

Sustainable Solutions in the Construction Industry of Hong Kong
Improving Waste Management for Small and Medium Enterprises

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ABSTRACT

Construction is a booming industry in Hong Kong, in which subcontracting plays a key role. A major challenge the construction industry faces is that sustainable waste management is often difficult for subcontractors due to a variety of hurdles. This report identifies these hurdles that construction subcontractors, typically classified as small and medium enterprises (SMEs), experience when trying to practice sustainable construction, with a primary focus on waste management. The methodology used to collect data includes conducting interviews, surveys, and comparative analyses. The final recommendations of this project identify practical ways to encourage SMEs to more sustainably manage their waste and how the government, organizations, and contractors can assist SMEs.

EXECUTIVE SUMMARY

Small- and medium-sized construction firms encounter many hurdles that prevent them from performing greener business practices, especially when managing waste. Under current practices in Hong Kong, about half of the waste is recycled at transfer stations. Construction firms generally dispose of all waste together, rather than sort it for recycling, which contributes to the accumulated waste of the city at landfills. Despite the government's efforts to reduce irresponsible dumping of waste, regulations have not been able to successfully curb excess waste production. At the current rate of waste production, Hong Kong's landfills will reach capacity within the next decade ("Waste not," 2012).

Construction and demolition projects generate troublesome amounts of waste under current business practices. Construction waste includes the scrap material that remains unused in the development of a project, while demolition waste, which constitutes significantly more of the total waste, consists of the material of nearly all of the remains of old structures (Chung & Lo, 2003, p. 132). The materials from both projects consist of organic materials, such as wood and plastics which must decompose in landfills and contribute significantly to the overflow, while materials like steel and concrete can be more readily recycled at transfer stations or reused in future projects. However, some of the latter materials have also been dumped into the ocean for controversial land reclamation projects, which have expanded the land area of the city and allowed for more development but potentially cause damage to marine environments (Wang, Chen, Zhang, Jin, & Lu, 2010, p. 2250).

In the construction industry, small and medium enterprises are firms that employ 50 or fewer employees (Lau, 2007). These firms employ engineers, architects, project managers, and contractors, all of whom could contribute to making construction practices more sustainable. Architects and engineers can design structures that use the least amount of materials, while project managers can improve the process of construction, which includes transfer of materials to and from the construction site, to be performed by the subcontracted workers, such as by planning for waste sorting. Our focus was on these subcontracted workers who dispose of materials on site without separating them, as typically directed, making recycling difficult. If companies provided training for workers in green practices, these subcontracted workers would be able to deal with waste materials more sustainably. However, measures like providing training

in responsible waste management are perceived as costly to companies, despite the real long-term savings provided by being sustainable (Tam, Le, & Zeng, 2012, p. 18). Construction firms of all sizes may attend training sessions that demonstrate how to perform more sustainable waste management practices. However, according to Wong and Yip (2010), only about 20% of surveyed construction firms have had representatives attend these. A third of the responding companies who did not attend any training were not even aware of the existence of these programs, while another 28% could not receive adequate funding to attend (Wong & Yip, 2010). Small and medium enterprises, which must work with very limited funds, need more financial support than larger firms to attend sustainability training. It is very important that they are informed about the problems of their current practices and the availability of sustainable solutions; however, there are many other challenges towards improving their practices.

The purpose of this project was to identify the hurdles faced by small and medium construction firms that prevent them from performing sustainable construction. By interviewing representatives of the industry, we gained a full understanding of how the construction industry operates in terms of waste management. Through case studies, we analyzed how other cities have dealt with waste management issues and made recommendations on how to improve current business practices in Hong Kong.

Background research on the structure of the construction industry was necessary for us to begin discussing current practices with members of the industry. This identified the size of contracting firms in the construction industry and types of contracts under which they work. In addition, we researched waste management practices in Hong Kong to identify what is currently being done and the improvements that can be made. Our sponsor, the Business Environment Council, identified key members of the construction industry whom we then interviewed to gain their perspective on the current issues of sustainability. An expected lack of support for “green” measures due to perceived costs underscored the importance of finding more favorable means of implementing sustainability measures.

Our research investigated small and medium enterprises in the construction to identify their current waste management practices in addition to their attitudes towards sustainability. Upon identifying the challenges of making their practices more sustainable, we recommended suitable means for them to improve their material usage and waste management. These policies were primarily based off of effective waste management policies from around the world, tailored

to the need and culture of Hong Kong. It is clear that the government of Hong Kong needs to take a stronger stand on environmental issues, through incentives for recycling and reuse of materials and stricter penalties for irresponsible dumping of waste at landfills. As companies are most concerned about their finances, they would consider the financial costs of these initiatives on their businesses. The culture of the subcontracted workers also needs to change, as they do not prioritize environmental protection. Educating current workers on the job and future workers in schools about sustainability would change the culture of apathy found throughout the industry towards a culture of concern for the environment. Finally, contractors need to provide more support to smaller businesses through contractual requirements and site space allotted for waste storage and sorting. By assisting these companies with these resources, workers will have much more ability to manage waste sustainably.

1. INTRODUCTION

Hong Kong is a city under constant development, with expansions and improvements in buildings, skyscrapers, railways, and other construction projects. A considerable amount of waste is produced in nearly all construction projects, either from excess construction material or from the remains of demolition. Although the prospective effects of poor waste management on the city and communities are recognized, the lack of appropriate disposal methods are expected to result in serious problems, many of which are beginning to emerge today. In order to resolve or reduce this growing waste problem, there has been increased pressure to introduce more sustainable waste management practices into the industry in order to promote more responsible waste management, which will reduce the amount of waste being sent to the landfills. Several programs and policies have already been introduced, but there is still much that can be done to further improve the waste management practices of the construction industry.

Among the most pressing, waste-related issues are the city's landfills, which are expected to reach capacity within two to six years ("Waste not," 2012). The continuous development of Hong Kong and lack of sustainable waste management in the construction sector will only increase these problems, with the negative effects possibly being felt by as early as this generation. However, receiving public approval and finding space for new landfills would be difficult to do in a city that is so compact and constantly growing. The city already boasts high rise residences and towering commercial buildings while scenic landscapes spread beyond the metropolis towards the neighboring Guangdong province of mainland China. In addition to the growing expanse of current landfills, building space is limited due to previous and current construction projects. These limitations may stymie further development and cause overcrowding in existing residential settings, or lead to more demolition and production of waste. In order to rectify this landfill crisis, Hong Kong is in need of more sustainable initiatives.

According to data from the Environmental Protection Department from 2009, the city of Hong Kong produces 15.4 million tons of construction waste per year, which accounts for over one fifth of the total waste collected at landfills (as cited in Yu, Poon, Wong, Yip, & Jaillon, 2012, p. 1). The government of Hong Kong has implemented some policies in order to curb the disposal of so much waste, but the production of construction waste has not been reduced enough to alleviate the current waste problem. Further reduction of construction waste has the potential

to significantly cut the burden that is already on landfills and extend their life beyond the short term expectations.

Another challenge the construction industry faces when trying to reduce its waste is the organization of the industry. The construction industry is a very large and complex organization that consists of large construction companies and numerous subcontracted small and medium enterprises, which are also known as SMEs. Due to how the industry is organized, no single policy or program can effectively reduce the amount of waste being sent to landfills by all companies in the industry because of the varying characteristics of each company and construction project. This makes it important to focus on one section of the industry, such as SMEs, rather than the industry as a whole.

SMEs make up a majority of the construction industry in Hong Kong. According to Farhoomand (2009, p. 12), there were 20,355 construction firms in 2008, 98.4% of which were small and medium enterprises. According to Hong Kong's definition, SMEs in the construction industry are firms that directly employ 50 or fewer employees, featuring small ownership, innovative technologies, and strict project timetables (Lau, 2007). Despite the small size of each individual firm, their combined manpower rivals that of the few large construction firms. This comparison highlights the importance of these small and medium firms in the construction industry. However, due to their small size, SMEs often face challenges when attempting green construction, which larger companies are less likely to face because of their size and resources available.

The goal of our research was to identify the hurdles for SMEs in the construction industry that prevent the implementation of sustainable waste management practices, and to recommend practical ways to overcome these hurdles. In an effort to gain insight into Hong Kong's construction industry and sustainable construction practices, we analyzed how the size and contractual type of SMEs in the Hong Kong construction industry affect green development practices. We compiled the data into a compendium, creating a centralized source of information on the construction industry. Additionally, we explored key issues for SMEs in building sustainably, with a focus on waste management. Our policy recommendations outline practical ways to encourage SMEs to build green with respect to their environmental contexts. Our research supports the Business Environment Council (BEC) in its efforts to effect real change in

the construction industry towards the improvement of the environment and the everyday lives of Hong Kong's residents.

To begin, our team conducted a series of interviews to gather first-hand information from industry insiders, including SMEs, trade organizations, and large construction companies. We examined the attitudes of the construction workers and project managers to investigate their experiences with the industry and their understanding of sustainability. Discussions about their relevant personal experiences and challenges helped us identify feasible means to manage waste responsibly. In addition, we acquired information from larger general contracting firms and SME subcontractors to discover the differences between how they practice sustainable construction, with a focus on waste management. This helped us to better understand how the construction industry in general is approaching sustainable waste management and some methods used. Although methods from larger companies may not always be appropriate for SMEs, the ideas served as useful starting points for the concepts of sustainable construction practices tailored towards SMEs.

To continue to enhance our understanding of sustainable construction practices, we investigated solutions to construction problems in cities and countries similar to Hong Kong, such as the United Kingdom and Singapore. This helped expand our knowledge of the waste management issue and provided us with more information on applications of "green" practices from places that have already researched or dealt with these problems. A connection to cities facing the same issues of waste management during rapid expansion and development helped to solidify the importance for industrial refinement as well. We then used all of this information to identify practical solutions for the problems with sustainable construction in Hong Kong.

In summary, the project's main objective was to identify challenges in the construction industry that prevent small- and medium-sized subcontracting firms from using sustainable construction practices so that the BEC can assist these firms in improving their practices. The major focus of this research was on sustainable waste management, although it was important to understand the workings of the industry as well. With all of the aspects of our research mentioned above, it was possible for our team to accomplish our present tasks. Promoting sustainable practices will have a lasting effect on future generations. Such long-term solutions are crucial for the development of a sustainable society.

2. BACKGROUND

2.1 Overview of Hong Kong

Hong Kong is one of the world's leading centers of commerce and development. With a population of over seven million people, the city is one of the most densely populated in the world. Including each of the territories and islands of the Special Administrative District of China, Hong Kong covers just over 1,100 square kilometers of area, or about 6,500 people per square kilometer ("Hong Kong—the Facts," 2012). The most urban, densely populated territories are Kowloon Peninsula and Hong Kong Island in the southern part of the district. In addition to the city, there is much more land covered by the mountainous New Territories to the north, near mainland China, and the remote islands of Hong Kong to the south ("Hong Kong—the Facts," 2012).

2.2 Construction Industry in Hong Kong

As the city continues to expand, the number of construction projects also increases, and with any construction project comes large amounts of construction waste. It can be excess material that is left unused after construction projects as the remainder of new materials, scraps lost on a construction site or thrown out after unsatisfactory construction, or material that is scrapped from demolition projects (Tam, Le, & Zeng, 2012, p. 14). According to the Environmental Protection Department, overall, about 23% of the total waste of the city comes from construction and demolition projects; inert materials like steel and concrete make up over 80% of this waste, while the remaining waste consists of organic materials like wood and bamboo, which decompose over time (as cited in Tam, Le, & Zeng, 2012, p. 14). Further data from the Environmental Protection Department shows that, of all construction waste, 93% is sent to public fill reception facilities, or municipal waste transfer stations, where about half of it is recycled (as cited in Tam, Le, & Zeng, 2012, p. 14). The recycled material consists mostly of plastics, paper, and steel (Tam, Le, & Zeng, 2012, p. 14).

Table 1: Comparison of construction waste and total waste sent to landfills from 2007 to 2011 ("Monitoring of Solid Waste in Hong Kong: Waste Statistics for 2011", 2012)

Year	2007	2008	2009	2010	2011
Number (Unit: ton/day)					
Construction Waste to Landfill	3158	3092	3121	3584	3331
Overall Waste to Landfill	13901	13504	13326	13817	13458
Percentage	23%	23%	23%	26%	25%



Non-inert Construction Waste



Inert Construction Waste



Figure 1: Two different main types of construction and demolition waste: non-inert waste, such as bamboo and cardboard, and inert waste, such as brick, metals, and rocks.

With the production of so much waste from current practices in the construction industry, consideration is being given to more sustainable practices. According to Chung and Lo (2003, p. 119), sustainability is reducing or eliminating the environmental impacts of an operation. In terms of construction, sustainability refers to reducing usage of materials such that there is as little waste generated as possible. For example, in order to prevent excess that would go to waste, only a bare minimum quantity of materials to complete the construction should be ordered. Another sustainable practice would be sorting demolition waste by type of material for ease of recycling.

Current waste management practices in the construction industry are not as mindful of sustainability as they could be. Disposed remains from projects lead to landfills full of organic material like wood and paper packaging product, while inert materials like steel and concrete are either sent to sorting facilities or public fills. Rather than tossing materials into landfills, demolition projects, which produce much more waste than construction projects, could be executed more carefully, such as by selectively removing components and separating them by material type (Chung & Lo, 2003, p. 132). However, it would be difficult to find support for this method due to extra time and labor costs for such selective work.

Hong Kong is running out of landfill space and time to implement alternative disposal facilities. As a result, the Environmental Protection Department has plans to integrate incinerators into future transfer stations for processing waste (“Waste,” 2012). Despite the possibility of expansion, the current landfill sites cannot avoid reaching capacity in the future due to the limited amount of available territory in Hong Kong and the endless accumulation of waste from industries and from residences at current rates of production. Exportation of waste to mainland China is also minimal. According to Tam and Tam (2006), researchers who examined existing recycling practices in Hong Kong, it would not be an option due to “[e]xtensive procedures, including tax and permits in transporting these materials” (p. 1653), making this very costly and cumbersome. There is no doubt that the amount of waste being sent to landfills can be reduced if small and medium enterprises are able to better manage their waste. These companies are major contributors to construction waste generation but also entrepreneurial ventures with innovative ideas. Regardless of the means of conservation, wood, steel, concrete, and plastering materials need to be conserved because they are all resources that can be exhausted and become a burden on the environment.



Figure 2: North East New Territories (NENT) Landfill, Tseung Kwan O, first of Hong Kong's landfills set to overflow within this decade.

2.3 Small and Medium Enterprises

According to the website of the Support and Consultation Centre for SMEs (SUCCESS), small and medium enterprises, or SMEs, in Hong Kong are defined as manufacturing enterprises with fewer than 100 employees and non-manufacturing enterprises with fewer than 50 employees (“Government Departments,” 2012). There were around 300,000 SMEs in Hong Kong in June 2012 (“Government Departments,” 2012). In total, they account for about 98% of the total business units and job opportunities for more than 1.2 million people, providing for about 48% of total employment (“Government Departments,” 2012). Construction SMEs consist of less than 50 staff, with the average contractor aged 50 and speaking only Cantonese (Leung, Chan, & Yuen, 2010).

The Hong Kong government supports SMEs throughout their development. In fact, the Small and Medium Enterprises Committee (SMEC) updates the Hong Kong Chief Executive (CE) about the progress of SMEs and suggests ways in which they can be supported. The Hong Kong Trade and Industry Department funds SMEs, allowing them to take out loans, internationalize their markets, and increase their competitiveness. SMEs are also advised by the Support and Consultation Centre for SMEs (SUCCESS), which offers free business information and consultation services (“Hong Kong: The Facts,” 2012). With all this support for SMEs, entrepreneurs are able to lead their businesses to success and expand their range of influence.

Among the small and medium enterprises of construction are subcontracting firms. Subcontractors consist of specialized operators of various trades who usually work under main contractors for short-term projects (“Subcontractor,” 2012). Especially among these smaller-scale contracting firms, the construction industry is competitive and follows strict schedules. If work is not completed on time and according to contract, late fees are levied by the owner of the project and a firm’s reputation is put at risk for future projects. Therefore, finishing projects within the expected time frame is very important. As a result of this focus on the swift completion of projects, less planning is dedicated to site issues such as organizing for recycling space. In order to address this, the Business Environment Council has identified specific environmental guidelines for client organizations, contractors, and authorities.

2.4 The Business Environment Council

The sponsor of our research is the Business Environment Council (BEC). According to their website, they are a non-profit organization founded in 1989 to “promote...social and environmental responsibility” (“Introduction,” 2012). The backbone of the BEC consists of several committees, with each having about ten to twenty members. In addition to the committees and their members, there is a Board of Directors which provides guidance on the policies of the committees, an Executive Committee which approves projects and policies, and a Secretariat, responsible to the Directors and Executives, which implements their suggested policies (“Our Partners & Programs,” 2012).



Figure 3: Logo of our sponsor, the Business Environment Council (“E-newsletter,” 2012).

