owned companies or local environmental sanitation bureaus), most tenders are open for all the relevant MW treatment companies. Even the overseas technical or equipments suppliers can obtain contracts to enter into China’s market via tendering. With increased transparency throughout the whole process of tendering, selecting the candidate equipments suppliers or projects operation companies becomes the main responsibility for government, and taking part in tenders’ turns to be the primary way for the companies doing MW treatment in China.

Those Finnish companies, who are keen to share Chinese MW treatment market, can take an intensive advantage of local relevant Chinese companies. For example, the bid invitation agency, who can obtain public bidding information very quickly and provide various services at a relatively low price, like tracking information on relevant bidding companies and introducing joint invitation to tender. But huge risks existing in this process might be faced by Finnish companies who are new to cooperate with Chinese local companies. For instance, the real level of local companies’ professional qualification cannot be easily identified by Finnish companies who lack of field investigation and international business experience.

5.4 Market barriers and challenges

The barriers and challenges for investors entering into Chinese MW treatment industry are mainly the negative factors, which objectively exist in China, and will affect the business process inevitably. Identifying market barriers and challenges can help Finnish investors doing good preparatory work, planning suitable market strategy, improving competitive power.

Informal recycling collector and treatment facility management

The biggest issue formal MW treatment companies should be concerned about is the existence of informal recycling collectors and illegal treatment facilities. The primary reason for explaining this atmosphere is the private interests. Some hospital staffs reach an agreement with informal collectors on secret dealings. For example, injectors and other plastic MW can be recycled by informal collectors at 1-1.5Yuan/kilo or 2000-3000Yuan/t, informal collectors sell them to illegal treatment facility at 3000Yuan-4000Yuan/t, so informal collectors can illegally gain 1000-2000Yuan/t. According to investigation, those plastic MW are normally crushed into small particles for manufacturing shoe pads. In addition, selling MW to informal collectors, hospitals not only can easily increase income but also can reduce the volume of MW and furthermore lower the treatment cost. So, although self-dealings of MW are not allowed, some hospitals do little to stop the illegal practices.

With implementing the health care reform, government has addressed tough punishment on illegal dealings of MW. According to the field investigation, many hospital staffs found it's unworthy to deal with MW privately due to the high fine of 30000 Yuan. Although official policies have had some success in decreasing those illegal actions, the informal recycling and underground-deals still exist in current Chinese market, especially in small towns and private health centers.

Inpractical legislations

In order to strengthen the power of environmental protection and to improve the MW mechanism, central government and all level of municipal governments has formulated and promulgated series policies and regulations, but many of them have failed to be implemented in practice.

For example, according to "Regulations for Medical Waste Management", in article 11, "health care institutions and medical waste centralized treatment enterprises should implement the policy of hazardous waste transfer duplicates management, which is based on the 'Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste'", every hospital shall complete the hazardous waste transfer duplicates (five sets in total) accurately every day. However, in practice, in order to reduce cost and decrease

cross-infection, many hospitals only sign or fill in one set, and input the data into a computer. It is inconceivable that every department of a hospital has enough time to fill so many complicated duplicates every day.

Furthermore, despite the “Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste” requires collecting, transporting, storage and disposing MW properly, the detailed regulations and policies on the requirements of MW generators, transporters, collectors and disposers have been formulated very slowly.

Additionally, MW supervision requires a systemic mechanism and asks for coordination between policy-maker, executor, and supervisor. However, current Chinese MW policies and regulations refer to a large number of departments of governments in different levels, such as health and anti-epidemic departments, urban environmental sanitation bureau and environmental protection departments. The duties of those departments are inherently ambiguous or overlapped. In China, there is no efficient supervisory system and a few trained supervisors.

Higher requirement of entry threshold

With the development of MW treatment industry, competition in this sector is more and more fierce; the entry threshold is much higher than before. Chinese MW treatment market requires efficient integrated operation mechanism from business players rather than small scale business. Companies combine MW collection, transportation and disposal management are encouraged by current market, whereas the ones with lower ability to implement the process of MW treatment will be eliminated in the near future.

Unbalanced development of regions

China has a rapid development in recent years, which has reflected in national GDP. But by viewing the economic development rate of each province, the economic achievements are quite different from north and south, from east to west. In general, the economic development is relatively high in the east, whereas the mid-west areas are far behind. Unbalanced development of regions causes the governments' subsidies for MW treatment projects to differ. Because a MW project operation requires huge amount of investment, and can't obtain benefits in a short-term, the amount of local government's subsidies decides a project scale, the technical use and its overall performance.

In China, developed cities and regions normally can afford relatively high cost, like Beijing, Shanghai, Guangzhou, Suzhou, Hangzhou, and Tianjin. But with the government policy on encouraging western area development, some mid-west cities have more potential in the field of MW treatment industry, for example, Chengdu, Chongqing, and Wuhan.

Adaptability of MW treatment technology

While the MW classification and collection standard are well practiced in Finland, China's MW is still mixed collection and disposal. This directly causes the components of MW to be varied in different situations and the requirement for MW treatment technology is different from that in Finland.

Because of the crude MW collection method, 80% of Chinese MW is household wastes, which with high moisture and organic materials, the MW treatment technology applied in China shall have high combustibility.

Technology transfer and loss of Intellectual property (IP)

This situation happens, when Finnish companies enter into Chinese market and develops local partners, transfer latest hi-tech to the Chinese subsidiaries of Finnish companies and to the joint-ventures. Chinese government gives a priority of choosing local products in public tenders, and even the foreign subsidiaries are not considered as local. Therefore, a Chinese contractor will be employed; probably will be involved in the process of technology transfer. Additionally, technology suppliers must promise the greatest transfer of know-how in the tender contract. This might cause the loss of core technology, at worst, IP.

As the recommendation given by Euro Biz, foreign investors should analyze their local competitors comprehensively, and better to make a name list of all potential and existing competitors. Devise and review in-home IP protection measures. Define the limits of what can and cannot be transferred and defend that position vigorously. When compulsory know-how sharing situation happens, Finnish companies should vigilantly monitor and proactively register for relevant rights before negotiations. Pay close attention to local industrial policies and laws, the goals of potential partners and ownership structure of them as well as to the unusually frequent personnel changes. If a company's key patents, trademarks and copyright are registered already, make sure to build in contractual barriers to prevent partners from abusing IP. (Euro biz, 2011)

Room for improvement in terms of public awareness

Public awareness and understanding of environmental sanitation is associated closely with government's formulation and implementation of MW treatment policies and regulations. Thanks to the publicity, people have realized that MW is a severe pollutant for local environment. Because of lack social guidance on classification and collection, and additionally, without a sufficient management mechanism, the public hardly participates in MW treatment industry.

5.5 Summary of the practical discussion

In this chapter, current situation and future trend of Chinese MW treatment industry are described based on a range of data analysis and, an analysis of actors' actions along with the market change and their internal relationships. The main information covered in this chapter is:

First, exploring market potential of MW treatment industry through reviewing 11th Five Year Plan and forecasting 12th Five Year Plan. Government's plan of investment on MW treatment industry reflects the importance of this field and also reveals the business opportunity from macro-economic control's point of view. Additionally, MW output brings the market demand as well as present problems, which requires the intervention of MW treatment enterprises.