The mission of the BEC is “to advocate environmental protection amongst [their] members and the broader community” (“Our Commitment, Vision & Mission,” 2012). Through the use of “clean[er] technologies and practices which reduce waste, conserve resources, prevent pollution, and improve the environment” (“Our Commitment, Vision & Mission,” 2012), the

problem of waste management, a prime case in which increased environmental protection is needed, can be solved. To this end, the BEC has been working to promote sustainability initiatives in the construction industry.

One of the BEC's focuses is sustainable development in general, which is defined as developing projects to satisfy today's needs without jeopardizing the ability to develop in the future ("General Sustainable Development," 2012). A specific project, known as "Moving the Construction Sector towards Sustainable Development," focuses particularly on small and medium enterprises to promote more sustainable and environmentally friendly practices in the construction industry ("Construction Sector," 2012). Waste management is a major area of construction that could benefit from improvements, such as by recycling construction materials like steel and wood rather than carelessly allowing them to contribute to landfills. In Hong Kong, laws and government actions have typically dealt with construction waste management. However, even though regulations like charge schemes have been used to control polluting industries, they have not been entirely effective ("About Us," 2012).

In addition to focusing on businesses, the BEC strives to promote public awareness of environmental concerns through programs and grants ("General Sustainable Development," 2012). Overall, the focus of the BEC is to promote a societal awareness of the environment, in the business setting and in communities throughout Hong Kong. This environmental concern is a focus shared by other organizations in Hong Kong as well. For example, the Chartered Institution of Water and Environmental Management (CIWEM), whose main challenge is to protect the environment, while taking into account Hong Kong's complex urban development ("About CIWEM Hong Kong," 2012). There are many hurdles for SMEs that prevent them from performing green construction. If the BEC and similar organizations understood these challenges for companies, it would be much easier for them to accomplish their goals towards sustainability.

2.5 Contemporary Waste Management Practices in Hong Kong

The city of Hong Kong has come up with several methods to address the current problems with waste management. However, there is still a need to investigate alternative methods in order to address the waste management issue more effectively. Presently, there are three types of facilities used for construction waste disposal: landfills, public fill facilities, and sorting facilities. Public fill and sorting facilities handle the inert construction waste while the

remaining, mostly non-inert, waste goes to landfills. There have been recent conversations about using some public fill to continue land reclamation projects, a recent example of which is shown in Figure 4, but it should be a goal of the city to find more environmentally friendly means of recycling and reusing materials and to promote more responsible waste management practices.



Figure 4: Construction along Austin Road, West Kowloon, site of one of Hong Kong's most recent land reclamation projects.

Contractors in Hong Kong are required to have their own Waste Management Plan before commencing the construction process. The plan sets a target for the kinds of waste that will be reduced, and how much will be reduced or recycled. Different types of waste are treated in different ways, so it is necessary to establish various waste reduction systems based on the materials used. Lastly, to be a healthy plan, monitoring is indispensable. This policy originated from European countries and was efficient when applied to large companies (Solís-Guzmán, Marrero, Montes-Delgado, & Ramírez-de-Arellano, 2009, p. 2543). However, SMEs have loose organization and they tend not to be as legally savvy as the larger companies. Thus, it is difficult for each small or medium enterprise to negotiate an agreement with the government and set up a target for waste reduction.

The government of Hong Kong has also enacted policies intended to curb these environmental issues. For example, they initiated a polluter-pay policy, or charging scheme, in 1995. This charging scheme established set rates for waste disposal in Hong Kong based on weight; at landfills, the cost is HK\$125, or about US\$16, per ton of construction waste (Yu, Poon, Wong, Yip, & Jaillon, 2012, p. 2). The economic pressures that this put on construction firms initially caused them to reduce their waste production, but over the following years this measure lost its effect and waste production increased again (Yu, Poon, Wong, Yip, & Jaillon, 2012, p. 2).

Prior to the enactment of this policy, small and medium businesses were used to paying nothing to dispose of construction waste. As identified in other studies, the cost of the waste reduced a large portion of smaller companies' profits and caused them to oppose the policy (Tam, Le, & Zeng, 2012, p. 19). Some even considered moving out of the city, although cheaper land and labor costs in mainland China were identified as more significant factors than environmental regulations when considering relocation (Yuen, 1996, p. 31). On the other hand, larger companies with higher incomes became repeat offenders due to the low penalty costs (Yuen, 1996, p. 42). According to Yuen (1996), eleven companies were convicted of five offenses in one year (p. 42). These studies demonstrate how ineffective these measures were for large companies while smaller companies were deterred from responsibly managing waste.

In addition to economic incentives to recycle rather than dump waste, more effective strategies for improving waste management are needed. The government also encourages sorting of mixed construction waste; however, it is hard for the SMEs to practice sorting waste because the small size of their sites limits the availability of space for sorting.

2.6 Alternative Policy Options for Future Discussion

Aside from regulatory initiatives, policies could be implemented by firms at the discretion of project managers. One possible initiative is to rely on off-site prefabrication of more components of the project. According to Tam, Le, and Zeng (2012), environmental benefits of prefabrication include that factories may be better equipped to deal with waste and recycle it in their own projects later and that they are more skilled with their particular materials so they could develop elements with as little material as possible. Economic benefits from prefabrication would come from saved time in construction projects, which would eliminate penalty costs

incurred on companies from going over the scheduled deadline on a contract. However, there may be issues with using only prefabrication to reduce construction waste, such as that factory prefabrication may still have high costs for extra labor and different delivery methods, and that projects could get tied up waiting for one particular component, increasing risks of schedule overrun penalties. There are also issues caused by limitations to the size of pieces, which may have to be transported long distances, inhibiting the prefabrication of particularly large components. Like other sustainable construction practices, prefabrication also has its drawbacks.

2.7 Waste Management Practices throughout the World

Since waste management is an issue experienced globally, other cities or countries around the world already have established solutions, performed studies, and collected information that can assist Hong Kong in improving its understanding of present waste management systems in the construction industry. Although there has been minimal research performed on construction SMEs in Hong Kong, similar research has been performed elsewhere, such as in Singapore. Another densely packed Asian city, Singapore has encountered landfill and waste management issues similar to Hong Kong; however Singapore has been much more proactive in dealing with its waste. It is estimated that the landfill in Singapore will reach capacity within the next 30 to 40 years (Hwang & Yeo, 2011, p. 400). Although the lifespan estimate for Singapore's landfill is significantly higher than those for Hong Kong, a large amount of research and intervention has already been performed to deal with this impending crisis.

One such study, "Perception on benefits of construction waste management in the Singapore construction industry" by Hwang Bon-Gang and Yeo Zong Bao (2011), confronts the issue of how project characteristics affect the benefits of improved waste management in the construction industry in Singapore. The primary focus of their study was to identify which projects would benefit the most from improved waste management based on a project's characteristics. This study brings up a very important issue when dealing with a complex construction industry, that "...every construction project is unique and thus apples-to-apples comparisons may be infeasible" (Hwang & Yeo, 2011, pp. 394-395). The project characteristics that the study investigated were project size, type, nature, duration, and key materials used for the project. After the study, they also identified the following as important project characteristics

worth considering: contractual arrangement, level of subcontracting, types of clients, and procurement methods. All of these characteristics addressed in this study could possibly be the root causes of the hurdles that SMEs encounter when performing sustainable construction. The study revealed that a single construction project can have a large degree of complexity, which makes it very difficult to have a single waste management solution that fits the needs of an entire construction industry. This underscores the need for sustainable practices tailored towards SMEs in Hong Kong's construction industry.

The study also investigated which waste management benefits were most influential and desirable among construction industry experts. From their research, the two biggest benefits were cost savings and profit maximization. Both of these benefits are “financial benefits”, which is not very surprising considering that companies strive to improve financially. Other benefits worth mentioning included: image improvement, productivity improvement, and quality improvement, all of which can be linked to possible future financial benefits (Hwang & Yeo, 2011, p. 399).

This study of Singapore had a few potential flaws that may have led to bias, incomplete data, or inaccurate conclusions. This study was conducted through literature research and a survey of 66 industry experts that consisted of six different position designations. Although these experts identified the many benefits and project characteristics, the authors had no definite method of determining the extent of the impact of these (Hwang & Yeo, 2011, p.402). In addition, this study only focused on the benefits of waste management without any reference or mention of the negative aspects of waste management. This could possibly be caused by bias or the thought that the negative impacts were not worth mentioning. The authors mentioned that this could be an incomplete study because it lacked quantitative data from actual projects that could be used for analyses (Hwang & Yeo, 2011, p. 402). Due to these potential flaws and limitations in this study, it may not represent the views of the entire construction industry or draw completely accurate conclusions.

2.8 Known Hurdles for Small and Medium Enterprises

The BEC has identified some hurdles preventing SMEs from adopting sustainable waste management programs. One of the most important issues regarding sustainability is waste management following a project's completion. While small subcontracting firms in Hong Kong have almost no means to properly manage waste, larger construction firms do have some means

available to them. One inhibitor for smaller firms compared to larger firms is the lack of funds for equipment and training in sustainable means of waste management. Research performed by Tam, Le, and Zeng (2012) reported that the initial investment costs for green waste management methods are restrictive for any construction company, regardless of their long-term benefits (p. 19). Despite the first impression of these initiatives, one interviewed professional proclaimed that the costs of an environmentally-friendly business plan for construction over its lifetime were far less than the costs of current practices (Tam, Le, & Zeng, 2012, p. 18). If subcontractors are trained to sort waste on site, then recyclable materials can be removed from the waste to be disposed of. The cost of construction waste disposal, per the charging schemes by weight, is then reduced in all future projects. Small construction firms would benefit from sweeping sustainability training initiatives, but they do not see it to be worth overcoming costly start-up investments. In order to counter these costs, the BEC needs to identify less prohibitive means of implementing sustainable construction initiatives.

In addition to the restrictive costs of sustainability training, we have identified several other hurdles for small and medium enterprises. The industry is loosely organized due to the size of the firms, so information may not spread too efficiently. Many companies also lack legal knowledge so they are unaware of environmental regulations and programs. Finally, depending on the size of projects, a smaller plot can also mean very limited space for waste. Therefore immediate disposal would be necessary and time would be too short to waste on separation for recycling. Better practices need to be identified, and implemented, so that SMEs can overcome the hurdles of sustainable waste management.

2.9 Sustainable Construction in Small and Medium Enterprises

The purpose of our team's project was to assist the BEC in identifying the hurdles, such as lack of space and knowledge as well as fees associated, that SMEs encounter when trying to practice sustainable waste management as well as determining ways that SMEs could overcome these hurdles. Our research approach, described in the next chapter, provides evidence to fully support recommendations to the BEC. Our team was determined to make recommendations that will enable SMEs to be more sustainable in the construction industry, which assists the Business Environment Council in accomplishing their mission of "... advocating environmental protection" ("Our Commitment, Vision & Mission," 2012).

3. METHODOLOGY

The goal of this project was to identify the hurdles that prevent small and medium enterprises (SMEs) in the construction industry from performing sustainable waste management practices. Upon the identifications of these hurdles, we were able to assist the Business Environment Council (BEC) in tailoring initiatives to help SMEs to improve the environmental sustainability of their practices. This chapter explains the methods that we used to collect and analyze data for our research to establish our findings.

3.1 Enumeration of Objectives

In order to identify the challenges that smaller construction companies face when sustainably managing waste from their projects and to identify means of improving the industry's practices, we established the following objectives for our research:

1. Understand the construction waste problem in Hong Kong:
 - a. Current events related to landfills and land reclamation
 - b. Locals' opinions and knowledge on environmental issues
2. Characterize SMEs in the construction industry:
 - a. Composition of individual firms by workforce
 - b. Composition of the industry by segment
3. Identify current waste management practices in the construction industry:
 - a. Practices available to construction firms
 - b. Sustainable initiatives taken by small and medium construction firms
 - c. Hurdles to sustainable waste management
4. Recommend policies for making waste management more sustainable
 - a. Practices that have successfully changed waste management in other countries
 - b. Impact of successful sustainability policies
 - c. Applicability to Hong Kong

We have addressed each of these objectives using appropriate research methods, which we have defined in the following subsections.

3.2 The Problem of Construction Waste

The first objective of our research was to examine the current waste problem through the views of the local populations. We investigated the detriments caused by Hong Kong's waste

problem through archival research on some of the major methods of waste disposal and other environmental concerns. This was intended for us to develop a better understanding of why the construction industry needs more sustainable practices. By gaining a local appreciation of this waste problem, we were able to better understand how to identify the hurdles that Hong Kong's SMEs face and develop more effective methods for SMEs to overcome these hurdles.

This objective focused on two major locales throughout the city that have been heavily impacted by the activities of the construction industry. The first was the landfills, which have been threatening to close due to minimally controlled dumping of construction waste, as well as great amounts of municipal solid waste, pushing them closer to reaching capacity. The other was the sites of Hong Kong's land reclamation projects, to which the rest of the construction waste often ends up going, if not reused from public fill. Dumping waste into the sea to expand the land area of the city has particularly negative effects on the marine environment; therefore it was also important for us to recognize that the construction industry's waste has affected the waterfront.

Additionally, we have also assessed the public's opinions and knowledge of environmental issues, including:

- Air pollution
- Health effects from pollution
- Waste management practices

We have done this by reviewing a variety of newspaper stories related to these sites from multiple sources, which allowed us to obtain this information without needing to perform exhaustive surveys or interviews. While there has been a dearth of recent public polling, we reviewed the most recent comprehensive data available on environmental awareness. These data also included some older survey data for comparison, which allowed for a better understanding of the trends in environmental awareness in the city over time. Overall, these helped to quickly provide us with better insight into the negative effects of the waste management and pollution issues and how the public has responded to them, if they even had the awareness to respond.

When selecting sources of news, it was important to find information from the most recent articles. Therefore, articles written between December 2012 and February 2013 contained the most relevant news stories. These articles provided the news on the most recent public sentiments and happenings in the construction industry in regards to the waste problem of Hong

Kong. Other news stories researched included the government's plans for dealing with the city's waste following the landfills' closure and plans for further housing development, as well as news on other major sources of waste contributing to the landfills and the problems that those are causing. Further, this proved to be a significant period of time in the government's development of policy, with Chief Executive Leung Chun-ying delivering his first major policy speech in office in January 2013. This was especially useful for understanding the direction in which Hong Kong is expected to go in the following years in terms of environmental issues. These articles came from digital versions of many reputable print newspapers circulating throughout Hong Kong, mainly from the South China Morning Post, although some international construction industry publications were also helpful for our understanding.

After completing this objective, we had a better and more complete understanding of the current waste management problem at hand and the opinions of those who have dealt with this overflow of waste. With this newfound knowledge, we were better able to conduct the rest of our research as we could be on the lookout for more relevant information. It was only with a full understanding of the problem of waste management that we were able to identify and recommend the most effective solutions when analyzing our direct research of the industry.

3.3 Characterization of Small and Medium Enterprises in Construction

The next step in our research was to assess the current state of the construction industry. It was our goal to survey various small- and medium-sized construction firms about a wide range of topics relating to their business and waste management practices. We distributed a written survey because it would be too difficult to get in contact with enough businesspersons for interviews and their limited knowledge of the English language, or lack of confidence in speaking ability, would limit the amount of discussion we could have. To overcome our research's own hurdle of the language barrier, we finalized our written survey in English and translated it into Chinese, specifically Cantonese, which is the prevalent language in Hong Kong. When distributed, we provided versions in both languages to each company. This allowed our respondents to answer in English if he or she were comfortable, which was convenient for us because we would not need to translate open response answers, or he or she could answer in Chinese, which was expected to help to increase the response rate but required more processing

time. The English version of the full survey is located in Appendix E1 and the Chinese version in Appendix E2.

In order to distribute our surveys, we decided to use email once we had established our list of respondents. Most SMEs are very difficult to contact due to their busy work schedules and lack of means of communication. In addition to us needing knowledge of Cantonese in order to verbally communicate with most companies, many also have such tight budgets that they could not even afford telephone or internet service. Using email also had the advantage of being essentially free of charge since there was no postage cost nor other charge associated with distribution. Rather than solicit these business directly to ask for them to respond to our survey, we distributed the bulk of our surveys through the Hong Kong Construction Sub-Contractors Association (HKCSA), an organization that represents about 300 subcontractors throughout the industry. One of our most valuable interviewees was a member of HKCSA, which helped in assuring us that his members would provide reliable information. With the additional help of our sponsor, Ms. Sarah Choi of the BEC, the organization distributed our surveys to all of its members via email. If the composition of this organization was not sufficiently representative of the industry, it was also important to have a backup source of survey data.

To supplement our survey data from the HKCSA, we used a government database of registered construction companies to identify potential targets for our surveys. This database, known as Registered Minor Works Contractors by Company, provided by the Buildings Department (2013), included a comprehensive list of subcontracting companies registered with the government. There were many different registers provided by the Buildings Department, including various lists of individuals registered as engineers and lists of specialized contractors by subdivision of the construction industry (2013). However this register was expected to be the most useful since it provided the most comprehensive list of companies, listing all subcontractors, regardless of in which part of the industry they work (Buildings Department, 2013). Information such as their classifications by nature and work type was listed here, as well as voluntarily provided contact information including email addresses and telephone and fax numbers. The former would not be as useful as a company was not expected to identify itself if responding, therefore we could not return to the register to find background information on it, but contact information was especially useful for us in the distribution of surveys. Once we

established each list of companies to solicit, we distributed our survey, as described in the following section, in both languages.

Prior to distribution, our survey questions required careful review. We identified the most important questions to ask in discussions with our sponsors. It was important to mix multiple choice questions and open response questions, in order to gain quantitative data and the reasoning behind it. As this was intended to be a comprehensive survey of the construction industry's practices and mindsets, the survey's data would contribute to reach several of our objectives, as described below.

The first five questions in our survey addressed our second objective, the characterization of construction-related SMEs, while the subsequent questions addressed the third objective of our research, identification of the current waste management practices. In characterizing the SMEs, we attempted to identify the portion of the industry covering each type of contract. Hong Kong's construction SMEs can be involved in several different types of contracts, as each construction project has unique conditions which involve scheduling, government requirements, budgeting expectations, financing issues, and more. For example, a small scale project with a complete but relatively simple design may use a *lump sum* contract, because fewer change orders are expected so the project price can be paid up front (Ollmann & Schuchardt, 2010). If involved in public works, the government contract may be *unit-price*, in which the project cost is by length of road set or pipeline placed (Ollmann & Schuchardt, 2010). Therefore each construction enterprise can be involved in a variety of contract types based on the needs of the project. This information was used to help us identify whether recycling policies were stronger with certain contract types, or if companies were given more freedom to enact policies on other types. Aside from contract types, we asked companies to provide some other information about their composition.

This first set of questions also addressed the composition of the company's workforce. According to the government of Hong Kong, small and medium enterprises in the construction industry are defined as companies composed of fewer than 50 direct employees ("Government Departments," 2012), but companies vary a lot amongst the industry. In our survey, we asked for the number of employees of each company in order to identify differences in waste management practices based on a company's workforce. Similarly, we asked about the company's segment of the construction industry, such as civil, mechanical, or electrical, and the trades employed to

identify any differences in their practices. The insights that could be gained from our in-depth examination of the construction industry and its practices would have been great help to us to tailor sustainable solutions to individual companies.

3.4 Current Sustainable Practices in the Construction Industry

The third step in our research was to investigate the current waste management practices in the construction industry. It was important to identify what companies are currently doing and how sustainable their practices are before the Business Environment Council can make further suggestions for the industry. Our written survey continued by asking many multiple choice and open response questions of the companies, so that we could establish their current practices. Additionally we interviewed representatives from several subcontracting companies and construction organizations. An in-depth survey and interviews also provided us with detailed information into the mindset and reasoning for why companies do or do not manage their waste more sustainably.

After asking about the makeup of a company in the first five questions for our previous objective, all of the remaining questions in our survey addressed the current practices of waste management in each company and the company's opinions towards sustainability, as follows:

- Which materials could be recycled
- How a company perceives its own business practices
- How a company perceives the industry's practices

These data would have been useful because they could give an overview of what the industry has been doing that is effective and what is not. They also would have briefly identified how the executives of the industry have responded to various waste management initiatives, which was useful in determining how best to encourage new sustainable practices in the industry. The following subsections address which data we were looking for in questions 6 through 28 of our survey.

3.4.1 Recyclability of Construction Materials

Following identification of the trades employed by a company in our characterization of the industry, our survey continued by asking in questions six and seven about the materials that they use and recycle on a daily basis. These quantitative data would have quickly identified which materials were being reused or recycled and which ones were not, and further questions

asked for reasoning as to why some or all of their materials were not being reused or recycled. We expected that some materials were more easily recycled than others, or that some would be almost universally sent to landfills. Some companies may not have been recycling anything, but regardless of what they were doing to manage their waste, it was always important to identify why. By giving the companies the opportunity to explain why they were or were not managing their construction and demolition waste in a sustainable manner, we would have been able to better understand the hurdles that they face every day in recycling.

3.4.2 Self-Evaluation of Business Policy

The next set of questions in our survey focused on other company practices that would be relevant when identifying sustainable means of waste management for companies. For example, in questions 9 through 11, we asked whether firms keep track of the amount of waste of which they dispose and the amount of money they spend on waste management. If firms do not keep track of how much they are spending, then we may be able to identify lack of financial incentives (or punishments) for responsible waste management as one possible reason. Firms which did keep track could have had specific positions for environmental issues, about which we asked in question 12, such as a supervisor or engineer in charge of waste management, and positions like these would have been important in assisting companies with waste management. Although firms may have taken such measures in their practices, we also needed to identify how effective they have been for the companies.

These questions also asked companies to evaluate their own policies regarding reusing and recycling materials. If companies were not being responsible in their waste management practices and did not see a problem with it, then we could identify apathy or lack of knowledge as being issues in the industry. If they had noticed the problem in the industry, then there could have been a lack of motivation to recycle or other underlying issue in the industry. We provided multiple choice options for the most common reasons that we suspect a company had for not recycling, based off of what we learned from our early interviews and background research. However, we provided options for “other” in several questions for companies to provide explanations, as well as open response questions 15 and 16 to give our respondents the opportunity to explain their practices and their attitudes towards waste management. This also helped to provide a full understanding of the companies and to not shape our results based on preliminary impressions of the industry. Input on individual companies was useful for tailoring

waste management practices to companies, but there needed to be an analysis of the industry as a whole in order to form broader policies.

3.4.3 Self-Evaluation of Industry and Governmental Policy

The final questions, 21 through 27, were intended to assess the companies' views of the construction industry as a whole and the views they have about Hong Kong's current initiatives to reduce the construction waste that they produce. We attempted to identify whether firms thought they were making any kind of progress in terms of sustainability, and why they thought that they could be. It was also important here to determine what roles the workers were playing in their waste management practices, or if it was all up to the management of the project or company. We would also have found inconsistencies, such as companies thinking that they were making progress when they claimed to not be recycling at all, which would demonstrate a lack of knowledge in the industry. Finally, assessing their knowledge of the current sustainability initiatives of Hong Kong, such as charging schemes for waste disposal and training sessions for environmentally friendly practices at work, would have provided an understanding of which initiatives have been effective at moving waste management practices in a sustainable direction and which have not. Such information would be useful in future expansion of effective initiatives and adjustment of less effective programs.

3.4.4 Survey Analysis

Our methods for analyzing survey data would have been dependent on the amount of responses. A higher response rate would have likely resulted in more reliable data, especially when adjusted to better represent the composition of the construction industry. Alas, following the distribution of our surveys, we had a very low response rate. While there were no data for us to analyze, this lack of response was representative on its own of the challenge of encouraging companies to identify their own practices to change in their businesses. We have discussed the lack of response to our surveys in the next chapter.

3.4.5 Interview Analysis

While the surveys could have provided the majority of the quantitative data on what different types of construction companies are doing, in terms of sustainable waste management, much more in depth information was acquired through interviews with members of the construction industry. According to Berg (2007), an interview is "a conversation with the purpose...to gather information" (p. 89). Conversations allowed us gather more substantive

information, as we delved into the waste management issues more thoroughly. Rather than ask what a company does, we had the opportunity to ask follow-up questions for detailed explanations of why the company does something as it does. Similarly, we asked the organizations about their members and why they work as they do. Limiting responses, as our survey did, to “yes” or “no” and “agree” or “disagree” for many questions, could have restricted our data, and while some questions were open response, holding conversations allowed us to ask for more details and explanations.

We performed interviews with several individuals with experience in the construction industry. In total, there were five interview sessions and six interviewees contributing to our research. Most of these interviews were either with subcontractors currently working in the construction industry on various projects, or current or former subcontractors who also represented trade organizations involved with the construction industry. A few respondents also represented larger contracting companies. Each of these individuals was familiar with the subcontracting process of the construction industry and the practices employed throughout the industry. Overall, our interviewees were much more familiar with the civil engineering practices. However, there was some familiarity with electrical and mechanical (E&M) engineering practices.

The interviews were rich in data for our research. Each conversation lasted 45 minutes to an hour. We typically had one interviewer asking questions from our rough interview guide, located in Appendix B, while other members of our group were taking notes and asking follow-up questions in order to get as much information out of the discussions as possible. A description of each of our interviewees can be found in Appendix C. At the request of an interviewee, we were not able to record the audio from one interview. The other four interviews were recorded for us to transcribe the conversation later. The transcriptions for our interviews are located in Appendix D. Finally, using our interview notes and interview transcriptions, we identified the most commonly discussed hurdles and challenges that the construction industry has faced when managing waste, in order to formulate policies to make construction practices more sustainable.

3.5 Policies for Making Waste Management More Sustainable

In order to recommend effective policies, we chose to analyze solutions from other cities and countries for their applicability to the waste management issues of Hong Kong. If these cities

and countries were found to have the same types of issues and circumstances surrounding them, then it is possible that these initiatives could also be applied to Hong Kong. From background research, we have decided that the methods for controlling waste that have already been enacted in Singapore and the UK would be most applicable to Hong Kong. For further study, we reviewed prior research, archives, and government data in order to study the efficacy of these waste management issues. As case studies gather qualitative data to better understand the research problem, according to Berg (2007), we had to consider the culture of Hong Kong and the imminence of its waste management issues compared to Singapore and the UK. By examining the construction industry's practices in these cities, we recommended policies to help solve urban construction sustainability issues in Hong Kong

3.6 Conclusions

Based on the archival research, interviews, and case studies that we have performed, we identified the challenges faced by the smaller construction firms in practicing sustainable construction. Our analysis of the data collected from our objectives served as the primary tool to complete this objective. This analysis of our research, gathered through these methods, provided us with the hurdles that prevent SMEs from sustainably managing waste in Hong Kong. From this, we were able to develop policies to encourage SMEs to practice greener construction as well as means for the contractors and organizations to support and guide them. We have also determined which methods would be more difficult to implement or would cause more issues than they would resolve based on prior solutions and input from industry experts. We recommended these methods to the Business Environment Council in order to promote sustainable practices amongst SMEs and to reduce waste produced by the construction industry.

4. RESULTS AND ANALYSIS

The goal of this project was to identify the hurdles faced by small and medium enterprises (SMEs), particularly subcontractors, that make sustainably managing construction waste difficult. By identifying what has prevented more sustainable practices from being taken up in the industry, we also intended to identify means of tailoring new waste management practices to different construction firms through recommendations made to the government, industry organizations, and main contractors. We have performed archival research, surveyed various subcontractors, interviewed other representatives of the construction industry, and performed case studies of cities that have faced similar waste-related issues to Hong Kong. This chapter summarizes the data that we gathered from our research and the analysis that we used to establish our conclusions and recommendations.

4.1 The Problem of Construction Waste

We first examined the construction waste issues in Hong Kong through archival research. This research focused on the analysis of current events and public opinion polling relating to environmental issues and construction. With an understanding of current issues from a local perspective, we were better able to recommend waste management policies for Hong Kong.

4.1.1 Current Events

It was immediately apparent that, with the Tsueng Kwan O Landfill set to close within the next few years and the others not far behind (“Waste not,” 2012), the government has finally had to make a decision on how to manage the waste crisis. We found that the most recent happening in this issue is a new plan to invest more in infrastructure to handle the waste that burdens the city. According to deputy environmental minister Christine Loh Kung-wai, the total planned is HK\$31 billion over 7 years, including HK\$14.9 billion to build a massive incinerator as well as some expansions to the current landfills (Cheung, 2013a). Plans from the previous administration to build an incineration facility had already drawn strong opposition from not just environmentalists, but from residents too (Cheung, 2013a).



Figure 5: Locations of Hong Kong’s current landfills, and sites for proposed incinerators. Map adapted from “Hong Kong districts map” (2010), locations provided by Environmental Protection Department (EPD, 2013).

The following concerns have been indicated with the use of incinerators for municipal solid waste. Although emissions from incinerators can be controlled by legislation to relatively safe limits, according to McKay, extremely toxic, carcinogenic chemicals such as dioxins and benzofurans, as well as harmful heavy metal and hydrochloric acid emissions, are still created and released by such municipal solid waste incinerators (2002). Further, such an incinerator would only be able to handle non-inert waste, mainly plastics, timber, and food from residential waste, so there would be little ability to combust non-inert waste from construction and demolition projects like rock fill or scrap steel. The public has likely been opposed to these incinerators due to the high development and maintenance costs to the city and the effects on the city’s already poor air quality. Although it seems to be the government’s only solution to the waste issues, this is not a particularly favorable strategy in general, and is almost ineffective at dealing with construction waste.

Additionally, the government has been in a difficult position lately when trying to balance the city’s housing problems with its environmental issues. In more of the recent plans

unveiled by the government under Chief Executive Leung Chun-ying, the government is discussing land reclamation as a means of expanding the city's land area. The Secretary for Development's plan includes 600 hectares of new land to be reclaimed from the coastlines, mainly outside the harbor, but also potentially in the form of a new artificial island ("Hong Kong considers," 2013). These land reclamation projects could be one means of dealing with the over-production of construction and demolition waste in Hong Kong. Inert construction waste sent to public fill facilities can be reused in other construction projects, but much of the fill may be unsuitable for such reuse. The material could be used in land reclamation instead, in order to relieve the build-up of waste at public fill facilities, but other research suggests that land reclamation has serious environmental consequences on marine ecosystems.

Xiamen, another city located on China's southeast coast, has been considering land reclamation projects to expand its area. Wang, Chen, Zhang, Jin, and Lu assessed the environmental impact of land reclamation in this city, and found that land reclamation projects have "caused significant damage to coastal ecosystems and the services they provide" (2010, p. 2550). Components of the environment affected include the natural waste transport throughout the ocean and erosion control from the destruction of coastal plants and coral reefs (Wang, Chen, Zhang, Jin, & Lu, 2010, 2550). Land reclamation also clearly is detrimental to human activity by the destruction or removal of beaches, which provide "aesthetic and recreational services" (Wang, Chen, Zhang, Jin, & Lu, 2010, 2550). For example, such developments could hurt a city's tourism, in addition to the natural ecosystems that are cleared out in the process of extending the land area off coasts. It can also be expected that the debris that ends up in public fill will contain some materials that would pollute the coastal waters if dumped into the sea. Therefore, because of the damage to or loss of ecosystems caused by and the poor aesthetics of these projects, using inert construction waste public fill for land reclamation cannot be a sustainable practice used to deal with Hong Kong's construction waste issues.

Analysis of public opinion also shows that land reclamation should not be the answer to the city's problems with construction waste. Boat operators in Victoria Harbour, located between Kowloon and Hong Kong Island, have witnessed the shrinking waterways over time as more and more land has been reclaimed on the waterfront (Ngo & Cheng, 2013). According to the South China Morning Post, over 50 years of land reclamation has developed more than 2800 hectares of land and narrowed the harbor from 2,300 meters wide to 910 meters (Ngo & Cheng, 2013).

One man, Chan Tsu-wing, who has operated the Star Ferry for nearly 30 years, said that "Reclamation has seriously affected the water currents and made it harder for us to moor boats,,. The pollution is also quite bad" (Ngo & Cheng, 2013). Citing the shrinking harbor as the cause of choppy waters, boating operations have become more difficult. Pollution from various kinds of waste has also made life difficult for fishermen in the harbor, whether from construction and demolition projects or land reclamation on the coast, or likely emissions from ships and on-land sources creating acid rain. There needs to be more control over the amounts of pollution in Hong Kong, and redirecting waste from the harbor should be another goal.

Many residents with fond memories of the harbor before reclamation also spoke with discontent about the expansions projects. Chan Ngan, a longtime resident in the Western District on Hong Kong Island, spoke about her young life working at the piers (Ngo & Cheng, 2013). With water transport having been made more difficult and land transport having taken its place, her old way of life has been replaced. Long-time residents, like Chan Ngan are left with only memories of a way of life that has been terminated by the land reclamation projects.

Others in opposition to these projects include environmental groups. Eleven groups, including Friends of the Earth and Green Sense, jointly opposed new plans from the government under CY Leung to swiftly reclaim land for housing development projects. They questioned whether he was breaking his pledge to improve the state of the city's environment during the 2012 election campaign, according to another article by the South China Morning Post (Cheung 2013b). However, now with his proposal to reclaim more land for development, he may have drawn even more opposition. Samuel Hung Ka-yiu, chairman of another opposing environmental group, Hong Kong Dolphin Conservation Society, said that "the most loyal supporters of his environment platforms have quietened [sic] down" (Cheung 2013b). These groups are opposed to more than just the part of his plans to reclaim land, but to develop on other green lands to solve a housing dilemma. Evidently, there was clear opposition to his environmental policies from a wide variety of groups, which may have reflected a poor public opinion on land reclamation.