Second, it introduces four main companies involved in MW treatment industry with different entry modes and specific market strategies. It's mainly for exploring their business risks, problems and the solving approaches, providing samples for Finnish investors to reference, as well as assisting in recommending a feasible entry strategy in the end. Utilizing Porter's Five Forces to analyze market competition in the field of MW treatment industry aims to identify the degree of power of objective factors, like competitors, new entrants, substitutes, buyers and suppliers, which can strongly influence Finnish investors' market strategy and competitive advantages as well.

Third, it analyzes stakeholders that are closely associated with MW treatment players, show the various local networks, by which business can be established and the relationship with which somehow decide business success. Government as the most important stakeholder is explained separately in section 5.2 Administrative framework. This mainly because government's policies can significantly affect MW treatment industry, especially in aspects of authorizing franchising, giving official approval for MW treatment projects, and the most important is, providing subsidies and pricing MW treatment. Stakeholders' analysis can be used to suggest marketing strategy.

Fourth, it explains tendering process, which is the essential part for business operation. In China, participating in tenders is the only way to acquire MW treatment projects. The importance of tender is addressed in the section 5.3 tendering process.

Fifth, it identifies market barriers and challenges, which are the last issue included in this chapter, whereas market potential is introduced at the beginning of this chapter. Barriers and challenges show the entry threshold of MW treatment industry, which help Finnish investors with formulating strategic solutions and understanding own competitive advantages. Those analyses in chapter 5 can well support explaining the business opportunity for Finnish investors to participate in Chinese MW treatment industry, and to recommend them a way to formulate business model and marketing strategy in China.

6 RECOMMENDATIONS AND CONCLUSION

Recommendations addressed in this chapter partly with summarizing the business opportunity of MW treatment industry in China, especially based on three different types of companies, which are investment management companies, equipment manufacturers, technology consulting companies, partly by providing Finnish investors with marketing strategy from decision-making to after-sales service, which consists of entry modes selection, local networks establishment, systematic solutions especially in terms of technology provision, principal of pricing strategy and sustainable service of after-sale.

The conclusion combines findings of the secondary study and primary study in section 6.3 summary of the study, and summarizes the purpose and usefulness of this paper, which along with the limitations of this study gives a proposal for the possibility of further research.

6.1 Business opportunity for Finnish investors

China's 1.3 billion population has stimulated MW output. A large part of the continuously increasing population in pace with the improved living condition,

have a higher requirement on medical treatment. Thus, numerous specialized hospitals and health centers with advanced techniques and specialists have been established in recent years; as a result, MW output presents an appearance of diversity and regionalization. Diversity reflects the high requirement on the MW treatment technology, while the regionalization reflects the regional choice. Chinese government has made great efforts to encourage the development of MW treatment industry. For instance, “Comments on accelerating marketization progress in municipal public industry” (2002) aims to promote marketization progress actively and steadily. Although this legislation indicates the limited financial capacity of Chinese government, it certainly provides domestic and international investors with a great opportunity to enter Chinese market and to participate in the project construction of public infrastructure. Moreover, other regulations and standards promulgated by Chinese government for standardizing MW treatment industry can be regarded as entry guidance for Finnish investors. For example, the government’s requirement of MW centralized treatment asks for hi-techs from foreign investors.

As a conclusion of foresaid analysis, business opportunity in the field of MW treatment can be explained from three aspects for Finnish investors. The first one is the competitive advantage of Finnish MW treatment companies; second is the geographic distribution of centralized MW treatment facility; the third is the entry mode recommendation for Finnish investors; finally, the business model recommendation will be provided in this part.

6.1.1 Competitive advantage of Finnish MW treatment companies

MWM has three main steps: MW collection, transportation and disposal. All those steps require secure equipment and well-trained staffs. However, MW generated in China is not well managed. Responsible staffs mix hazardous MW and household MW, or personally sell MW to informal collectors for money collection. Some hospitals or health centers openly dispose MW with non-purification system. On the contrary, Finland has stricter regulations and

standards to treat MW. It's hard to say Finnish companies or hospitals' treatment approaches are the best one in the world, but compared with Chinese MWM, Fins already have more than 20 years' experience in treating MW and many optimal available technologies and can provide training courses internationally. Based on Chinese market current situation, Finnish investors with feasible and total solutions from start to end-disposal are required and welcomed.

6.1.2 Geographic distribution of MW centralized treatment facility

Geographic Distribution for business expands. China's unbalanced development of population and economy directly causes the MW output to be varied in different regions. With huge financial support from central government in the past decades, eastern areas are more developed than western areas.

Figure 17 presents the number of MW centralized treatment facilities aligned with each province and municipality until 2010. Eastern provinces, like Guangdong, Shandong, Zhejiang and Hebei have had established more MW centralized treatment facilities than that have been set up in western region, like Gansu, Ningxia, Yunnan, Qinghai. But along with "the policy of Development of the West Regions", mid-west areas have reached a significant growth in recent years, for example, Sichuan, Shanxi, Inner Mongolia, Hunan, especially the capital cities in this region have a strong market volume. Four municipalities, Beijing, Shanghai, Tianjin and Chongqing have less MW treatment facilities due to the smaller size of city compared with other provinces and the government's policy of each area above rural level should establish one. Taking Beijing as an example, it already has four centralized MW treatment facilities. This reveals that megacities' large market volume is far beyond the number released by government policy, which also shows the market potential in those places. There is no MW treatment facility in Tianjin and Xizang by 2010, so those two areas are not concluded in the Figure 17. But according to the up-dated information from Tianjin Environmental Protection sciences Research Institution, Tianjin Han Yang Hui He Environmental Protection Technology Company will invest

85.71 million Yuan this year to establish a centralized MW treatment facility in Tianjin's economic development zone with incineration scale of 25t/d and high temperature sterilization scale of 15t/d (TAES, 2011). According to MEP, "State-construction system" has conducted in Xizang, which means the project of MW treatment facility is planned and constructed by the central government; until now, private capital has no access to investing in the construction of MW treatment facility in Xizang.

All in all, high costly facilities, such as incinerators, can be easily afforded by eastern areas of China, which are still popular places for investment. Additionally, with recent rapid economic development and government's financial support, the mid-western region shows huge demand for incineration technology, especially the capital cities of mid-west, like Chengdu, Wuhan, Chongqing, the population of which are all over 10 million, and the GDP (2010-2011) of which are ranked in the top 10 of China. (See Appendix 4)