4.1.2 Public Opinion Polling

Although not as recent as Leung's administration, a variety of public opinion polling has demonstrated citizens' concerns about environmental issues in the past few years. Polling on the construction industry was very scarce, but there were more data on environmental issues and

concerns from the public. As shown in the polls that we researched, there is much concern amongst the public for air pollution, in addition to several other issues.

In terms of the 2012 elections, although not elected simultaneously with Chief Executive Leung, voting for members in the Legislative Council was affected by the concerns about pollution in Hong Kong. According to surveying of over 700 voters performed by the Clean Air Network prior to the election, 73% of voters were moderately to heavily influenced in their vote for representatives by his or her agenda on air pollution (“Legislative Council,” 2012). As the question asked specifically about improving air quality, individuals opposed to air pollution ordinances were not considered influenced in their votes (“Legislative Council,” 2012). Clearly, a majority of the city is concerned about pollution and wanted change to pollution policies. However, contradictory to these data, the political group held the most seats after the 2012 Legislative Council election, the Pro-Beijing camp (Tam, 2012), did not seem to be concerned about air pollution. The commissioners of this survey asked candidates to sign a pledge to improve air quality through legislation, and few of the candidates from the parties composing this bloc, particularly the dominant Democracy & Progress of Hong Kong Progressive Alliance, were signatories (“Legislative Council,” 2012). While this survey focused on effects on elections, other data are more general about air pollution concerns.

One poll from 2008 by the Civic Exchange, published in a report known as Hong Kong’s Silent Epidemic, surveyed over 1,000 adults in Hong Kong, and found that in terms of air pollution, more than half of the public complained about it at least occasionally to friends or colleagues (57%) and family (54%) (DeGolyer, 2009). Many also had reported themselves or loved ones suffering from breathing disorders exacerbated by air pollution, such as coughing issues (27% occasionally, 7% frequently) and even asthma (10% occasionally, 4% frequently) (DeGolyer, 2009). While not necessarily compatible with the Clean Air Network surveys, these data show that there is a clear majority of individuals in the city concerned about air pollution. As these data are older than the previous survey, there is also likely a trend in growing concerns about pollution over time, as more people seemed to notice the pollution more in 2012 than in 2008. Although not affecting everyone, air pollution is still a public health issue that has not been taken seriously enough, especially by the government.

Other polling data also focused on air pollution in Hong Kong. The media were given a more favorable opinion on how they have addressed the issue of air pollution in 2008, 48%

satisfied or very satisfied versus 44% dissatisfied or very dissatisfied (DeGolyer, 2009), but this still demonstrated a divide in how people feel about the portrayal of problems in Hong Kong.. When compared similarly against 2001 polling numbers, the media's response to the air pollution issues had also faced similar issues over time, with a similar level of satisfaction (47% combined) of people satisfied in 2001 but a remarkably lower level of dissatisfaction (31% combined) (DeGolyer, 2009), showing that as some people became more aware of environmental issues, they may have been able to better identify a weaker response to the pollution issues in the media.

Similarly, Hong Kong University has surveyed the public frequently on their satisfaction with the media in general. Interestingly, in late 2012, people were more satisfied than not (50% satisfied and 14%, dissatisfied) and found the media to be somewhat credible (rated 6.16 out of 10) ("Sources of News," 2013). In 2008, when the DeGolyer survey was taken, satisfaction and credibility were about equal to 2012's data, although there was less dissatisfaction ("Sources of News," 2013). The most important thing to take from these data was the great difference in disapproval. General approval took into account all coverage, such as that of all political and social events, while approval of environmental coverage was very specific. People likely have been concerned about the environment and pollution, and have seen the conditions portrayed as much better than they really are. If people noticed the environmental aspect of news coverage specifically, then it has likely been a great issue on their minds. Therefore, this difference also demonstrates the concerns of the people about the environment and, specifically, air pollution.

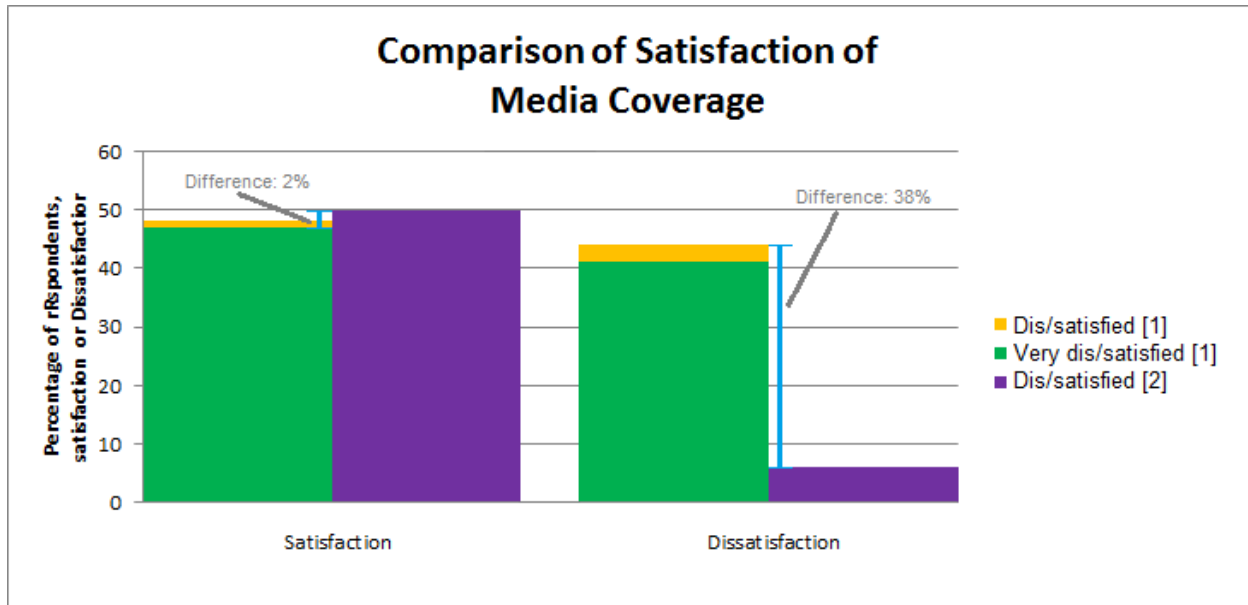


Figure 6: Comparison of media satisfaction rates, based on air pollution-related coverage [1] and general coverage [2] in 2008. Notice the larger gap in dissatisfaction than satisfaction between pollution and general coverage.

Note: [1] refers to Civil Exchange study (DeGolyer, 2009) and [2] refers to HKU study (“Sources of News,” 2013)

In addition to air pollution, survey data show concerns about other environmental issues. As it is relevant to construction waste management practices, one survey found that 69% of people were at least somewhat concerned about land reclamation (DeGolyer, 2009). This clearly constituted a majority of people considering the environmental impact of reclamation. As it is met with such skepticism from the public, it is not a reasonable solution to the problem of construction waste. Additional research on current methods of waste disposal has identified public concerns about the landfills. In Tsueng Kwan O, citizens have complained about the pollution and social problems resulting from the South East New Territories (SENT) Landfill, the landfill most in danger of reaching capacity. According to complaints gathered over the years of 2009 to 2011, the landfill reeks of an unpleasant odor, thereby affecting nearby residents (Yau, 2012). The government has proposed to solve this issue by limiting dumping to only construction waste, which is generally odorless (Yau, 2012). Unfortunately, while this may address citizens’ complaints, it only encourages more production and dumping of construction waste. .

Looking towards the future, it was important to consider the mindset of the youth to when formulating our policies. Another survey, performed by the Hong Kong Institute of Education (HKIEd), showed the youngest generation is particularly concerned about the environment. Amongst only the 15 to 30 year old individuals whom were surveyed, 82% were concerned about the environment compared to 73% who were concerned about economic growth (“Survey by HKIEd,” 2013). As is described in detail in our interview results, the current members of the construction industry are much more concerned about money than the environment. If this younger generation prioritizes environmental issues, then perhaps there will be a better chance of solving issues like those in construction waste management in the future. Additional questions focused on concerns of younger people about the Tseung Kwan O landfill. The most frequent responses was concern about health issues at 60%, but water and air pollution were the second and fourth most cited concerns about the landfill (“Survey by HKIEd,” 2013). It was clear from these data that the younger generation is very aware of these environmental issues. The next generation of workers, consisting of these current students and others freshly out of school, would need to be mindful of the environment in order for our recommendations to have any efficacy. As long as their mindsets do not change over time, there can be hope that the issues of air pollution and waste accumulation will be solved by the current young people.

It is evident from polling data that there has been much concern for the environment throughout Hong Kong. Although environmental protection is a large, complex issue, there are a number of ways to tackle it for the good of the public health and the environment itself. There are currently ordinances in place in the city to regulate pollution, in the air and water and in the form of noise, and international standards such as ISO14001, to promote environmental protection. However, none of these have been sufficiently effective in reducing construction waste, which is still a great problem in Hong Kong. From our research of the current waste problems, it is evident that continuing to dump in landfills or expand the city through land reclamation should not be solutions to the waste problem. The public should not accept policies that further harm their health or daily lives and make pollution any worse of a problem for a city already choking in poor air quality.

4.2 Characterization of Small and Medium Enterprises in Construction

We attempted to gain as many data as possible from a population that was expected to yield a very low response rate. In order to do this, we distributed our surveys to the entire list of registered construction companies. Out of 6,572 registered companies, we found that 4,405 provided email addresses for their business, or about two thirds of businesses (67%). Upon distribution it was apparent that there were many inactive email addresses on the list, since we received 296 notifications of failed delivery, or 6.7% of the total emails sent out. This was to be expected as companies may go in and out of business quickly and dissolve their business account. Following the initial distribution, we came into troubles in our research, as we received almost no responses. We have identified and described the following factors as contributing to our lack of polling data:

- Timing of distribution
- Business interests and resistance to change
- Survey format

While we received almost no responses for our surveys at all, as shown in Figure 7, we have also identified some results from our lack of data.

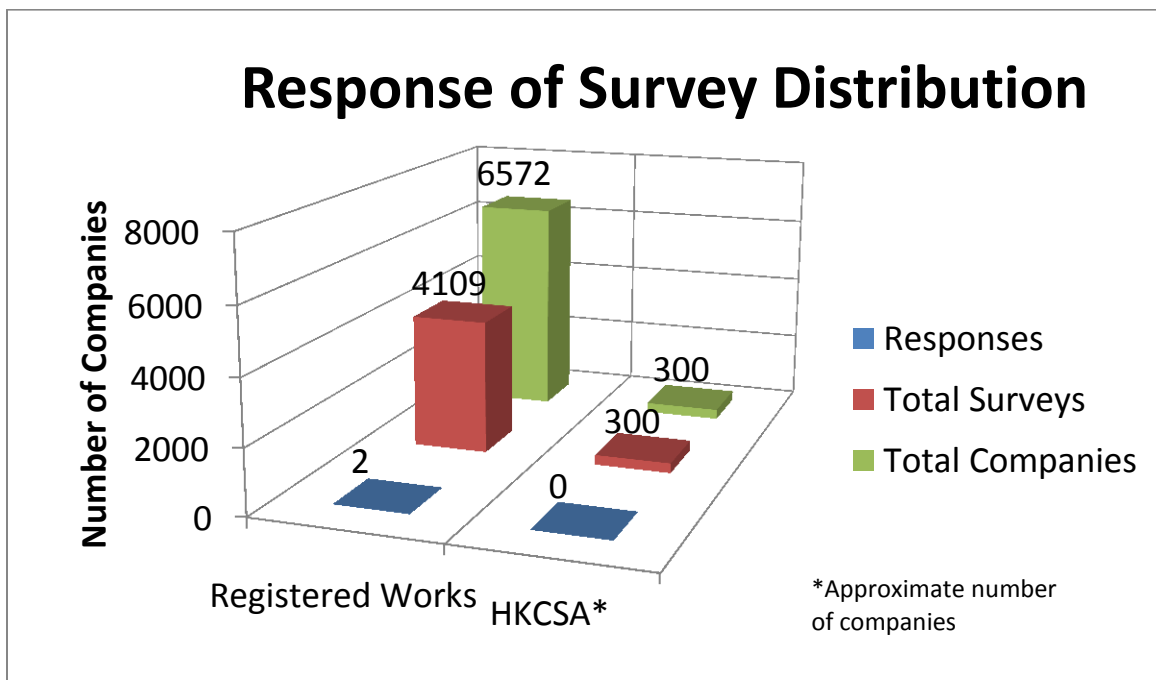


Figure 7: Number of survey responses received from the two groups of construction subcontractors to whom we attempted to distribute the surveys.

4.2.1 Timing of Survey Distribution

After our surveys were distributed to the companies, we had very little success in getting responses. The language barrier is one of the most obvious issues that one could identify in reasoning why we did not receive responses, but that is not the case as our survey was distributed in both Chinese and English. It is likely that timing was the main issue that prevented us from receiving adequate responses. Although most respondents were given about a week to complete the survey, this time period fell on the week before the Lunar New Year, the biggest and most important holiday in Chinese culture. Around this time, the Chinese participate in what is known as “the biggest mass human migration on Earth,” according to the BBC (“Millions prepare,” 2013). At this time, companies were likely scrambling to complete projects and other work in time for pre-holiday deadlines, so they had no time to respond to our survey. Even when we distributed our surveys to the HKCSA again after the holiday week, we still received no response as some companies had longer breaks than others.

4.2.2 Company Knowledge and Interests

In addition to our own errors in distributing the surveys, we have assessed some of companies’ issues in filling out our surveys. One potential flaw was that if companies had no position knowledgeable about sustainable measures, then the survey may have been dismissed automatically. Our questions may have requested too many details for someone without the proper understanding of the practices of a company. While small and medium enterprises may have not had environmental specialists, even project managers may not have felt comfortable answering environmental questions, especially if a response could lead to newer regulations for the business. As was evident from our interviews, businesses in the construction industry and elsewhere are focused on finances, and they will be resistant to regulations that could cost them any more money, as waste management regulations would likely do. For example, raising the fees implicated in the charging schemes would be met with fierce resistance from the construction industry as it costs more for waste disposal, despite that it would be effective in reducing the disposal of waste to landfills.

Potential respondents also may have dismissed the survey automatically if they had no interest in environmental protection, or environmental issues in general. If our survey came off as supporting policies that companies found to be too progressive, than that may have been an immediate deterrent from participation. Still, others could have been supportive of more

environmental regulations for the construction industry but felt that any eventual efforts to effect change would be for naught, knowing well the resistance of the rest of the industry to regulations and change. In general, if the recipient of the survey found no benefit to himself or his company, he would not have taken the time to respond.

4.2.3 Survey Length and Format

Regardless of the topics covered in the survey, there seem to be other issues with surveying businesses. According to Sheehan (2001), survey length can be a deterrent from business participation in surveys, whether distributed by email or traditional mail, although some studies presented contradictory results. Studies by Jobber and Saunders demonstrated that business “were more sensitive than consumers to survey length,” while Tomaskovic-Devey, Leiter, and Thompson concluded that survey length played a key role in deterring business response in surveys (as cited in Sheehan, 2001). While the definition of a “long” survey was not provided, our survey may have been perceived as long as the Chinese version of our survey spanned six pages. (The English version was longer at seven pages, but there was no difference in content.)

Interestingly, we did receive one partial survey response. In the survey, the respondent completed only the first page. We expected that confusion would have been caused by splitting the bank of multiple choice answers across two pages for questions at the bottom of a page. To remedy this, we left blank space at the bottom of some pages so that a full question would appear on the top of the next page. As there was white space on the bottom of the first page, this respondent may have thought that our survey only spanned the first page. As the survey appeared so short, the time required to participate was not enough to deter this individual from responding.

Other formatting problems may have made our survey unappealing. Although no more than seven questions appeared on one page, the number of options in the early multiple choice questions may have been intimidating. As the Chinese version of our survey was only a translation, cultural differences may have been lost, creating a misunderstanding for the recipient of the survey.

Ultimately, two full surveys were returned to us, both from the list of registered subcontractors. Less than 1% of the population of subcontractors is not representative of the industry and cannot be extrapolated to form meaningful conclusions. Upon review, the data reflected what we gathered from the interviews, which we presented in the following section.

4.3 Current Sustainable Practices in the Construction Industry

The bulk of our data came from interviews with representative from the construction industry. In general, the interviewees included current subcontractors, current or former subcontractors who also represented trade organizations, or engineers representing much larger companies. In order, our first interview was with Dr. King Wong, who represented Municipal Sustainable Development Consultants (MSDI), a construction firm specializing in environmental issues. Next we interviewed Mr. Ringo Yu of Hong Kong Construction Association (HKCA), and then Mr. David Chiu, quality and environmental engineer for Shun Yuen Construction Company. The following interview was with Mr. Lawrence Ng of Hong Kong Construction Sub-Contractors Association (HKCSA) and Dr. Sammy K. M. Wan of Hong Kong Federation of Electrical and Mechanical Engineers (HKFEMC). Finally, we interviewed an anonymous assistant environmental manager of Kum Shing Construction. Each of our interviewees is described in full in Appendix C.

From the interviews that we performed with these representatives of the construction industry, we have determined the major hurdles that have prevented construction SMEs from implementing more sustainable waste management practices. The results from our interviews are found in Tables 2, 3, and 4, summarizing the identified hurdles, waste management practices, and waste management policies. Each representative shared his own experiences with waste management and explained the troubles. We have described these main hurdles in the following subsections, in addition to some minor hurdles:

- Money and company finances
- Government policies on the environment
- Worker culture and apathy

Table 2: Major hurdles for sustainable waste management practices in the construction industry, as identified from the five interviews.

Hurdle		Interviewees						
		Dr. King Wong	Ringo Yu	David Chiu	HKCSA	Kum Shing Go		
Money	Business profit, general finances	O	O	O	O			
	Low material value in reuse	O			O	O		
	Hiring contractor for recycling	O			O		O Identified as a hurdle	
	Paying workers for sorting			O	O		X Identified as not a hurdle	
Manpower	Environmental awareness, education	X	O	O	O	X		
	Worker focus, motivation (eg. Do the need reminders? Instructions?)			O	O	O		
	Lack of environmental officer, management		O	O	O			
	Manpower		O		O			
Design	Contract issues	O	O		O	O		
	Small area, poor arrangement for sorting waste		O		O	O		
	Timeline constraints, scheduling priorities		O	O		O		
	Engineers' lack of knowledge		O		O			

Table 3: Current and suggested waste management practices in the construction industry, as identified from the five interviews.

Waste Management Practice	Interviewees						
	Dr. King Wong	Ringo Yu	David Chiu	HKCSA	Kum Shing Go		
Non-inert material disposal at landfills	O			O			
Inert material disposed at landfill	O	O	%				
Inert material to sorting facility		O	%		O	O Identified as a current practice	
Central sorting facility (general)	%	%	O			% Identified as a possible practice	
Recycle/reuse through supplier	O				O		
Metal recycling			O	O			
Trip ticket			O	O			
EPD Eco Park					%		

Table 4: Current waste management policies and how effective they have been, as identified from the five interviews.

Effective current policy							
	Dr. King Wong	Ringo Yu	David Chiu	HKCSA	Kum Shing Go		
Government incentives, compensation for recycling	*	*	*	*			
Government safety, regulations	O		O	O			
Government chemical waste regulations				O	O	O	Identified as effective
Government contractual requirements		O	O	O		X	Identified as ineffective
Non-government contractual requirements	O	X		X	Δ	Δ	Identified as both effective and ineffective
Charging scheme for dumping waste					O		
Trainings	*	O	O	*	*	*	Suggested
BEAM/LEED Standards				Δ			
EPD Building Account				O			
Trip ticket system				O			

4.3.1 Financial Troubles and the Drive for Profit

The most prevalent and stressed responses from the interviews were the hurdles of money. Specifically, that is that all businesses are driven by profit and any business practices that do not save money or waste time, which in essence is money, are not acceptable. One response that stood out was the hierarchy of importance placed on certain aspects of a contract when deciding on a company for a project. According to Mr. Ringo Yu, the most important factor is always the cost of a project, followed by quality of a company's past projects, record of safety, and finally environmental impact, in descending order (personal communication, January 14, 2013). Most bids for contracts are selected primarily on the basis of price, and although that is still based on factors like scheduling, the selection process almost completely neglects environmental impact. Interviewees also mentioned that sorting materials for recycling was rarely considered because workers would need to be paid for the time that they used when recycling or entirely new job positions would need to be established in order to cover the work (S. Wan, personal communication, January 24, 2013). Even if companies had the manpower available to sort waste, they would still run into hurdles of accommodating the waste during storage and sorting.

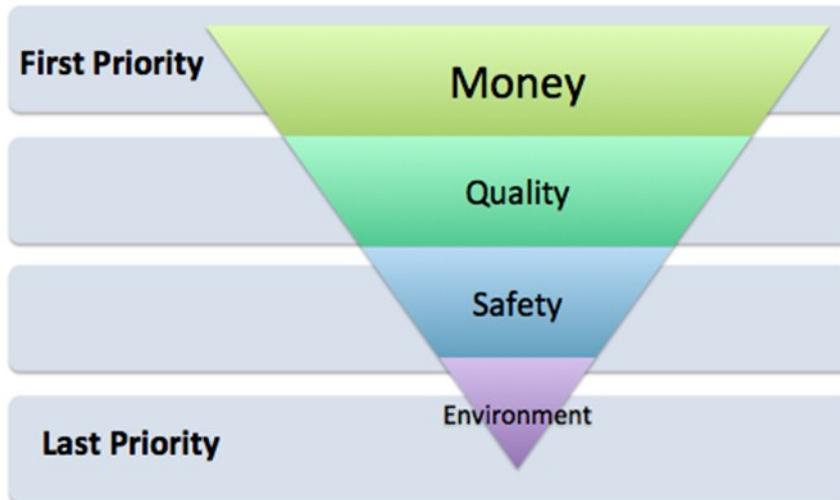


Figure 8: Hierarchy of contracting priorities as mentioned by Mr. Ringo Yu

Another related issue that was frequently mentioned was affordability of space to sort and store materials. Most construction sites are too small for waste to be stored or sorted, and most did not have off-site storage facilities. Even extra material that was not used in projects was found to be disposed of with little consideration for storage and reuse due to their lack of space, according to Mr. Ringo Yu (personal communication, January 14, 2013). Direct company finances are one problem, but there are also problems with the materials when trying to improve waste management.

In our interviews, we still found that companies only recycled the most valuable materials while dumping the less valuable waste. Mr. Sammy Wan, experienced in the electrical and mechanical (E&M) side of construction, mentioned the ease of recycling metals over other materials because of its comparably high value (personal communication, January 24, 2013). In contrast, Dr. King Wong noted the very low value of a glass bottle, perhaps five or ten cents, and by weight, glass is very inefficient to recycle due to its much lower value (personal communication, January 12, 2013). If the cost of transporting material like glass is more than the return value, there is very little incentive for recycling companies to collect the material, thus no incentive for SMEs to hire a collector. Several other issues relating to money were mentioned in the interviews, including lack of incentives for sustainable waste management practices and affordability of making some innovations. However, they will be described in more detail under some of the following hurdles.

4.3.2 Lack of Government Leadership

The next major hurdles that we identified from the interviews were related to inactivity in the government. Currently, the government has established charging schemes for paying to dispose of waste properly and fines for improper disposal (Yu, Poon, Wong, Yip, & Jaillon, 2012). However, there are no adequate incentives from the government for recycling. While companies are more willing to recycle materials like metals because of their high return values, they find that there are no incentives for recycling materials with lower return values (K. Wong, personal communication, January 12, 2013). Instead of being punished for improper waste management, Mr. David Chiu, representing a larger company of 100 direct employees, mentioned that businesses would rather be motivated by incentives for properly managing their waste than be punished for improper management (personal communication, January 21, 2013). Incentives and punishments are still financial issues with these companies, but punishments may have further consequences on companies, such as reputation problems, which would be just as unfavorable as they could result in further losses in the future from lost bids.

Additionally, we found that other regulations have been effective in changing industry practices. The issues of safety and air, noise, and water pollution issues amongst construction companies were taken much more seriously (D. Chiu, personal communication, January 21, 2013). This seemed to be the case in particular because these initiatives have already been in existence to handle these issues. Further, air and noise pollution seem to be much more noticeable in daily life in the city than environmental pollution, so violations are much easier to be caught, and workers' health seems to be among the most serious issues in regards to company reputation. If the government established environmental ordinances with equal strength of those used to regulate air and noise pollution and workers' safety, there could be significant improvement in construction companies' waste management practices.

4.3.3 A Culture of Workers Unaware of Their Actions

The final major hurdle in preventing SMEs from sustainably managing construction waste is the culture of the industry. Although some of our results were contradictory, it seems that the current laborers in the construction industry generally do not prioritize environmental protection or recognize the imminence of the waste issues (R. Yu, personal communication, January 14, 2013), which results in a less responsible attitude towards managing waste. As a consequence, even if the other hurdles were overcome, they would most likely continue

disposing as irresponsibly as always because they would not know any better. These construction workers are typically older, averaging around mid-50s, and their generation does not seem to have as much awareness of the environment.

One solution to the problem of awareness will be time. One may expect that the younger generations are more aware of the consequences of the waste issues on the environment, but they are not able to have much of an impact on sustainability in the industry yet. Additionally, proper education of the next generation of workers would be necessary now to develop a culture that can ensure that a difference is made in the future (R. Yu, personal communication, January 14, 2013). It will take years of turnover, likely decades, for the younger generation to be able to make a difference; they would need to replace more than just the workers who may have the power to take some initiative, but also the managers who have the power to make strong policies. Educating the current workers may also be possible through waste management training programs, but employers may be reluctant to support attendance to these. It could also be expected that these workers would be reluctant to learn better practices, as the assistant environmental manager of Kum Shing Construction mentioned that constant reminders are necessary to ensure that better practices are carried out by the workers (personal communication, February 6, 2013). Education will be necessary to improve a culture in the industry that seems to be apathetic towards environmental concerns, but it may only be the passage of time that brings real change to the workers.

4.3.4 Minor Hurdles: Careless Contracts and Insufficient Trainings

In addition to the major hurdles to sustainable waste management, there are a few other issues that were mentioned in the interviews that have caused problems for small and medium enterprises. Contractual obligations were one issue mentioned by representatives including Mr. Sammy Wan (personal communication, January 24, 2013) and Mr. Ringo Yu (personal communication, January 14, 2013), particularly because government contracts generally have much stronger environmental clauses than private contracts. It was also mentioned by Mr. Ringo Yu that even if a main contract does have some form of environmental protection clauses, they will not necessarily be carried through to lower contracts in the subcontracting process (personal communication, January 14, 2013.) This weakens the contractual agreements and leaves companies free to their own profit-driven vices. Perhaps most importantly, subcontractors also only work by the contract (K. Wong, personal communication, January 12, 2013). If they are not

directed to manage waste sustainably in the contract, they would never go out of their way to do so. This also reflects the issues with the culture of the industry.

The main contractor could also provide more assistance to the subcontractors. Waste management practices could be improved through resources like trainings and storage space for waste management and sorting. These trainings would provide information on legal and contractual requirements, responsible environmental practices, and other policies, which would at least make it easier for subcontractors to make sustainable decisions on business practices. Stronger contractual regulations would likely make great improvements to the waste management practices if the main contractors had the initiative to make change in their policies.

Other issues raised were the lack of trainings for workers or companies on means of sustainable waste management. As mentioned under the section on culture, workers, who overall are not environmentally aware, have not been given proper trainings into responsible waste disposal, or not even taken the time to receive the existing trainings. According to Mr. Ringo Yu, whose organization has held several similar workshops in the year 2012, only about 50 individuals attended each session (personal communication, January 14, 2013). These training sessions typically cover safety in the workplace and environmental ordinances like air, noise, and water pollution, but could be expanded to cover responsible waste management. This has been seen as another financial issue as companies do not want to pay to cover trainings (K. Wong, personal communication, January 12, 2013). Regardless of how affordable the trainings are—just HK\$50 (about US\$6.40) for some, others free (R. Yu, personal communication, January 14, 2013)—for one worker to attend one session—and that construction industry associations also provide compensation to the companies for their workers' attendance, trainings still are not very popular. This problem seems to be that companies do not want lose labor time in the projects to allow workers to attend, which would cost them even more money by delaying a project. In order to participate in environmental initiatives like these training, companies are going to have to make this minimal investment.

4.4 Solutions from Around the World

In order to identify applicable solutions for the issues of waste management for Hong Kong, we have reviewed other waste issues from around the world. The purpose of these case studies was to compare waste management policies in Hong Kong to those of Singapore and the

United Kingdom, in order to identify strategies that may serve as a model for the Hong Kong construction industry. These countries have already tackled the issue of construction waste with policies stronger than those currently in place in Hong Kong. By comparing their issues to those in Hong Kong, we identified effective waste management policies that could be applied to Hong Kong. The policies that we reviewed in depth are summarized in Table 5.

Table 5: Summary of studied waste management policies.

Country	Policy	Brief Description	Goal
Singapore	Recycling companies	Government partnerships with private recycling companies.	Make recycling easier for everyone to take part.
	National Recycling Programme	Extensive plan for reuse and recycling, and waste management through incineration and limited landfill accessibility.	To conserve land space, as well as produce energy with a lack of natural resources. Promote reuse and recycling.
United Kingdom	Landfill tax	A tax on the disposal of waste on landfills.	Make sustainable waste management more attractive by deterring dumping waste at landfills.
	Aggregates levy	A tax on raw material, such as fresh rock, used for creating aggregates for construction.	Encourage the use of recycled materials through charging on raw materials.
	Site Waste Management Plan	Requires contractors to form plan for waste management prior to project commencement.	Help companies plan out material usage in projects.
	Code for Sustainable Homes	An assessment system for rating the sustainability of new homes, during and after construction.	Encourage sustainable development.

4.4.1 Singapore

Singapore has long been aware of the issues regarding urban waste management. The city-state first began to notice problems with its waste production in the middle of the twentieth century, and by the end of the 1970s, it was apparent that Singapore could not rely on landfills forever (National Environment Agency [NEA], 2010). While it was not a perfectly

environmentally sound solution, Singapore has developed four incineration plants since 1978 to convert waste into energy (NEA, 2011). This was also not a reasonable solution to the production of construction waste, as over 80% of construction waste is inert material, such as rocks and metals, which cannot be incinerated (Tam, Le, & Zeng, 2012). Singapore still has one landfill open on the island of Semakau, which is expected to last until at least 2040 (NEA, 2002), far longer than Hong Kong's three landfills. This landfill could take construction waste, but the city-state has developed ways to conserve precious space. In order to restrict waste from going to landfills, Singapore has developed a strong recycling program, as described in the following subsections.

The National Recycling Programme

Rather than abuse landfill space, Singapore has been very proactive in dealing with its waste. The National Recycling Programme was put into effect by the government's National Environmental Agency in an effort to conserve land space, as well as produce energy with a lack of natural resources (Corazon, 2004). This heavily promoted reuse and recycling of materials to conserve resources and prevent waste from burdening landfills. To facilitate the recycling process, Singapore's government has formed partnerships with some private recycling companies, such as Hock Chuan Hong Waste Management (HCH) which specializes in recycling construction waste ("Recycling Facilities," 2011). There are several construction and demolition waste recycling facilities operating in Singapore, some of which primarily sort materials while others are in charge of processing materials (Tay, 2008). The sorting stage involves manual sorting for recyclable materials like wood and plastics and use of magnetic separators for ferrous materials, while processing can use remaining concrete and stone to create aggregates for precast concrete in future construction projects (Tay, 2008). Other companies contracted by the government, such as Veolia Environmental Services and Colex Holdings, known as public waste collectors (PWCs), are in charge of collecting and recycling household materials and have contributed to the overall reduction in disposed of waste under the National Recycling Programme (NEA, 2011). Increasing means of recycling is a good method of increasing the amount of reuse of materials.

Extensive Recycling Practices

Understanding the success of this program was important in identify its applicability to Hong Kong. According to the Singapore's National Environment Agency, over 6.9 million

tonnes of waste was produced in 2011 and of that, 1.2 million tonnes (over 17%) was construction and demolition waste (NEA, 2011). However, only about 1% of this waste was disposed of (NEA, 2011), either to be incinerated or sent to the landfill, an astonishingly low amount when compared to Hong Kong. Overall, 59% of waste is recycled, mainly from metals and wood and paper products, while the remaining waste includes plastics and food waste (NEA, 2011). Singapore's sophisticated waste management program has promoted extensive recycling, as evident by their total rate of recycling. As noted by Neo (2010), this has been facilitated by the government's housing program, as housing is subsidized to some extent for 81% of the population, so recycling companies hired by the government can be organized and operated efficiently. The government has stake in housing and recycling company operations, it has been able to integrate the two to improve environmental conditions while supporting business. While the government has been able to significantly reduce the amount of waste that is sent to landfills through intensive recycling programs, there is still too much waste that is generated in Singapore.

Instead of only promoting recycling, there are other means of waste management that have been considered. In particular, it is important to "recogniz[e] that prevention is better than the cure," (Neo, 2010). Waste generation needs to be reduced through preventative means, such as by reducing the amount of plastic in packaging that needs to be disposed of or the amount of food waste from throwing out leftovers or excess food items. Unfortunately, Singapore with its great consumption patterns as a heavily developed city-state has not prioritized waste minimization over reuse and recycling (Neo, 2010). There are also some issues with recycling, at least in recycling household waste. Although some of the public has the convenience of recycling pick-up on their doorstep every two weeks, Cheah stated that this service is not available everywhere in Singapore (as cited in Neo, 2010). In terms of construction and demolition waste, minimization could only come from using fewer materials in development, a challenge that would require sustainable engineering to be overcome. However, reuse of materials, such as in aggregates, is already performed successfully. While minimization of waste would be a strong policy to reduce the burden on the cities like Singapore and Hong Kong, an effective recycling plan is a strong foundation for policy that looks to improve waste management.