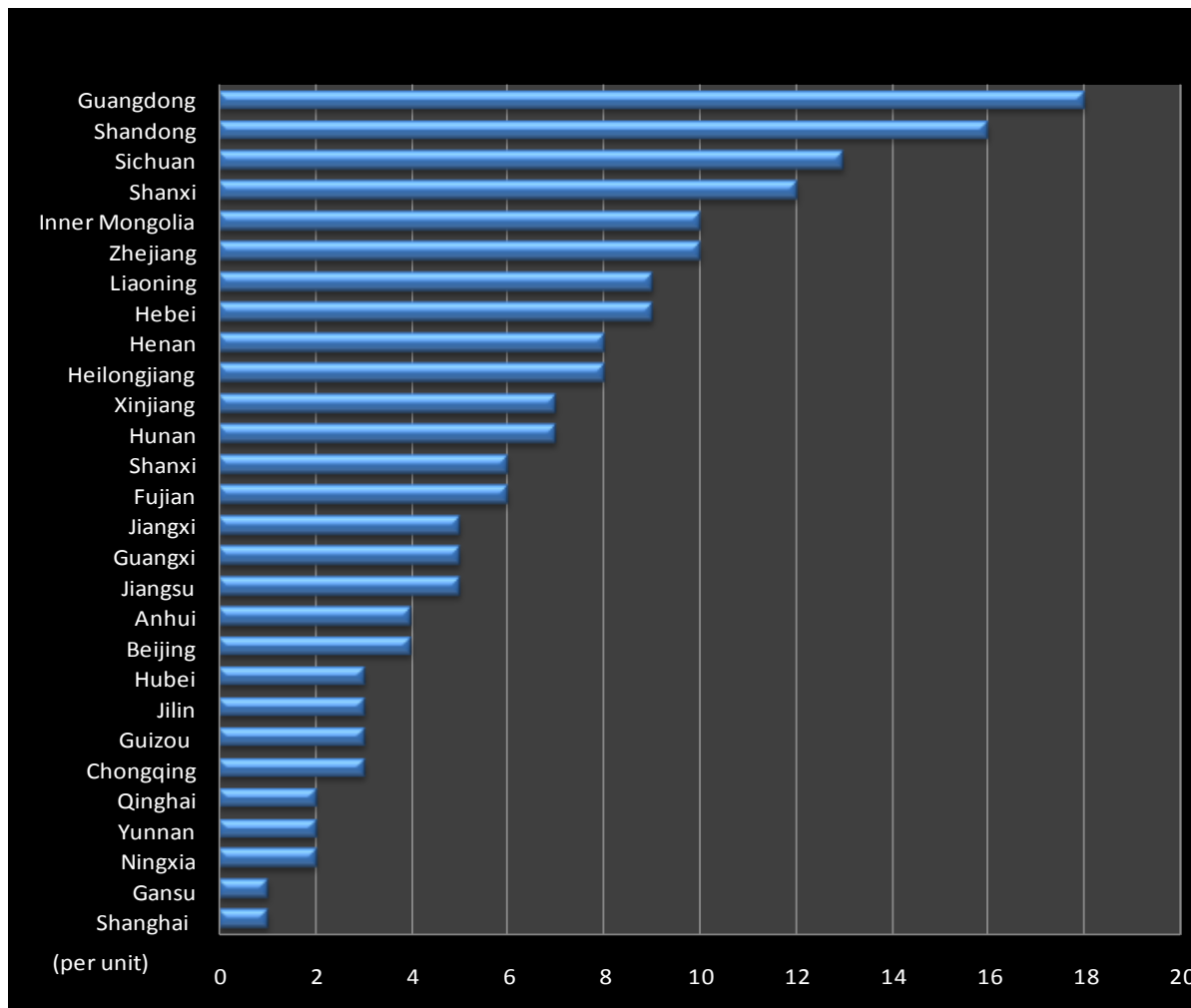


Figure 17: The number of MW centralized treatment facilities aligned with each province and municipality until 2010

6.1.3 Entry mode recommendations for Finnish investors

Due to maximizing reduction in investment risk, there are three main entry modes extensively chosen by current foreign investors who are involved in Chinese MW treatment industry.

- Establishing local representative offices

When companies are abroad, it's hard to get up-dated and useful information for tendering or for reaction. Companies and active in Chinese MW treatment industry might ignore the technology, products or services from Finland as well as Chinese government. Establishing local subsidiaries or representative offices are the best way to get access to local market. Establishing local representative offices in China is the simplest and the most cost-efficient way can help parent company with local market information gathering and with market research. For example, Onyx, a Singaporean company, whose business scope is exporting and importing water treatment and waste treatment equipment, and doing relevant market research, it can obtain deep information about China market by establishing offices in Shanghai and Guangzhou, it also cooperates with other domestic companies to jointly operate projects. Such as the project of Chengdu Luodai waste incineration power plant, Onyx acquired a technology supplying contract by cooperating with Shanghai Environment Investment Group and Shanghai Haiwan Investment Management Company.

However, simply being a feedback provider and a connection between foreign and local, a local representative office has no rights and inadequate financial support to operate projects.

- Joint venture and wholly foreign owned enterprise

Although Finnish companies have advanced technologies and products, they may not compete with local companies, even whose quality and life-cycle of products are low. This mainly because of the numerous project costs. Despite government somehow being able to provide subsidies, companies' initial nationwide market layout is costly.

Therefore, taking advantage of local companies in terms of business networks and tendering process is important for Finnish companies. Joint venture is the good way to cooperate with local companies. By joint venture, a Finnish company also can reduce its direct cost to build new contribution channels.

However, companies who are willing to establish production lines for manufacturing are recommended to establish wholly foreign owned enterprises, this mainly because of the IPR protection.

- Mergers and acquisitions

The mode of Merges and acquisitions is the most efficient way for foreign companies entering into Chinese market, due to the fact that it's easy to inherit local companies' current business resources, such as contribution channels, business customers, local networks, and so on.

But it also has a huge risk on financial connection, because local companies may have liabilities in the process of business development. In current Chinese market, loans and financing are the most popular way for mid-small size companies developing their business. This may potentially cause financial risk for foreign companies if there is a lack of careful investigation of local companies' previous records.

But by comparing those entry modes, Finnish investors are recommended utilizing Joint venture to enter Chinese MW treatment industry. The main reasons are explained below:

- Chinese local companies lack high-techs and huge capital to well operate MW treatment projects, which are the Finnish companies' competitive advantages.
- Chinese local companies have good relationships with local government, and local players. When taking part in tender process, they can easily get the up-dated information through their established business channel, which can be used directly by Finnish companies.
- Finnish companies can reduce risks by joint with local companies. For example, they can reduce direct cost to build contribution channel.

Therefore, Finnish investors are recommended establishing a joint venture company with a local player. The business model of this kind of Joint Venture Company is proposed in the following section.

6.1.4 Business model recommendation for Finnish investors

Based on business model canvas, the essential factors of establishing a joint venture MW treatment company are explained for Finnish investors.

Partners

Partners are local government, China Association of Environmental Protection Industry, NGOs, local joint company

Key activities

Investment research, Project operation, MW collection, transportation and disposal, power sell, apply for project by tendering; apply for project operation license