4.4.2 United Kingdom

While not as similar to Hong Kong as Singapore in terms of culture, the United Kingdom has been facing similar waste management issues. The issues and the need to address them first became highlighted by the European Union's Landfill Directive in 1999, which called for nations to reduce municipal solid waste (MSW) and encourage material recycling and reuse (Burnley, 2001). At the time of the directive, the 60 million people of the UK were producing over 30 million tonnes of MSW per year (Burnley, 2001). According to the statistics from the Department of Communities and Local Government (DCLG) (1999), nearly 70 million tonnes of construction and demolition waste was produced in 1998, about a third of which was recycled and another third dumped in landfills (as cited in DEFRA, 2012). Out of the total waste produced of 95 million tonnes (Villegas, 2010), this construction waste accounted for about one fourth of the waste. Another issue from construction practices arose from development of housing. According to the DCLG (2006), energy used to heat and provide electricity to homes accounted for over a quarter of the greenhouse gas emissions, such as carbon dioxide, in the United Kingdom in 2004. More sustainable development practices could reduce energy consumption in homes. With such a great portion of the country's waste being created by the construction industry, the UK had a great opportunity to reduce its waste production by reforming policies on construction and demolition waste management.

As a priority for reducing waste production, the United Kingdom has employed several waste management policies:

- Landfill tax
- Aggregates levy
- Site Waste Management Plan (SWMP)
- Code for Sustainable Homes

In the following subsections, we have described each policy and its effects on the United Kingdom's landfills.

Landfill Tax

The first reform introduced was the landfill tax in 1996, prior to the EU's Landfill Directive but intended to be its response to the call for action ("Landfill tax," 2011). Initially a tax on landfill operators and passed onto dumpers, each tonne of non-inert waste disposed of was charged at £7, increasing over the years to £56 in 2011 and to the current ceiling of £80 in 2014

(Her Majesty's Revenues & Customs [HMRC], 2012). As most construction waste consists of non-inert waste like rock, concrete, and fills like sand, this was a significant charge passed on to the construction companies.

In 2008, at a charge of £32 per tonne, the 22 million tonnes of waste sent to the landfill would have generated about £704 million (DEFRA, 2012). Consequently, the amount of construction and demolition waste sent to the landfill was reduced from 37% in 1999 to 22% in 2008, as waste management practices such as crushing rocks and concrete for reuse in aggregate became more appealing options (DEFRA, 2012). This was also likely caused by the aggregates levy described in the next subsection. Although the total amount of waste produced jumped significantly between 1999 and 2001, the following years saw very little change in the total annual production of waste (DCLG, as cited in DEFRA, 2012). As there was very little growth in waste production, it is possible that the tax encouraged more innovation in sustainable methods of construction so that companies could avoid the hefty and growing costs of disposal. Other taxes were also used to reduce the construction industry's effect on waste generation.

Aggregates Levy

The next reform was the aggregates levy. Enacted in 2002, this was a tax on the creation of new aggregates from rock, sand, and gravel (HMRC, 2011). The rate for the tax was £2 per tonne of applicable materials and additionally required transparency in business through applications and other registration methods (HMRC, 2011). While this was initially applied to operations at quarries for mining stones for aggregate, the HMRC, who levies the fines, began targeting construction firms whose operations fell under the jurisdictions of the levy (Stagg, 2008). In targeting construction companies, this encouraged these businesses to reuse fill or recycle waste materials such as concrete and rock for use as aggregates in new concrete, rather than use new resources to create building materials. According to the DCLG, the proportion of construction and demolition waste recycled for aggregate almost doubled over a decade, from 35% in 1999 to 61% in 2008 (HMRC, 2011). Similar to the landfill tax, there was not a large change in the amount of aggregate recycling over the years after enactment (HMRC, 2011). However, the initial increase in recycling rate proved that companies were put under pressure by the tax to enact more sustainable measures regarding material usage. In addition to taxes, other policies encouraged more sustainable business practices in the United Kingdom.

Site Waste Management Plan

The final two policies enacted were intended to promote more sustainable construction practices in the development phases. First is the Site Waste Management Plan (SWMP), which requires contractors to identify and plan how to “maximize waste efficiency” in the planning phases of a project (Department for Environment, Food and Rural Affairs [DEFRA], 2008). The SWMP was enacted in 2008 to require designers of larger construction and demolition projects to plan out how to efficiently manage site waste in order to reduce the environmental impact of a project, with an additional goal of helping companies identify savings that were made on materials and labor (DEFRA, 2008).

Unfortunately there are very few legal guidelines regarding what is required of the management plan, only that there may be penalties for not producing a SWMP (DEFRA, 2008). Although this encourages companies to plan out their resources more, there is limited legal force to it and with so few requirements, many companies could complete the form and ignore it during the project. Advantages of the plan, including encouraging cost savings and reducing materials usage, would be effective in reducing construction waste, but with little legal force it is not as reliable as a tax.

Code for Sustainable Homes

The second policy for sustainable development is the Code for Sustainable Homes. The objective of the Code was “to drive a step-change in sustainable home building practice,” designing more sustainable homes through optimizing water resources and reduced use of polluting materials (DCLG, 2006). Although the Code is intended to make home development practices sustainable at all stages, waste management is one of the focuses of the plan. The SWMP is part of the construction waste management standards, which would monitor waste from the project, while household waste management plans provide for recycling and composting facilities (DCLG, 2006). The Code uses an assessment system to score companies based on their adherence to the sustainability principles that are outlined (DCLG, 2006). A company’s reputation can be improved by touting a good score, if a project is certified as sustainable. While companies are not required through legal means to build according to the Code (DCLG, 2006), it is an excellent opportunity to make a positive impact on the environment compared to other projects. In conclusion, reducing the amount of construction waste could be achieved through other certification program based off of the Code for Sustainable Homes.

Overall, the United Kingdom has extensively attempted to control waste production in order to reduce the burden on its landfills. Tax policies on landfills have discouraged irresponsible dumping of waste while charging on raw materials has promoted reuse of materials. Businesses have been further encouraged to be sustainable through the Site Waste Management Plan and certification under the Code for Sustainable Homes. Applying sustainable policies modeled after the UK's efforts throughout the world could significantly improve the outlook for the environment.

4.4.3 Applicability to Hong Kong

A “one size fits all” approach would not work when deciding which policies would work for Hong Kong. As each city or country is different, careful considerations about background and culture are often necessary when applying policies across the world. However, most of the policies on the surface could be applied to Hong Kong, at least to some extent, while specifics such as tax rates and timetables would need to be set with much more detailed consultation.

From our interviews, it was apparent that the government of Hong Kong has not taken a strong enough stand on environmental issues. In a culture strongly rooted in capitalism, government regulations and taxes are often met with criticism. However, if the city wants to escape from its waste management crisis, the government is going to have to be more proactive. Singapore's overall recycling effort, years ahead of Hong Kong's, would be a great model, especially considering the similarities between the cities. As recycling companies now have little encouragement to collect many materials due to their value, Hong Kong could reduce the amount of waste sent to landfills by partially subsidizing recycling collection companies, as well as companies that process recycling into new materials. However, in order to be applicable, the funding for such programs needs to come from somewhere.

In order to generate more funds for stronger recycling programs, the Hong Kong government could collect more taxes. Since the funding is going to waste management, the revenue should also come from waste management. Like the United Kingdom, Hong Kong could issue stronger fees on dumping at landfills. Hong Kong already has several charging schemes at landfills but they are very low, at HK\$125 per tonne at landfills and HK\$27 per tonne at public fill facilities (about US\$16 and US\$3.50 respectively) (Advisory Council on the Environment, 2007). Compared to the UK, that is hardly enough to discourage companies from dumping. If

Hong Kong raised the dumping charges over time like the UK did, a significant amount of money could be generated to fund recycling programs.

It will be difficult to raise taxes on an industry already so resistant to change. As workers and businesses do not have environmental protection high on their lists of priorities, it would be difficult to change the practices of a stubborn industry. It is not likely that it would be easy to implement regulations on companies such as a Site Waste management Plan, especially on top of the pressure that they would be under to recycle and reuse materials. As the UK has done, the SWMP could initially be enacted with limited force, and then over time Hong Kong's government could enact stronger requirements for developers.

Hong Kong's waste management crisis has been on the horizon for a long time. It has not solved itself yet, and likely will not solve itself without the right force and incentives. As Singapore and the United Kingdom have demonstrated, strong leadership from the government is necessary to solve environmental issues, as free market prioritizes profit over progress. By making nearly-limitless dumping at landfills less appealing and recycling and reusing options for viable, Hong Kong could save itself another landfill crisis in the future.

4.5 Conclusions

Through our research we have identified the hurdles that prevent construction companies from sustainably managing waste. The bulk of our research came from interviews with representatives from construction companies and associations, providing us detailed explanations of the current waste management practices in the industry. It is evident that as long as companies are focused on their own profit over environmental progress, they will not invest in sustainable practices like waste sorting or recycling. The government has also not been taking a strong stance on the environment like they have been with air and water pollution, providing hardly incentives or fines on waste management practices. Finally, the culture of workers themselves has not been one that prioritizes environmental conservation, therefore the workers have as just as little interest in sustainability as the owners and managers of the companies. In order to recommend policies that would improve the current state of waste management practices, we have also identified recycling and tax policies that have successfully reduced waste dumping in Singapore and the United Kingdom. If applied similarly in Hong Kong, it is likely that the city's environment will benefit from these policies.

5. RECOMMENDATIONS AND CONCLUSIONS

Hong Kong is in much need of improved waste management practices, but simply managing the waste should not be the goal of any future policies. Environmentally friendly methods of waste management should be the primary focus of future policies and improvements rather than less sustainable methods of waste management including landfill expansion, land reclamation projects, and incinerators. Although it may be required to implement these three methods of waste management to a small degree due to the lack of space for landfills and public fill as well as the large amount of waste produced by a growing society of consumerism, the focus should be placed on methods to prevent, reduce, reuse, and recycle waste. These more sustainable methods of waste management, on which our recommendations focus, would better protect the environment from further pollution and harm as well as increase quality of life for the residents of Hong Kong.

Based on our research and analysis of data that we collected, we have developed three main areas for recommendations that can help improve the sustainability of the waste management practices of small and medium enterprises (SMEs). As described in the following sections, these recommendations focus on increased:

- Government engagement
- Education and training on environmental protection
- Main contractor support

5.1 Government Engagement

Although increased government engagement is discouraged in free economies like Hong Kong, the combination of the looming waste problem and the current culture of the construction industry makes government intervention a necessity. The government must enact policies that would immediately reduce the amount of waste being irresponsibly managed by construction companies as well as have long term, lasting changes on the mindset of the industry regarding environmental protection, specifically waste management. This can be done through education, which is discussed in section 5.2 Education and Training on Environmental Protection, and policies directly related to improving construction waste management by companies.

From our research, our team has concluded that the following government policies would effectively increase the sustainability of waste management practices if implemented:

- Enactment of stronger policies on poor waste management
- Incentives for recycling companies
- Establishment of construction waste collection points

5.1.1 Stronger Policies against Poor Waste Management

Due to the “profit first” mindset of the construction industry, outside involvement is needed to encourage and require improvements to current waste management practices. The Hong Kong government has been able to reduce other problems in the construction industry, such as worker safety as well as air and water pollution, in the past through the implementation of policies and project requirements. Similarly, the few policies that do address the management of construction waste have had limited success, such as the charging scheme, which effectively reduced the amount of construction waste being sent to landfills initially. While these policies were a good start at tackling the issues in construction, they are not nearly as substantial as those on noise, air and water pollution, and safety.

In order to be as successful and effective as these existing pollution policies, more and stricter waste management policies need to be enacted. Such policies could include:

- Punishments, such as fines or penalties, for extremely poor waste management
- Heavier landfill penalties
- Incentives for using recycled materials in projects
- Required waste management training yearly or biennially

These policies must take into account the organization of the construction industry such that the benefits and punishments do not favor certain companies, such as large construction companies over SMEs. These policies must also be adequately publicized and promoted to the entire construction industry, especially SMEs, which tend to be less knowledgeable and aware of environmental requirements and practices. If implemented, these policies could provide enough incitement to drive construction SMEs to attempt to better manage their waste.

5.1.2 Incentivize Recycling Companies

Construction companies in Hong Kong are sending too much recyclable material to landfills. From our research, we found that only high value materials, such as metals, are currently recycled, but low value materials like glass are sent to landfills due to their low or non-existent potential for profit. If the government implemented a program that subsidizes recycling

companies for handling these less profitable materials, far less recyclable material would be sent to the landfills. This program would not only enable, but also encourage recycling companies to accept all recyclable materials because there would be a potential for profit on all such materials, as there is in Singapore, even the low value materials. Recycling is a far more sustainable approach to waste management than landfills, and a program aimed at creating incentives for recycling companies would increase the amount of construction waste being recycled, thus decreasing the amount of material being sent to the city's landfills.

5.1.3 Construction Waste Collection Points

Our research showed that many SMEs have a difficult time sorting waste as well as storing reusable materials due to lack of space, manpower, and resources, such as capital and technologies. The government already provides a few sorting facilities for construction companies, but these are few, far apart, and limited in their uses. Further waste management support is needed, primarily for SMEs, to be able to increase the amount of recycling and reuse of construction waste, which would reduce the burden on landfills.

Using waste recycling companies in Singapore as a guideline, Hong Kong should create easily accessible central waste collection points as an extension of sorting facilities. These central collection points, whether wholly or partially operated by the government or privately owned with subsidies, would receive construction waste from companies that are physically unable to properly sort waste. The collection points would recycle and allow for the reuse of all possible materials before properly disposing of the remaining waste in existing facilities, such as public fill and landfills. This would reduce the amount of recyclable and reusable materials entering waste facilities as well as provide SMEs with the needed waste disposal assistance. Charges for the disposal of waste at the central collection points should be included into the charging scheme in order to continue to promote construction companies to reduce, reuse, and recycle materials when possible, but another layer of recycling and reuse would be added by the collection points.

Although such facilities would increase sustainable waste management, significant investment by the government would be necessary for the establishment and maintenance of such facilities. The upkeep costs could be offset by stronger policies on levying taxes on waste disposal or increasing the charging scheme's current cost for disposal of waste at landfills. Furthermore, if the government is able to consider investing a significant amount of money on

less sustainable waste management infrastructure, such as incinerators, we believe that they may also have the necessary funds to establish and support facilities aimed at sustainably managing construction waste. By financing more environmentally friendly infrastructure, the government can avoid further environmental damage caused by current waste management practices.

5.2 Education and Training on Environmental Protection

The culture and of the construction industry is very resistant to change. The mindset does not place environmental protection as a high priority, negatively impacting efforts to sustainably manage waste in the industry. Although government policies may force or encourage construction companies to be more sustainable in their waste practices, an informed and environmentally conscious industry is more likely to conform to environmental policies and adopt sustainable practices, as well as to potentially create stricter environmental policies themselves. Our team has established the following recommendations in order to create a more environmentally-minded and knowledgeable industry:

- Increase environmental awareness in schools
- Increase sustainability training

With these reforms to instruction in schools and businesses, Hong Kong could increase the desire and ability of companies to practice sustainable waste management:

5.2.1 Environmental Awareness in Schools

Although not directly related to the construction industry, proper education is essential to fostering future generations of environmentally knowledgeable workers. Over time, the current workers and management in the industry will be replaced by younger generations. If these new members of the industry have learned more about people's negative impact on the environment, then they may have a completely different mindset and base knowledge of environmental protection than the current workers in the construction industry. If the workers and management in the construction industry viewed environmental protection as a priority, they would place more attention on sustainable waste management practices and other environmental issues, such as air and water pollution. This additional attention would then decrease the amount of waste being handled irresponsibly through the use of greener practices, including reduction, reuse, and recycling.

To increase environmental education in schools, we recommend that the Hong Kong government enact policies requiring or encouraging schools to either: include this in their science curriculum, or create classes, clubs, or groups to integrate environmental protection into their students' education. Through environmental education, the mindset and culture of the construction industry, in addition to other industries, can be adjusted to value environmental protection, such as waste management, as a higher priority. Once waste management becomes a higher priority in construction projects, less waste will be produced and greener practices can be implemented

5.2.2 Sustainability Training

Throughout our research, we found that SMEs' workers had insufficient environmental awareness, specifically concerning waste management. Additionally they lacked the motivation to perform sustainable practices. Without the knowledge or motivation, many sustainable practices are often overlooked in these construction projects, which can lead to more irresponsible management of construction waste. The reasoning for this is that waste management, as mentioned in our results, is a low priority in the industry, especially for small and medium enterprises. Unlike larger construction companies, SMEs often lack the resources and knowledge to be able to properly motivate and inform their workers on the use of sustainable waste management practices and thus require external assistance.