Key resources

Advanced technologies, huge capital, skilled staffs, good management

Value proposition

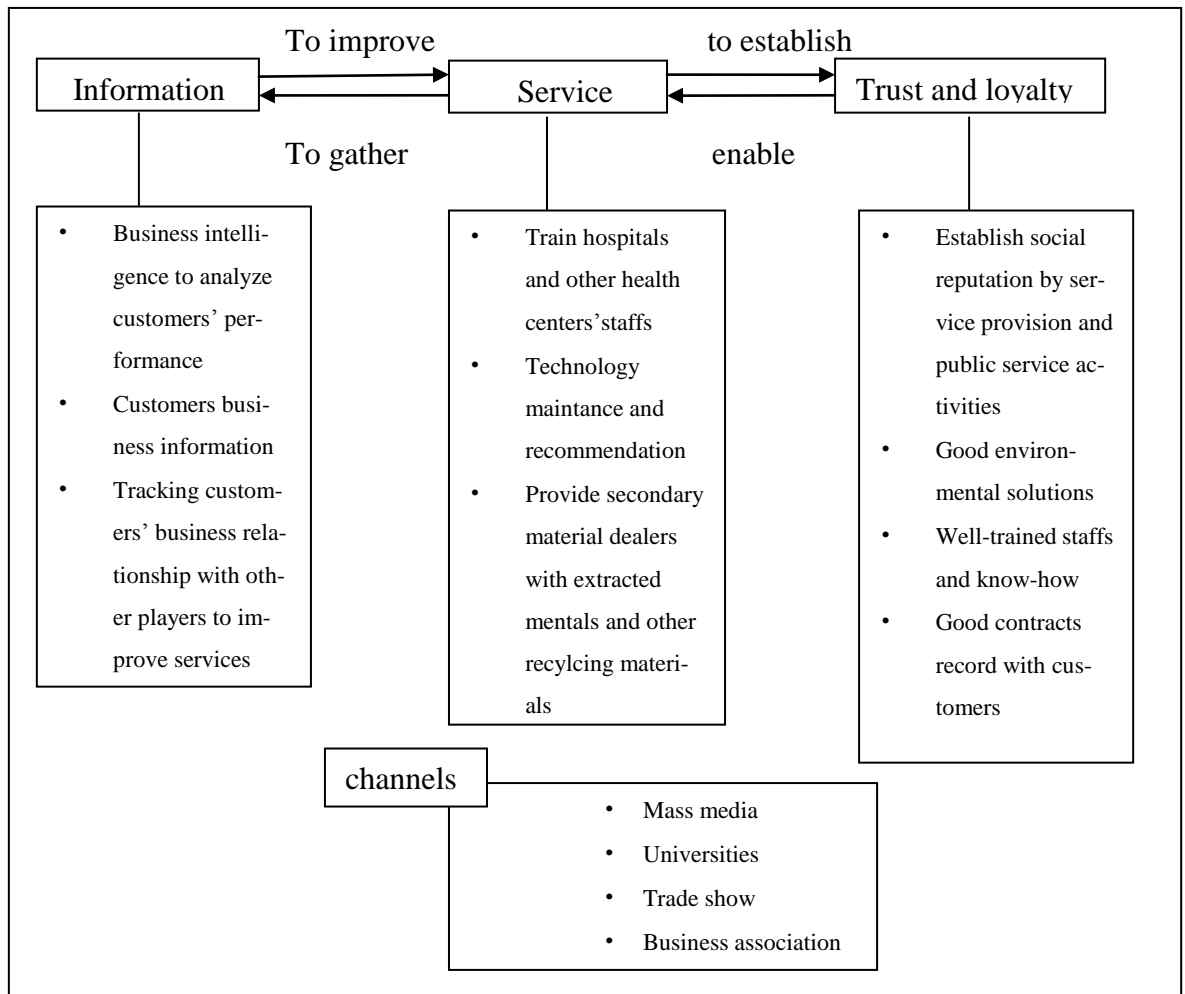
Provide from start-to-end MW solution for customers, like hospitals; reduce environmental pollution, like dioxin; help Chinese local companies to be listed in the stock market by directly investing in them so that relatively stable bonus can be obtained annually as well as the stock.

Target customers

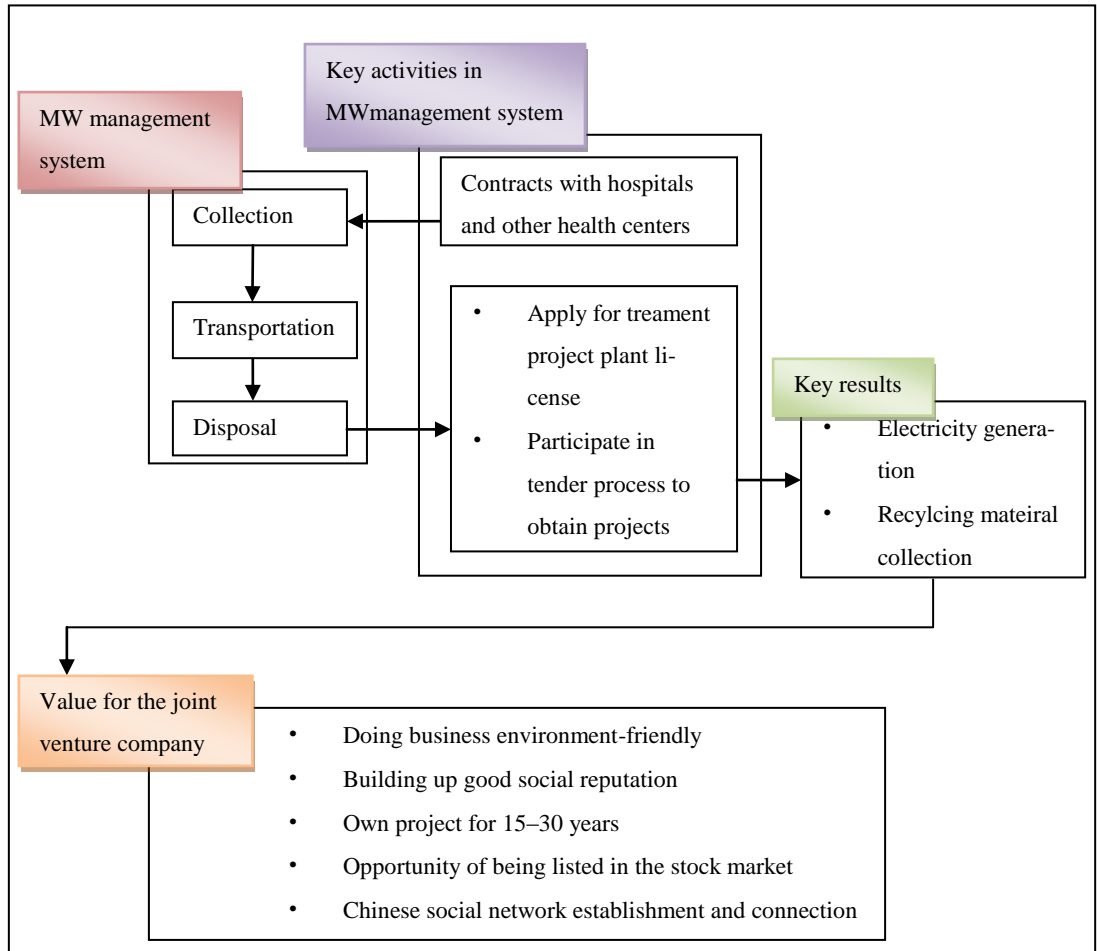
Target customers can be segmented as following groups:

- Hospitals or other health centers
- Power supply bureau
- Secondary material dealers, for example, manufacturing factories would like to purchase extracted materials, glasses and plastics, etc for new products making.

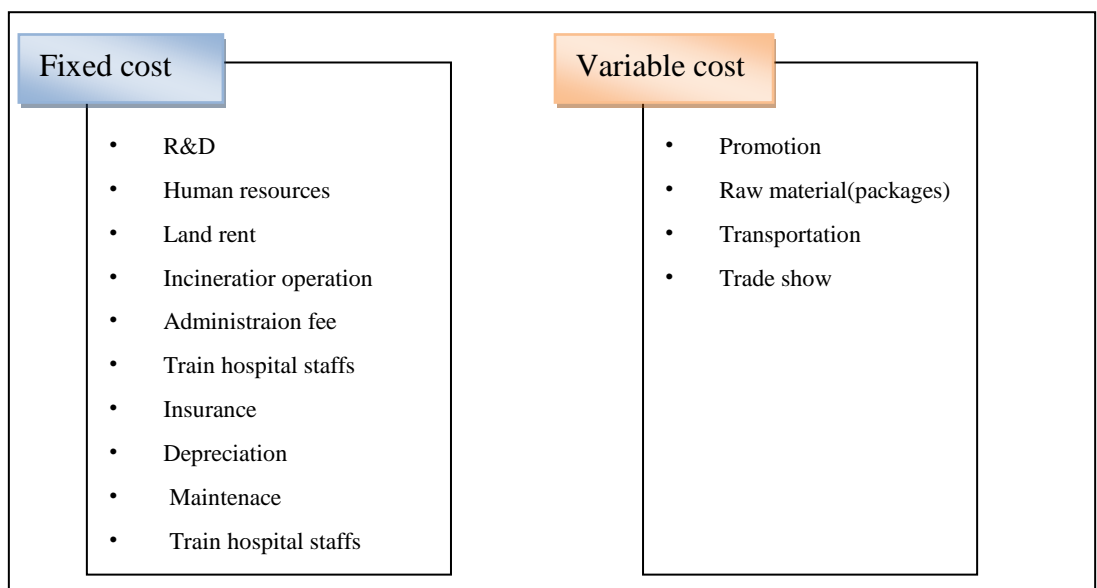
Customer relationship



Value chain



Cost drivers



Revenues streams

The joint venture company can obtain income from:

- MW treatment facility projects. The revenue of operating projects can be gained by government's subsidy, electricity power sales and the treatment fee paid by hospitals and health centers.
- Selling after-sterilized recyclable materials to new products' manufacturers.
- Providing training courses to local hospitals and health centers.
- Providing technology solution and technique maintenance service.
- Seeking financing by listing on the stock market. This revenue model can make business sustainable and also can solve the problem of cash flow.

6.2 Marketing strategy

Marketing strategy is recommended to Finnish investors for making plans of entering into Chinese MW treatment industry.

6.2.1 Decision-making

The Chinese market of MW treatment industry is fiercely competitive on both the products and services provision. The bidding process somehow enhance the degree of competition between local companies and international companies. Additionally, business negotiation in China requires the knowledge of Chinese culture and language. Thus, decision-making of whether or not entering into Chinese market should be confirmed.

6.2.2 Local networks

Local networks especially refer to business networks in China. Paying special attention to local networks is very necessary for Finnish companies, who are facing with competition in Chinese market. Local networks can be established by attending trade-shows, symposiums, government trainings and by cooperating with local partners.

Local networks are the strong relationships with local stakeholders. Therefore, Chinese culture, language, local people's habit and people's working regulations should be taken into account.

6.2.3 Provide systematic solutions

Local companies' lower technical MW equipment level directly causes the project operation to not meet the international standards. For example, many MW treatment projects lack advanced equipment to completely prevent dioxin emission. Therefore, local market requires the foreign companies can provide entire technology with systematic solutions or turnkey projects.

This gives an opportunity to Finnish companies, who can supply the whole treatment facilities to meet the local requirement. Some companies only supplying one or two types of equipment should ensure the products can be well combined with other operational equipment, which are supplied by other companies.

6.2.4 Pricing strategy

Pricing is always based on business objectives. But to do international business, pricing also should be in synch with the local situation. In China, people are used to lower price, especially, when operating a MW treatment project, the purchase fee is an essential factor for total project costs. Whatever the quality of lifecycle of products, most of the project owners would like to compare the prices.

Therefore, pricing may change companies' competence.

However, higher prices of imported equipment or advanced technology are admitted by local companies, who are big and have a higher requirement on equipment or are operating projects in developed areas. Finnish suppliers can provide high quality products to these customers with a relatively high price. All in all, pricing should be based on the customers' capacities and the geographic distribution.

6.2.5 After-sales service

After-sales services, such as technical training and regular feedback between suppliers and purchasers are necessary to expand further cooperation and create local reputation.

All in all, Finnish companies are recommended to provide high quality and long life-cycle products with systematic solutions to Chinese customers in order to establish a long-term relationship with local stakeholders; choose any one of three modes of entry to extensively take advantages of local partners; provide products with an appropriate price to local customers; get feedback from local customers for extending business networks and winning a good reputation.

6.3 Summary of the study

This market study aims to provide Finnish investors with a profitable business opportunity in Chinese MW treatment industry. Its total six chapters are organized in an orderly manner to tell the market story through a range of information and data, which are collected by secondary research and primary research. Information and data collected by secondary research are mainly used to explain relevant concepts for market analysis and to support the analysis results, whereas that collected by primary research are used to replenish, prove and correct final findings.

One of the findings is the competitive advantages of Finnish MW treatment companies through comparing the different disposal approaches applied by Chinese MW treatment companies and Finnish MW treatment companies.

The other findings are associated with primary research, partly to present the government policies related to MW treatment industry, such as the requirements of marketization, the open threshold for public tender, the laws, regulations and goals of emission reduction, the investment plans of developing national MW treatment technology and that of project construction, and so on; partly to identify current Chinese MW treatment market by analyzing major players'

business performances, by exploring the competitors' operational risks and efficient solutions. Those findings reveal the market entry threshold of MW treatment in China. Through all the findings, feasible recommendations in terms of entry modes, business model and marketing strategy for Finnish investors who desire to enter Chinese MW treatment industry are provided in the last chapter. Due to Chinese government's policies, foreign capitals are welcomed. Especially in MW treatment industry, huge investments are required in the process of project operation. Therefore, central government promulgated the "comments on accelerating marketization progress in municipal public industry" (2002). Additionally, "regulations for municipal public utility franchising" (2004) indicates the BOT mode has been developed in Chinese market. So when operating MW treatment facility in China, a Finnish investor needs to have a BOT contract with Chinese government.

Moreover, a bidding method was utilized in the process of acquiring a MW treatment project. The bidding materials are usually sold directly by government; relevant information can be obtained via government's website.

Finnish investors are recommended to participate in the process of MW treatment facility operation, this mainly due to the stable payback: although the payback period of project operation is relatively long, normally 10-15years, the government subsidy on operation, the relative stable treatment fee and the electricity sales prop up the business. This attracts many investors and increases the competition.

Eastern areas and capital cities of mid-west are the best site choices for MW treatment facility.

Due to the fierce competition, Finnish companies also can directly invest in local companies, which have great competitive advantages to share market and search a chance to be listed. Thus, relatively stable bonus can be obtained annually as well as the stock.

However, this study only illustrates the pre-actions for Finnish investors, does not expound on the concrete steps of establishing a business in China. Therefore, further research necessary for Finnish investors building up a steady business in China can be seen in the following section.

6.4 Further research

After determination of entering into Chinese MW treatment industry, Finnish investors need further research to help with establishing practical business in China. Some issues of doing further research associated with marketing strategy are listed below:

- When entering into Chinese MW treatment market, how to communicate, negotiate with local stakeholders? What are the local government's plans of MW treatment industry?
- Providing customers with systematic solution should be based on the local situation, which can influence the characteristics of MW and the project operation, for example, local climate, and population, economy. Those factors need deep research.
- How to price products to local customers?