Currently, there are many training sessions and other educational resources for safety and environmental protection, but very few, if any, of these focus strictly on sustainable waste management. Not only does this further reduce the importance that construction SMEs put on waste management, but it also decreases the knowledge and skill that their workers have in practicing waste management sustainably. In order to counter this, we recommend that the government, construction trade organizations, and main contractors increase the number of training sessions and workshops on waste management as well as make them more attractive to SMEs. These educational resources need to be specifically tailored for SMEs, such that they would be provided guidance concerning waste management requirements, sustainable practices, and the importance and potential benefits of sustainable waste management. These training sessions and workshops would not only increase SMEs' knowledge of sustainable waste management, but also encourage and motivate them to accept greener practices due to the potential benefits and importance being put on sustainable waste management.

5.3 Main Contractor Support

The current organization of the construction industry and workings of contracts can also make it difficult for SMEs to properly manage their waste. There is a very weak contractor-subcontractor relationship, as the main contractor, after having finalized the subcontractor's contract, will leave the duties of the project and waste management entirely up to the subcontractor, which is typically an SME. Due to an SMEs' lack of knowledge, resources, and motivation, their waste is generally not sustainably managed as it is typically not required by contract. We recommend that main contractors provide the following support to the small and medium enterprises that they subcontract:

- Provide ample work space for sorting materials
- Include stronger requirements on environmental protection in contracts

5.3.1 Ample Space for Sorting Materials

The majority of construction sites in Hong Kong have very limited space due to how compact the city is. The nature of subcontracting causes SMEs to have an even smaller portion of this already limited space. This lack of space makes it very difficult or nearly impossible for SMEs to be able to conduct complete on-site sorting of waste, or sorting in general because they do not have the resources such as storage facilities to implement off-site sorting. Without being able to appropriately sort waste, SMEs are incapable of appropriately handling all materials that could be recycled and reused, which causes many of these materials to be irresponsibly disposed of at landfills.

To enable SMEs to better sort their waste, main contractors must provide more support to their subcontractors with regards to waste management. This can be as simple as providing SMEs with ample work space dedicated to waste management, including sorting and storage of materials for reuse. Main contractors would then be providing subcontractors with the necessary resources to be able to responsibly manage waste in a sustainable manner. Through the sorting of waste, the amount of materials being recycled and reused would increase to a higher percentage, decreasing the amount of mixed waste sent to landfills.

5.3.2 Stronger Requirements on Environmental Protection in Contracts

From analyses of our interviews, we found that SMEs will only complete or adhere to what is required by their contracts. In other words, if something is not on the contract, they will

not do it. Unfortunately, as described above, proper waste management is often not included on contracts. Therefore, if proper and sustainable waste management is included as a requirement on subcontracts, then SMEs would be liable to at least pay attention to this important issue.

These requirements could be anything from: minimum percentages of total waste that must be recycled or reused to sustainability training prior to starting a project. Requiring a certain percentage of recycling and reuse of material may be too difficult to ensure completion, but similar contractual agreements, such as requiring complete sorting of waste, may be more feasible. A requirement for sustainability training is far more practical. However, this would demand more subcontractor support from the main contractor since SMEs often do not have sufficient knowledge of available waste management resources and practices as well as project or government waste management policies. In addition, these requirements must not be overly complex or difficult for SMEs to complete since SMEs already may face many challenges when completing projects.

5.4 Conclusions

The construction industry desperately needs more sustainable waste management. Although infrastructure such as landfills and incinerators can help deal with excess waste, Hong Kong should opt for maximum prevention and reduction of waste and more environmentally friendly methods of waste disposal. We recommend that Hong Kong's government enforce stronger waste management policies, such as levying heavier construction waste disposal fees at landfills, and subsidize recycling companies to increase the amount of recycling being performed. Through increased environmental education in schools and sustainability training on the job, the culture of the construction industry can be changed to view environmental protection as a higher priority than it is now, which will lead to the adoption of greener waste management practices. Additionally, the government, trade organizations, and contractors should host numerous training sessions specifically on waste management for small and medium enterprises (SMEs). Finally, main contractors should include proper waste management requirements in their subcontracts. If these recommendations are addressed, responsible business practices in the construction industry will help Hong Kong to reduce pollution and become a much more sustainable and livable society.

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APPENDIX A: SPONSOR DESCRIPTION

The Business Environment Council (BEC), founded in 1989, is a non-profit organization in Hong Kong that has strived to promote environmental awareness in businesses. In order to accomplish this, the BEC performs research on various companies to assess their business practices regarding sustainability and provides training for those struggling with environmental issues. Funding for these goals includes membership dues and income from secretariat services, such as identifying sustainable practices for businesses and helping businesses implement them. Overall, their mission is “to advocate environmental protection amongst our members and the broader community” (“Our Commitment,” 2012), including areas such as better utilization of resources and reduction in waste and pollution.

The backbone of the BEC consists of several committees, with each having about ten to twenty members. These members are often representatives of major companies internationally and within Hong Kong. One such committee is the Committee on Sustainable Development which includes representatives from construction companies and associations. Especially relevant to our project are the committees on Sustainable Development and Waste Management, due to our focus on sustainable construction. Beyond the committees and their members, there is a Board of Directors which provides guidance on the policies of the committees, an Executive Committee which approves projects and policies, and a Secretariat that is responsible to the Directors and Executives, which implements their policies.



Figure 9: Organizational Chart of the Business Environment Council ("Our Partners & Programs")

By working with business leaders and other individuals knowledgeable in the various industries, the BEC is able to identify practical solutions to the issues regarding sustainability in business. In addition to the vast body of information that can be accumulated, funding can be gathered to affect the policies that are recommended by the committees. Further services

provided by the BEC include assessment of current business practices, which would be significant in helping us identify struggles that the subcontractors face in sustainable construction, and policy advocacy, which would promote the establishment of any solutions that may be identified.

Many of the BEC's committee members come from companies that are partnered with the organization. These include public and private companies within Hong Kong, mainland China, and the rest of the world. Some of these private companies include BEAM Society on Green Building Labeling and the Hong Kong General Chamber of Commerce. Assistance is also provided to public firms such as the Environmental Protection Department on Waste Separation. Although not part of the BECs internal structure, these partners are assisted by the help of the BEC and then work to implement their goals. By providing information to their partner businesses who would work for the BECs ideals, the organization can get even closer to reaching goal of sustainability in the corporate environment.

APPENDIX B: INTERVIEW GUIDE

Opening Statements

Good afternoon, _____. We are the Green Construction team working on our Interactive Qualifying Project (IQP) at Worcester Polytechnic Institute (WPI) in Worcester, Massachusetts, United States. Our project will be working with Small and Medium Enterprises (SMEs), investigating the waste practices of subcontractors in the Hong Kong construction industry. The goal of our study is to understand the hurdles that SMEs encounter in the construction industry when trying to perform sustainable construction. As we examine the challenges that prevent sustainable construction in Hong Kong, we would like to ask you a few questions related to your experiences with construction.

Please remember that you are not required to answer any question and you may end the interview at any time. This interview should take less than one hour. We would like to record the audio from this session so that we do not lose any of your comments, although we shall be taking some notes through the duration of the interview. ***Is the recording of this interview fine with you?*** (Either we will or won't record). Thank you.

We also would like to know if you want to keep your name (and/or company name) confidential. Otherwise, we would like to use these for our final report. ***(If they want to keep it confidential)*** We will keep your responses confidential. The responses shall only be shared within our research team and neither you nor your company shall be identified as the respondent. ***(If they don't mind)***

Thank you for your cooperation. Finally, if you would like a copy of our report when it is completed, we can send it to your email:

1. What is your role in the [[insert company name here]]?
 - a. Do you have any (or What are your) direct impact on the waste management practices of the company?
2. Please discuss with us your knowledge of waste disposal practices at construction sites.
 - a. What are some methods for sustainable waste management (that you know of)?
 - b. How are waste materials sorted?
 - c. If they are not, why are materials not sorted?

- d. Describe the differences between firms (of different sizes) in how they manage waste.
3. From your experience, what are the challenges of doing sustainable construction? Please identify several hurdles.
 - a. Such as: motivation, knowledge, or space
4. How does the local government manage construction waste in Hong Kong? Which laws passed by the government have addressed the construction waste problem?
 - a. How effective have they been? Was there a noticeable reduction in the amount of construction waste disposed of?

ISO Standards

ISO: 14001 - Environmental Management Systems

ISO: 4226 - Air Quality

ISO: 14065 - Greenhouse gas

ISO: 15099 - Thermal performance (windows, doors, shading devices)

ISO: 15270 - Plastics

ISO: 50001 - Energy Management

(Questions related to interactions with SMEs)

5. Have you had any interactions with small or medium enterprises on construction projects?
6. Based on your observations, how do they approach waste management? Do they embrace sustainability in their practices or find it to be a burden?
7. Does your company provide waste management assistance to companies you subcontract?
 - a. If yes, what assistance?

(Questions related to [[insert company name here]])

8. What types of contracts do you subcontract or are subcontracted for? (depending on size of his company)

9. How do sustainability initiatives affect your business specifically?
 - a. Do they work as intended?
 - b. Are there any that are counterproductive?
 - c. Are there any reasons that sustainability should not be a goal in construction projects?
 - i. Too costly?

(Final Questions)

10. Could you suggest any improvements to the construction industry that would make sustainable construction easier?
11. Is there anything else that you would like to mention about your experiences with sustainable construction?

Finishing Remarks

Thank you for sharing your experiences with us. We appreciate that you allowed us to discuss these matters with us in your spare time, and your knowledge is very valuable to us. We hope that we can apply these discussion topics to the rest of the community in our studies in Hong Kong.

APPENDIX C: INTERVIEWEE DESCRIPTIONS

One set of interviews that we performed was with representatives of subcontracting firms, who were knowledgeable about the current practices in the construction industry. From these interviews, we gained an in-depth view into how these firms are currently managing their construction and demolition waste, and the challenges that have prevented them from being more responsible in their waste management practices. The first of these interviews was performed in Worcester, MA with Professor Umberto Berardi of Worcester Polytechnic Institute, who had one year of experience working for a subcontractor before his current teaching career. The Professor explained to us that companies' environmental policies, if even existent, are going to be very different everywhere in the world and that there is no one solution. Therefore, sustainable construction practices in the United States may not be suitable for Hong Kong, and even within Hong Kong, different companies and different projects are going to have different needs in order to improve their practices. It was also highlighted in this interview that there is a significant lack of environmental awareness in the construction industry, an issue which became more apparent in the following interviews. Additionally, we gathered from this interview that there are several different types of sustainability involved with the construction industry and we would have to be mindful of this in future interviews, specifying environmental sustainability in construction.

After the interview with Professor Berardi, the remaining interviews took place in Hong Kong. We conducted these interviews with representatives from the construction industry and organizations that are involved with the construction industry. Many of these representatives also worked for a subcontracting firm, currently or in the past, so they had similar knowledge of the current waste disposal practices as the interviewees who represented only their construction firms. However, they also were knowledgeable about the practices of the industry as a whole, which provided a broader understanding of the struggles that the industry faces when managing waste sustainably. While less valuable when tailoring more sustainable practices to individual companies, these interviews did provide more insight into the lack of awareness of environmental issues in the industry, as well as the financial issues that each company is likely to face. Whether our questions focused on individual companies or the industry as a whole, each interview provided us with a better understanding of the hurdles that prevent construction SMEs from sustainably managing waste.

The first of the interviews in Hong Kong was with Dr. King Wong, who represented Municipal Sustainable Development Consultants Ltd. (MSDI), a consulting firm specializing in environmental issues and sustainable development, as well as the Community and Construction Professionals' Development Centre (CCPDC), an organization which promotes professionalism in the construction industry. This interview discussed more general practices and issues relating to waste management throughout the industry. The following interview was with Mr. Ringo Yu, who represented the Hong Kong Construction Association (HKCA) as its Environmental Committee's Chairman. While we again discussed mostly the general practices of the industry, a brief discussion of his own construction firm proved to be enlightening of the major hurdles causing troubles for the SMEs when managing waste.

We were able to use this understanding to get more details out of our following interviews into the struggles of these firms. For example, in the following interview with representatives from Shun Yuen Construction Company Limited, we were enabled to ask more about specific issues facing the company, such as why company policies were not effective or which resources were necessary to help improve waste management practices. The interviewees included Mr. David Chiu, Quality and Environmental Engineer, and Mr. Dan Leung, Quality and Environmental Officer, both important environmental positions within the company. The fourth interview, which resulted in more of a discussion on and refinement of what we already knew about the issues related to waste management, helped us piece together the majority of the data we had collected from the interviews. Most of the discussion was with Mr. Lawrence Ng, president of the Hong Kong Construction Sub-Contractors Association (HKCSA), and Dr. Sammy Wan, secretary of the Hong Kong Federation of Electrical and Mechanical Contractors Limited (HKFEMC), however Mr. Ng Kwok Ming and Mr. Tse Chun Yuen, vice-chairman and honorary president of HKCSA respectively, also provided important input. This interview was especially useful because it gave us a look into the practices of electrical and mechanical waste management, which focused more on metals and even chemical waste rather than civil waste management. Finally, we concluded our series of interviews with an anonymous assistant environmental manager from Kum Shing Group, who helped us to summarize our findings from all of our interviews and to confirm the challenges that small and medium enterprises encounter in performing waste management sustainably. In conclusion, we are exceptionally grateful to these representatives who took time out of their busy lives to help us in our research.

APPENDIX D: INTERVIEW TRANSCRIPTS

D1: Interview with Umberto Berardi

Interviewee: Professor Umberto Berardi

Professor of Civil and Environmental Engineering, Worcester Polytechnic
Institute

Interviewers: Jonathan Dorich

Lamyae Reklaoui

Location: Room 209B, Kaven Hall, WPI, Worcester, MA

Date: November 28, 2012

Note: Due to the audio quality of the recordings, some portions of the transcript may be incomplete. These sections are denoted by dashes (“-----”) in place of words.

Start of Interview:

Jonathan: *Opening Statements.*

Jonathan: Have you had any experience in the construction industry?

Professor Berardi: Like working experience or are you looking for an academic one?

Jonathan: Yea [working experience].

Professor Berardi: I was working for 1 year for a sub constructor.

Jonathan: Ok, and what would you say your expertise is in construction?

Professor Berardi: I'm working with sustainable assessment of buildings, so more looking at the process of construction and looking more at the final results and just trying to understand and assess the sustainability of the project in general.

Jonathan: Are you familiar with the idea of sustainable construction and describe what it means in your own words?

Professor Berardi: It's not an easy question, it's not even easy to answer in the short term because I'm teaching two courses, the first is sustainable construction, the other is sustainable building, so in some way, I can tell you I'm familiar with the topic, but the topic has several interpretations, including that you can approach the topic from a different point of view. Let's say, you can use the term of sustainability as a term which you are covering economic, environmental, and social aspects, which is more generally, but that is not very common in the building industry. Let's say, for several years,

sustainable construction was only evaluated from an environmental point of view. Let's say, energy efficient buildings was more or less similar to sustainable construction. Nowadays, there are few people and actually a lot of pressure in order to include economic and social aspects in the definition of sustainable buildings. So if I have to tell you or give you a definition, for sure nowadays, I'd say it's an environmentally friendly building or construction in general, in which we have taken into account economical and social aspects in a sustainable way. There is still a strong pressure on the environmental dimension, but there's a push, in order to include other topics.

Jonathan: So you mentioned the economic and social [aspects], could you give us like examples of some ways/some economic way that would be sustainable or?

Professor Berardi: Go to Dubai and you will realize a lot of green construction in terms, cause who's buying. It relies a lot on green construction in terms that they are energy efficient, but they are probably not sustainable in terms of economical or social aspects. You'll find a skyscraper in the middle of nowhere, it has been built with money, you know, a large amount of money that probably was not sustainable if we were to adopt that middle on a worldwide scale. You know, we cannot do that kind of things worldwide. So that is for sure an unsustainable economic solution. And you can do the same from the social part of view. You can't actually go to a land, in a mega city in China destroying everything to build energy efficient towers. It's still an environmentally sustainable solution, probably, but it's for sure unsustainable in terms of the social consequences.

Jonathan: Ok. So then on the... or can you identify some environmental ways of making or environmental methods, err sustainable methods related to the environmental part that you were just talking about, that would help the construction industry better manage the waste.

Professor Berardi: Well, there are several methods, it depends on what you are looking for and it depends on the scale of the building you are researching. A large [extra/part] of attention has to be paid to the scale of the building and so forth, that I'm speaking about. Skanska is a huge constructor in the US, in an environmental management system, so a mass of 14,000 for some folk, is different the kind of management system that you can have in Hong Kong with a very small subcontractor or with four or less than people, less than 10 employees. . I think you have to scale this question according to the topic, you know, it has a different answer if you are speaking about a big contractor or a small [sub]contractor or if we are speaking about someone who is building all the house, specifically looking at just one thing or one part of the building because obviously the waste and the way that we manage the building from an environmental perspective is different. They are actually working on a different scale.