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8 APPENDICES

Appendix 1: Medical waste categories according to EU Waste Catalogue, WHO and China (2003)

European Waste Catalogue (EWC)		WHO categories of healthcare waste	China (MOH, SEPA) Classification of Medical Wastes, 287-2003
18 01 01	Sharps Sharps (except 18 01 03)	Sharps (pinhead, suture stitch, scalpel, bistouries, scissors, slide,	Glass test tube, glass ampoule, etc.)
18 01 02	Pathological waste	Body parts and organs including blood bags and blood preserves (except 18 01 03)	Pathological waste: 1. Human organs from operation and other processes; 2. Animal organs and bodies from medical experiments; 3. Human organs after pathological section
18 01 03*	Infectious waste	Wastes, their collection and disposal are subject to special requirements in order to prevent infection	Infectious waste: 1. Materials contaminated by blood and body fluid excrement; 2. Daily wastes from institutions where patients with contagious or suspected infectious diseases are treated; 3. Culture medium, specimen and culture of pathogen; 4. Discarded medical specimen;

			5. Blood and blood serum; 6. One-time articles and instruments from medical treatment to be deemed as infectious wastes after use.
18 01 04	Non-risk or “general” healthcare waste	Wastes, their collection and disposal are not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers).	
18 01 06*	Chemical waste, waste with high content of HM	Chemicals consisting of or containing dangerous substances	(See Chemical waste)
18 01 07	Chemical waste	Chemicals other than those mentioned in 18 01 06	Chemical waste from medical labs, disinfection reagents, mercury blood-pressure meters and thermometers
18 01 08*	Genotoxic waste	Cytotoxic and cytostatic medicines	(See medicaments)
18 01 09	Pharmaceutical waste	Medicines other than those mentioned in 18 01 08	Medicaments: Antibiotics, non-prescriptive medicaments, cell toxic and inheritance toxic

			medicaments, medicaments that are suspected to cause cancer, vaccine, and blood products
18 01 10*	Waste with high content of heavy metals	Amalgam waste from dental care	
15 01 11*	Pressurized containers	Metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers	
National regulation [EU Proposal: COM (2003) 32 Final]		Radiological waste	

Note: * indicates the waste classified as hazardous.

(Source: LI Run-dong, NIE Yong-feng, Bernhard Raninger, WANG Lei “Options for Healthcare Waste Management and Treatment in China”, The Chinese Journal of Process Engineering Vol.6 No.2 Apr. 2006)

Appendix 2: Regulations of Shanghai Municipality on Disposal of Medical Waste and Protection and Control of Environmental Pollution

Decree of the Shanghai Municipal People's Government

No. 65

The Regulations of Shanghai Municipality on Disposal of Medical Waste and Protection and Control of Environmental Pollution have been adopted at the 124th Routine Meeting of the Municipal Government on October 30, 2007, and are hereby promulgated. They shall become effective on March 1, 2007.

Mayor Han Zheng

November 2, 2006

Regulations of Shanghai Municipality on Disposal of Medical Waste and Protection and Control of Environmental Pollution

(Promulgated on November 2, 2006 by No.65 Decree of the Shanghai Municipal People's Government)

Article 1 (Purpose and Basis)

For the purposes of preventing disposal of medical waste from contaminating environment and safeguarding the health of the people, these Regulations are formulated in accordance with the "Regulations on Management of Medical Waste" and in the light of actual circumstances of this Municipality.

Article 2 (Application Scope)

These Regulations apply to the collection, transportation, storage and disposal of medical waste as well as related administrative activities of prevention and control of environmental pollution within the administrative areas of this Municipality.

Article 3 (Administrative Department)

The Shanghai Municipal Environmental Protection Bureau (hereinafter referred to as SMEPB) shall be responsible for supervisory administration of prevention and control of environmental pollution in activities of collecting, transporting, storing and disposing of medical waste within the area of this Municipality while district and county environmental protection administrative departments (hereinafter referred to as district/county EPD) shall, according to their respective functions and duties, be responsible for the above-said supervisory administration within their respective jurisdictions.

This Municipality's related departments shall, according to their own functions and duties, coordinate in carrying out these Regulations.

Article 4 (Declaration of Production)

Every unit that produces medical waste shall, before March 31 every year, declare to the EPD the varieties and quantities of medical waste produced in the previous year. Among them, the producing unit that may conduct on-the-spot disposal of medical waste by itself under these Regulations shall report to the SMEPB and the producing unit that exercises centralized disposal of medical waste shall report to the local district/county EPD.

Article 5 (Collection)

Any unit producing medical waste shall not mix medical waste into domestic garbage.

Every unit producing medical waste shall, according to the State-set medical waste classified catalogue and this Municipality's relevant technical standards, set up collection vessels as required and exercise classified collection of medical waste.

Every unit producing medical waste shall collect its medical waste no less than once every day; in respect to medical waste produced in medical activities such as mobile medical treatment and on-the-spot emergency treatment, collection shall be made immediately after the end of medical activity.

Medical waste shall be packed as required. Among them, pathogen medium, pathogenic specimen, preserving fluid of bacterial and viral culture and other highly dangerous waste shall, according to the provisions set by the State and this Municipality, be sterilized before being packed.

The packing of medical waste shall comply with the requirements set out in the "Regulations on Special Packing, Vessel Standard and Warning Sign for Medical Waste".

Article 6 (Temporary Storage)

Every unit that produces medical waste shall establish a temporary storage spot for its medical waste, install necessary facilities and equipment and set up obvious warning signs.

Medical waste, after being packed, shall be temporarily stored in the prescribed collection vessels, which shall not be deposited in the open. Among them, the storage of chemical medical waste shall comply with the storage safety requirement of dangerous chemicals, in addition.

Article 7 (On-the-spot Disposal by Oneself)

Under one of the following cases, a unit producing medical waste may conduct on-the-spot disposal of medical waste by itself according to provisions.

- (1) A special medical health institution dedicated to diagnosing and treating contagious diseases, which has already built a system of collecting and disposing of medical waste which complies with the provisions.
- (2) There is no access to land transportation of medical waste to the centralized disposal venue.

Specific requirements for on-the-spot disposal by oneself are to be provided separately by the SMEPB.

Article 8 (Centralized Disposal)

Except for the cases of on-the-spot disposal by oneself set out in Article 7 of these Regulations, other medical waste shall be collected, transported and disposed by the unit that conducts centralized disposal of medical waste.

The unit making centralized disposal of medical waste shall be determined through tendering by the SMEPB in conjunction with related departments. The SMEPB shall enter into a contract for centralized disposal of medical waste with the bid-winner and issue a business license of medical waste.

Article 9 (Requirements of Collection)

A unit that conducts centralized disposal of medical waste shall, on a regular basis, collect medical waste at the temporary storage spot set up by units producing medical waste. The unit conducting centralized disposal shall make collection at least once every 24 hours at the temporary storage spots set up by Grade One and above medical health institutions; and at least once for every 48 hours at those set by other units producing medical waste.

Where a unit conducting centralized disposal of medical waste fails to make collection of medical waste on schedule, the unit producing medical waste shall report to the SMPEB or district/county EPD.

Under special conditions such as public health emergencies, in which a temporary storage spot set up by a unit producing medical waste according to provisions can not hold all of the produced medical waste, the producing unit shall notify promptly the unit conducting centralized disposal of medical waste, which shall run more errands for making collection to ensure timely transportation of medical waste.

Article 10 (Transfer and Handing Over)

When transferring medical waste to a unit making centralized disposal, the unit producing medical waste shall fill in a transfer form as provided for by the State and this Municipality.

When taking over medical waste, the unit making centralized disposal shall inspect the packing and marking of medical waste and check up the taken-over medical waste with the transfer form.

Where, after the inspection and check-up, the packing and marking comply with the provisions and the medical waste taken over correspond to the items described in the transfer form, the unit producing medical waste and the unit making centralized disposal shall sign the transfer form. Where the packing and marking is found not to be complying with the provisions or the medical waste to be taken over not corresponding to the items described in the transfer form, the unit making centralized disposal shall request the producing unit to make timely correction. In case of refusal, the unit making centralized disposal shall report to the local district/ county EPD, which shall make prompt treatment.

Article 11 (Transfer Station)

A unit conducting centralized disposal of medical waste may, depending on the need of medical waste transportation waste, set up a transfer station for medical waste. The establishment of a transfer station for medical waste shall comply with requirements of environmental protection and disease prevention and control and shall go through relevant formalities of environmental protection and sanitation according to the provisions.

Medical waste shall be kept in closed storage at the relay transfer station and the storage time shall not exceed 48 hours.

Article 12 (Requirements of Transportation)

Medical waste shall be conveyed in a special airtight vehicle, which shall comply with the provisions set out in the “Technical Requirements of Vehicles Conveying Medical Waste” and have warning signs on it.

A vehicle carrying medical waste shall be installed the vehicle positioning device, which shall be kept in normal use.

No loss, spillage or leakage of medical waste shall occur in the course of transportation. In addition, the transportation of chemical medical waste shall comply with the transportation safety requirement of dangerous chemicals.

Article 13 (Requirements of Disposal)

Disposal of medical waste shall comply with the State and this Municipality-set standards and specifications concerning disposal of medical waste.

The end-residue produced after the burning disposal of medical waste shall be treated according to norms for disposal of dangerous waste.

Pollutants discharged in the process of disposing of medical waste shall comply with the State and this Municipality-set emission standard and shall be put under online monitoring of pollutant emissions.

Article 14 (Operation Management of Disposal Facilities)

A unit that disposes of medical waste shall draw up the management rules for disposal of medical waste to ensure the normal operation of medical waste treatment facilities and pollution control facilities.

A unit that conducts centralized disposal of medical waste shall, as stipulated in the contract for centralized disposal of medical waste, install standby facilities and equipment for medical waste disposal to ensure the disposal facilities and equipment keep on operating incessantly in the period of overhaul and trouble removal as well as under emergency.

Article 15 (Disposal Record-keep Account)

A unit that disposes of medical waste shall establish a record-keep account of medical waste disposal, and shall, before January 31 every year as stipulated, declare to the SMEPB the source, variety, quantity, pollutant emission of medical waste disposed of in the previous year as well as the matters about operation management of relevant facilities and equipment.

Article 16 (Disposal Cost)

A unit that produces medical waste to take centralized disposal shall pay medical waste disposal fees to the unit conducting centralized disposal of medical waste. The specific standard of disposal fee shall be separately drawn up by the Municipal Price Bureau in conjunction with the SMEPB, the Municipal Health Bureau and other departments.

Article 17 (Management of Information)

The SMEPB shall establish a corresponding information system of medical waste management, accept relevant information from units producing medical waste and units conducting centralized disposal and exercise real-time supervision in a timely manner.

Class-one and above medical health institutions, when transferring medical waste, shall use electronic forms, establish a corresponding management information system, connect it to the administrative information system of the SMEPB and ensure its normal operation; and other units that produce medical waste are encouraged to use electronic forms in transferring medical waste.

A unit that conducts centralized disposal of medical waste shall establish the following information systems for disposal management of medical waste connect the systems to the administrative information system of the SMEPB and ensure the normal operation of the systems:

- (1) A positioning system of vehicles conveying medical waste;
- (2) An identity record system for transferring medical waste;
- (3) An electronic monitoring system for disposal operation areas. and
- (4) An online monitoring system for water and atmosphere pollutant emissions.

Article 18 (Provision on Early Termination of Disposal Activity)

A unit that conducts centralized disposal of medical waste shall not stop arbitrarily its activity in relation to centralized disposal of medical waste during the stipulated business term. In case of early termination of a disposal contract for special reason, a written notice shall be submitted to the SMEPB six months in advance.

The SMEPB shall, after receiving the notice or at the time when the unit that conducts centralized disposal of medical waste arbitrarily stops disposal activity, promptly arrange for relevant units to make centralized disposal of medical waste instead.

Article 19 (Accident Control)

The SMEPB shall, in conjunction with related departments, draw up an emergency preplan for environmental pollution accidents caused by medical waste.

Grade One and above medical health institutions and units that dispose of medical waste shall, according to the emergency preplan and their specific conditions, draw up emergency plans for environmental pollution accidents caused by medical waste and report to the EPD for the record under the provisions set out below:

- (1) A unit that disposes of medical waste shall report to the SMEPB for the record; and
- (2) Other class-one and above medical health institutions shall report to the local district/county EPD for the record.

When an environmental pollution accident takes place or is likely to occur, the unit that produces medical waste and the unit that conducts disposal shall take prompt measures to reduce accident damage. In case of an environmental pollution accident, the unit producing medical waste or the unit making disposal shall provide on-the-spot rescue and medical treatment for persons who fall ill and report promptly to the Emergency Joint-Action Agency for Public Contingencies under the district or county government where the accident takes place as well as to the EPD and the health department. The Emergency Joint-Action Agency, the EPD and the health department shall, according to the emergency preplan, take temporary control measures, evacuate persons and organize rescue.

Article 20 (Supervisory Inspection)

The EPD shall enhance on-the-spot supervisory inspection on units producing medical waste and units making disposal and establish corresponding supervision files.

The unit or individual person under examination shall reflect matters faithfully, furnish material relating to inspection content, and shall not practice fraud or conceal facts nor refuse or obstruct an inspector conducting an inspection.

Article 21 (Administrative Penalty)

For acts in violation of these Regulations, except as otherwise provided for by law and administrative regulations, the EPD shall impose penalties according to the following provisions:

- (1) Where, in violation of the provision under Article 12 clause 2 of these Regulations, a vehicle conveying medical waste has no positioning device installed as required or the positioning device fails to stay in normal use, a rectification within a time limit shall be ordered; if no correction is made after deadline, a fine of not less than 5,000 yuan and not more than 30,000 yuan shall be imposed.
- (2) Where, in violation of the provision under Article 14 clause 2 of these Regulations, a unit that conducts centralized disposal of medical waste fails to install necessary standby facilities or equipment as required, a rectification within a time limit shall be ordered; if no correction is made after deadline, a fine of not less than 10,000 yuan and not more than 30,000 yuan shall be imposed.
- (3) Where, in violation of the provision under Article 17 clause 2 of these Regulations, a class-one or above medical health institution fails to establish an electronic form management information system as required, or fails to connect the system to that of the SMEPB, a rectification within a time limit shall be ordered; if no correction is made after deadline, a fine of not less than 2,000 yuan and not more than 10,000 yuan shall be imposed.
- (4) Where, in violation of the provision under Article 17 clause 3 of these Regulations, a unit that conducts centralized disposal of medical waste fails to establish a management information system for disposal of medical waste as required or fails to connect the system to that of the SMEPB, a rectification within a time limit shall be ordered; if no correction is made after deadline, a fine of not less than 5,000 yuan and not more than 20,000 yuan shall be imposed.

(5) Where, in violation of the provision under Article 18 clause 1 of these Regulations, a unit that conducts centralized disposal of medical waste arbitrarily stop activity relating to centralized disposal of medical waste, a rectification within a time limit shall be ordered and a fine of not less than 50,000 yuan and not more than 100,000 yuan shall be imposed.

Article 22 (Effective Date)

These Regulations are effective on March 1, 2007.

Appendix3 Standards and Codes for Medical Waste

Engineering Technical Specification for Medical Waste Chemical Disinfection Centralization Treatment (In Trial) (HJ / T 228—2006)

Engineering Technical Specification for Medical Waste Microwave Sterilization Treatment (In Trial) (HJ / T 229—2006)

Engineering Technical Specification for Hazardous Waste Centralized Incineration Treatment(HJ / T 176—2005)

Engineering Technical Specification for Medical Waste Centralized Incineration Treatment(HJ / T177—2005)

Technical Requirement for Medical Waste Transfer Vehicle (In Trial)
(GB 19217—2003)

Technical Requirement for Medical Waste Incinerator (In Trial)
(GB 19218—2003)

Identification Standards of Hazardous Waste(GB 5085. 1—5085. 3—1996)

Control Standards of Hazardous Waste Incineration Pollution
(GB 18484—2001)

Control Standards of Hazardous Waste Landfill Pollution (GB 18598—2001)

Regulations for Medical Waste Special packaging, Container Standards And Warning Marks

Technical Regulations for Medical Waste Centralization Treatment

Name List of National Hazardous Waste

Control and Deal with Transboundary Transferring Hazardous Waste and Basel Convention

Relevant Laws and Regulations

The Law On Environmental Protection of The People's Republic of China
 Law Of The People's Republic of China on The Prevention And Control Of
 Environmental Pollution By Solid Waste
 Law of the People's Republic of China on the Prevention and Control of Radia-
 tion Pollution
 Law of the People's Republic of China on Prevention and Control of Infectious
 Diseases
 Regulations for Medical Waste Management
 Methods for Medical Waste Management Administrative Penalty
 Notices on Some Issues of Identifying Medical Waste Classification
 Notices on Recheck Principles for Construction Projects of Hazardous Waste
 and Medical Waste Treatment Facility
 Technical Principles of Environmental Impacts Assessments for Construction
 Projects of Hazardous Waste and Medical Waste Treatment Facility
 Construction Plan for National Hazardous Waste and Medical Waste Treatment
 Facility
 Lists of Medical Waste Classification

Appendices 4 TOP 15 Chinese cities rank in GDP 2010 and 2011

Table 13: Top 15 cities rank in GDP in China 2010

City	GDP	Increase Rate	Province	Region
Shanghai	1490.093	8.2%		East
Beijing	1186.59	10.1%		Northeast
Guangzhou	911.86	11%	Ranks The First In Guangdong	Southeast
Shenzhen	824.5	10.5%	Ranks The Second In Guangdong	Southeast
Tianjin	750	16.5%		East
Suzhou	740	11%	Ranks The	East

			First In Jiangsu	
Chongqing	585.6	14.9%		West
Hangzhou	509.866	10%	Ranks The First In Zhejiang	East
Wuxi	500	11.5%	Ranks The Second In Jiangsu	East
Qingdao	490	11%	Ranks The First In Shan- dong	East
Foshan	474.26	13.5%	Ranks The Third In Guangdong	Southeast
Chengdu	450.26	14.7%	Ranks The First In Si- chuan	West
Wuhan	450	13%	Ranks The First In Hubei	Middle
Dalian	441	15% increase	Ranks The First In Liao- ning	Northeast
Shenyang	435	14.1%	Ranks The 2nd In Liaoning	Northeast

Billion Yuan (Source: China Financial Daily 2011)

Table 14: Top 15 cities rank in GDP in China 2011

City	GDP	Increase Rate	Province	Region
Shanghai	9164.1	8.4%		East
Beijing	7418.1	8%		Northeast
Guangzhou	5730	11%	Guangdong	Southeast
Shenzhen	5200	10.5%	Guangdong	Southeast
Tianjin	5098.65	16.6%		Northeast

Chongqing	4797.68	17.4%		West
Wuxi	3250	11.8%	Jiangsu	East
Wuhan	3221.6	12.4%	Hubei	Middle
Dalian	3050	15%	Liaoning	Northeast
Hangzhou	2990.5	10.6%	Zhejiang	East
Nanjing	2967.46	11.9%	Jiangsu	East
Shenyang	2870	14.3%	Liaoning	Northeast
Chengdu	2799.68	17.8%	Sichuan	West
Ningbo	2713.6	10.3%	Zhejiang	East
Tangshan	2450	11.1%	Hebei	Northeast

(Source: 21 city.org, 2011)

Appendix 5 examples of three types of international and domestic companies in Chinese MW treatment industry

Investment management companies

Covanta

Waste Management Inc (the giant waste treatment company in America, March, 2010 joint venture with Shanghai Environment investment Group, 40%, it becomes the largest MSW treatment enterprise in China)

JFE

Alstom

Seghers

GE-Jenbacher

Local companies:

Sound Environmental Resources Co., Ltd

Shanghai Environment investment Group

Equipment manufacturers

Mitsubishi Heavy Industries, Japan

Takuma Co Ltd, Japan

Hitachi Zosen Corporation, Japan

Japan JFE

American ASIC

French ALSTOM

Belgium Seghers

Local manufacture companies:

Wuxi Huaguang Boiler Co., Ltd (Rank the NO. 1 of the market share in 200t/d)

Chongqing Sanfeng Covanta Environmental Industry Co., Ltd

Wenzhou Weimin Group

Hangzhou New Century Energy Environmental Protection Engineering Co., Ltd

Zhejiang Weiming Environment Protection Co., Ltd

Wuhan Boiler Group Co., Ltd

Hangzhou Boiler Group Co., Ltd

Dynagreen Holding Group Co., Ltd

Consulting companies

DHV Company of the Netherland

Black & Veach Company of the US

Climate Change Capital (CCC)

CH2M-HILL in the US

Appendix 6 Questionnaires

Questions for hospitals:

- How many (average) medical wastes are generated in your hospital?
- Do you have specific regulations or policies to treat medical waste in your hospital? If yes, what are they?
- How to collect the medical waste? How do the responsible staffs collect the medical waste? Do they wear special suits when doing the job?
- How do you transport the medical waste in hospital? Transport it by normal trash bag or use specific equipment?
- Does your hospital offer regular training to those staffs? If yes, by who?
- How many people are involved in treating medical waste? How many budget offered to manage medical waste in hospital base?
- Do you sometimes treat the medical waste like household trash just throws them away because it's the easier and economical way to do so?
- Does your company cooperate with some medical waste treatment company or normally sell the medical waste to individual collectors? If yes, is the cooperation temporary or permanent? Why? Any contracts?
- If contracting, the medical waste is sold by kilogram or by quantity? How much

does it cost by kilogram (quantity)?

Questions for companies:

- What are the main concerning issues for your company to do this business?
- Who are stakeholders of your company?
- Did you obtain some incentives from government? How much? And how can you obtain it?
- How much does your company invest into this business annually? Payback period? What's the value chain to process the medical waste?
- Do you collect the medical waste directly from hospitals or collect from other distributors? Does your company cooperate with hospitals by contracting? Is it temporary or permanent?
- Did the medical waste you collect (buy) or transport already classified? If no, do you know why? If no, do you have specific policies to collect?
- How does your company transport the medical waste? Do you use special equipments? if yes, What are they? How many staff involved in this process? Is there any specific requirement to the staffs?
- Does your company offer regular training to those staffs? If yes, by who?
- How many projects have been established by your company so far? Why you choose these areas? By which standards you choose these areas to establish the projects?
- How to operate a project?
- How do you obtain permission from government to establish a project? Do you bid for projecting permission? Do any companies who involved in this sector can bid? If no, what's the requirement?