Jonathan: Mhm, so you have worked for a subcontractor before then?

Professor Berardi: Yea.

Jonathan: Did you notice any methods for sustainability there?

Professor Berardi: No.

Jonathan: Was it just because of issues that they couldn't overcome or were they just not thinking about it?

Professor Berardi: There was no caution? Lack of awareness. They didn't really pay attention to that topic.

Jonathan: So then, next question would be: what has the overall impact of sustainability been in regards to the construction projects and has it been positive, negative, or a mix of both?

Professor Berardi: Oh, this question is strange. What is the impact of?

Jonathan: Yea, the overall impact. Has it been positive, in your views, a positive impact?

Professor Berardi: In general?

Jonathan: In general, yes. For the environmental part of sustainability.

Professor Berardi: I don't think... I don't think I'm able to respond to you. I cannot give you an answer that is valid worldwide, even it's not easy to give an answer that is valid on a national country base because, the practice of sustainability in construction are site specific, you cannot give a general ... Because the kind of buildings you have in China are different from the kinds of buildings you have in, let's say, E.R. (not sure exact word said here), that is different from the kinds of buildings you can have in South Africa. I don't feel confident to say "This is the solution; this is the rate of sustainability in construction".

Jonathan: Could you say that for one specific region you've had experience in or?

Professor Berardi: I mean, again, I would not expect the same answer to be valid for the same country. That should be applied, that specific question, to let's say: one city, one new construction theater, but it's not valid on a country base. I don't think it can actually be answered on a country base or long term perspective. You have to evaluate everything with what is happening now. If you are speaking about China, it's different if we are looking at: Ningbo, Nanjing, or Beijing (cities in China). You know like, you find different kinds of construction industries, different kinds of buildings, different kinds of practice, and for sure, the construction industry is an unsustainable sector, let's say the overall impact is quite huge. But then, there are good practices even in an unsustainable construction sector, you can find good actual practice.

Lamyae: So the next question would be: Can you suggest any improvements to the construction industry that would make sustainable construction easier?

Jonathan: For the small companies and more specifically with those.

Professor Berardi: I think in general there is no mind for it. The construction sector and the construction firms, in general, have no mind for it, they never recall the practice. So, I think a good practice would be to record the previous expertise because if you know from the previous expertise, “ok at the end of the construction site, I need, let’s say 15 cubic meters of new fresh land, because this was needed”, can actually create a memory. You know, the construction sector is different from our sector because if you are working in an academic, everything is recalled and there is a continuous cycle. In construction, the cycle takes at least a couple of years, people are changing from one building to another, even the same building, you have carpenter one month, then you may have another carpenter the other month, so there is no memory. So I think, probably, memory is a good practice to start to looking at.

Jonathan: So is better informing them....

Professor Berardi: The knowledge problem is a huge problem obviously. Even actually the company I was working for the owner didn’t know anything about topic because there was no knowledge, I mean there were people informed there, but there was no memory. No actual awareness created. We know what we have done before; we know what we have to do.

Lamyae: So besides, there is no record of what previous practices, are there any other challenges that inhibit the use of sustainable construction projects.

Professor Berardi: Well, another topic is that the construction industry is now client driven, most of the time it is the constructor driven, let’s say it’s probably could be a great chance. If we listen and pay greater attention to the people, to define a customer. Most of the time, contractors don’t really consider the customer or the customer doesn’t put too much attention to the environmental consequences of the construction itself. You go to buy a new building, you don’t really even know what is happening there, below there is something in the ground or around, or it’s the building, that acts like a big dam that’s moving the water underground, that could be potentially bad.

Lamyae: So the next question would be: Can you list any reasons, that you can identify, that would show why sustainability should not be a goal in construction?

Professor Berardi: ... A sector that is too fragmented, too many people, different voices, different powers, you know. It’s probably for [those] reasons.

Lamyae: And in your experience, what is the attitude in the construction industry with respect to sustainability?

Professor Berardi: Well, almost nothing.

Lamyae: So are people, do they look at construction sustainability with a positive attitude?

Professor Berardi: They don't look at it. That is the problem. They don't really have a bad idea, but they don't look at it. The problems are generally obvious.

Lamyae: Is it because they think of the economic factors?

Professor Berardi: Oh for sure, there is a great and a strong economic pressure behind, but there is still a lack of awareness. But sometimes, a lot of sustainable practices are still sustainable from an economic view. I think its wrong, to stay with the topic, "ok. Sustainable is more expensive", but being there is still a problem to say "ok, this is unsustainable, you have to be warned that this is unsustainable", and together with this, you need to start looking at sustainability, and it actually can improve your performance and it can even improve your economic outlook.

Jonathan: So would you say that if, some government would enforce regulations and better inform the small companies about sustainability and try to actually force them into it, do you think they would follow suit?

Professor Berardi: I don't think so. I don't think it's actually a problem in the regulations. We have some regulations; we need to grow the awareness of the people in general. You know if you are lighting a building, you still rely on very old and unsustainable lamps. In the Campus Center today was the "Light Fair", that is unsustainable from an economic point of view, unsustainable from an environmental point of view, it's unsustainable from several points of view, you know it's really unsustainable, but we still find very old lamps in every kind of buildings... (A sentence is missing here that could not be understood). The power output, the efficiency, 3, 4, and upward, when nowadays we can buy a light lamp of 50, 60 or so, 20 times more efficient. But unfortunately, there is too much pressure, and there is no really knowledge of what is going on.

Lamyae: Is there anything else that you would like to mention about your experience with sustainable construction?

Professor Berardi: No, what do you want me to?

Lamyae: For instance, since our project focuses on how small and medium enterprises manage waste, especially when it comes to subcontracting, have you ever had an experience or witnessed how small enterprises or medium enterprises manage their waste?

Professor Berardi: No

Jonathan: We just have a few last questions, mostly about you and your opinions. So how do you personally feel about green initiatives?

Professor Berardi: In a worldwide base?

Jonathan: Sure, or in a specific region.

Professor Berardi: We are doing quite a lot, but we still don't really find the momentum to make a change for a long term perspective so we have improved by a lot, but I think there are still several things to do.

Jonathan: And you feel like it's a good thing that we should be trying to do?

Professor Berardi: Why not? Everything sustainable must be done. You cannot allow a business to [ignore this], we can actually discuss about the way in which we are doing that, but it's still something that we have to do.

Jonathan: So, I guess we touched on this earlier, so you think that universities or construction companies themselves need to teach more about sustainability?

Professor Berardi: I just entered this faculty; I have just joined WPI for that reason. I think there is some pressure to increase the amount of [sustainability] in the construction. I have just published a new book that is called "Moving to Sustainable buildings"... I can give you a link because it is actually a neat book. It's not too long, it's 20 pages.

Jonathan: *Finishing Remarks.*

D2: Interview with Dr. King Wong

Interviewee: Doctor King Wong

Community & Construction Professionals' Development Centre

Chief Executive

Interviewers: Jonathan Dorich

Yao Li

Lamyae Reklaoui

Matt Steeves

Location: MSDI Office, Kornhill Plaza Office Tower, Quarry Bay, HK

Date: January 12, 2013

Note: Due to the audio quality of the recordings, some portions of the transcript may be incomplete. These sections are denoted by dashes (“-----”) in place of words.

Start of Interview:

Jonathan: Opening Statements.

Jonathan: Our first question would be how does the CCPDC assist construction companies in being more sustainable, such as like workshops or sessions?

Wong: Right, we're talking about two organizations. One is CCPDC, one is MSDI. MSDI is a company business entity. CCPDC in fact is a community center. So I'm not quite sure which one you're interested.

Dorich: I guess we could do each.

Wong: Well you can mention both. Anyway, CCPDC, as I said, is a community center. So what we're trying to do, or we're doing is try to introduce different- we shouldn't say new technology, just promote new technologies to those participants, and how they can do better on low cost environment.

Dorich: OK. Then would you say that the outreach from this reaches a significant number of SMEs or do they take advantage of this or they-?

Wong: OK, you see you use the word profitable, I'm not sure. We have specialist company in Hong Kong like those- They're basically making the biggest shares, profit. So back to your definition, basically you mention about those subcontractors. So subcontractors in Hong Kong must be more than two thousand, ok? And you can try to check out one list, which is called Wan Chui Subcontractor Registration. You can check it out from HKCIC, Wan Chui Subcontractor Registration. And I guess those- there will be some two thousand

or even more. So in there, of course, there are big companies, and most of them are small and medium enterprises, SME. So their turnover will usually less than ten million Hong Kong.

Dorich: Ok

Wong: OK? ten million Hong Kong. And there, we're talking about ten million Hong Kong

Li: Overall?

Wong : Overall. We're talking about one SME. One SME. So we're talking about ten million Hong Kong dollars per annual. I guess their employees, I mean, direct staff will be one, less than ten. And the rest would be suppliers or sub subcontractors. So we have multilayers of contracting system in Hong Kong. Your question about SMEs attitude on sustainable development?

Dorich: Ya.

Wong: Correct? Usually the main contract, say for government, they have a main contract. To view the government headquarter, which was built already. So the main contract will have the green policy that supposingly everyone should comply with, yet the main contractor will be taking care of them. So if they need to purchase or procure for materials, they will ask for the suppliers for the green policy as well. But that is on the main contractor's side. And subcontractors usually, especially those lower layers of contractors, usually, they just do, they don't think. But that's true because the system in Hong Kong is client, consultant, and contractor. So clients pay. Consultants design. Contractors do, they shouldn't think. Otherwise they will contradict the consultant. However, a consultant in Hong Kong now doesn't think. So a lot of contractors think. And that's why we have a design-build contract now, alright? Back to my statement, the main contractor needs to take care of green policy. Most of the subcontractors, they don't need to do so. I'm not sure whether you have checked how many SMEs, under your definition, they've got their OHSAS 18001 quite updated. Have you?

Dorich: What was that again?

Wong: I'm sorry, I'm talking about 14001. OHSAS 18001 is for safety.

Dorich: OK.

Wong: ISO 14001 is for environmental. The first question, I'm not sure I have an answer or not.

Dorich: We've already answered it. So we'll go on to the next question here. Could you discuss with us your knowledge of the waste disposal practices at construction sites, like what are some methods of sustainable waste management that you know of?

Wong: As I said the green policy relies on the main contractor, by the client, designed by the consultant.

Dorich: And this green policy is from the government?

Wong: Yes, exactly. No, sorry, not from the government, from each independent consulting firm. There are different policies, or requirements on different. It is not law, so they can think. So it depends on the consultant, on their design.

Dorich: OK.

Wong: Alright? So for the contractor side, for the main contractor, construction waste and C&D what we call. And if they need to dump to the refuse area, they need to pay. So they will be taking care of that as well. Again, back to SME or subcontractor, they don't need to think. They need to follow. So in the depot, what we call depot, under a main contract, there will be an area for you, for your parking, have an area for C&D, alright? So all the subcontractors just need to take everything to the C&D area, and the rest will be main contractor.

Dorich: OK.

Wong: So there seldom be any policy in subcontracting. That's why I asked the question whether you have checked how many SMEs they have, you know, updated under ISO 14001.

Dorich: Ya, we have not done that yet. So what kinds of waste are most commonly generated from the construction sites?

Wong: For- we have different kinds of contracts. On the road side, obviously picking of concrete or those building materials, on the road side, road surface. On the building side, concrete, maybe others like brick, all the construction waste, that is the component. And on the building side, we don't want- seldom they use it on the road side.

Dorich: OK, and most of this waste either- be sorted after or before it's disposed of or-?

Wong: Yes, they have to. Again, this is the main contractor's rule.

Dorich: And if, would there be any reason why they wouldn't sort materials or-?

Wong: There is no incentive for them.

Dorich: No? OK.

Wong: Nothing, apart from penalty. Say for the soil, some good rubbles, they cannot make use elsewhere apart from inside their own site, alright? So they have to dump it anyway, eventually.

Steeves: Ya.

Wong: That's the government policy.

Dorich: And then from your experience, what are some of the challenges of being sustainable, or performing sustainable construction with the waste management?

Wong: The leader must be the government. If they don't have the policy or incentive scheme, no one will do it themselves. They might, as yourself, as one of those laymen or citizens, you are not government, you shouldn't, and you cannot at all on behalf of the government.

Dorich: So they just don't have any motivation to perform it?

Wong: The society is a whole. The government needs to pay on medical, education, air pollution control so and so forth. So if they want to reduce the raise, the dust, solid waste, or the dust, right? So they need to, from those savings. Back to these issues, on the construction site. Otherwise who will do it? Even though you are willing to do it, you don't have the money to do it, because the society is much bigger than your own firm.

Dorich: Now do you think that knowledge or lack of space will also cause people not to want to perform better waste management or-?

Wong: I think knowledge is good enough, although we can still do more. I have mentioned already, that is the incentive problem.

Steeves: People are probably just not even any way aware of like the consequences environmentally.

Wong: They are aware of it. I'll tell you a case, happened recently. Our bottle, glass bottle, so it can be reused, right? So people start to do it, to collect, and then they don't have where to go.

Steeves: I was actually just noticing that, I see like no glass recycling.

Wong: The problem is the government doesn't have the system for the citizen dump to collection point. Then the government will pick them somewhere for reduce. So eventually they will throw up the mountain, in front of their home? So what they can do there, right? So- You know any Cantonese?

Dorich: No.

Dorich: So the local government does it do anything to help the construction firms to manage the waste or passing laws or just they don't need to pass laws?

Wong: If my answer is no, it's not fair to the government. The answer is yes, they have, or they have been trying. Yet they're trying to employment, that's all. I repeat my case, the glass bottle. They try to convince people to sort out different things.

Dorich: Yup.

Wong: Including the glass bottle, alright? And eventually they said we don't want to interrupt the business environment, so we don't provide the truck to collect. And you know how much is the glass bottle, ten cents maybe or even five cents maybe.

Steeves: Very low value.

Wong: And you know how much is one-way travel for the truck, five hundred maybe a thousand. So how many small bottles you need to collect for one truck, not to say the cost for the driver.

Dorich: Ya.

Wong: So who is going to pay, no one.

Li: So the problem is money?

Wong: No, Hong Kong government has a lot of money, much more than you. It's just my say.

Li: Oh.

Wong: It's just my say.

Dorich: OK, and then let's see. What types of contracts do you, or like subcontractors subcontracted to other companies, smaller companies, or sub- yeah?

Wong: You mean our company right?

Dorich: Yeah.

Wong: So I need to clarify to you again. CCDPC is an NGO, which do promotion only. It's not a company, not a business entity.

Dorich: Ya.

Wong: MSDI. So we subcontract to different kinds of companies, doing surveying, doing construction, and doing design works, OK? Again, of course we can do something. But we can't, sometimes we can't do everything. If it is government contract, It will follow, doesn't make change. The government already has a full list of documents, you need to compile it. Although no one can compile it. They still have the full list.

Dorich: OK, then so the companies that you subcontract to, do you notice how, if they embrace all the sustainable practices that they should be following, or do they try to, or do they go with, do their own way?

Steeves: Resistance.

Dorich: Waste management.

Wong: Sustainable is quite a word.

Dorich: Ya.

Wong: Usually talking about for those large companies. For small contractors, even like us, you know our brochure, we have a number of logos. So on the bottom right corner, first one will be the CSR advocate. CSR is the Complex Social Responsibility. CSI advocate, personal company. And then we have three triangles, those are ISO 9001, ISO 14001. and OHSAS 18001. Altogether called MIS in the three-dimensional system. And because of these logos, so we have to ask our subcontractors the same question, whether you follow the same, or you have similar. So all the subcontractors if they want to work with us, or work for us, they need to be registered under our system. So we have asked.

Dorich: And a lot of other, do you know if like other companies your size need the same thing from the people they subcontract, that they follow the similar guidelines right?

Wong: As I said, the rule is on the main contractor. So if we are the main contractor, we have to take care of them. If we are the subcontractor, the main contractor needs to take care. So the subcontractor usually would not, unless they themselves as the main contractor they're expecting. OK? We're talking about at least a hundred million turnover a year.

Dorich: So how do like these waste management initiatives affect your business, do they like work as intended, or are they counterproductive, or are they useful?

Wong: They're not affecting us at all at the moment. Even though, we have the logos. It doesn't count for.

Dorich: OK.

Wong: It just asks for, it doesn't count for. OK safety maybe I think a bit better, I mean if you have a big problem on safety, you'll be in trouble, but not on the environment.

Dorich: OK, and then so, are there any reasons that you can think of why waste management should not be a goal in the construction project, would companies avoid it because it would be too costly or-?

Wong: I'll tell you one example. You can try to answer yourself. In one of our contracts, we proposed to use solar panels, because there's no power supply to be our power supply

system for the lighting. And then we said we'll take care of the cost, alright? But the government rejected. Said we have no track record on that, so we cannot prove. You got my answer?

Dorich: I think so. OK.

Steeves: What did you mean by they didn't have record of-?

Wong: No one else has done the same. Everyone just used diesel generator.

Steeves: Oh OK.

Wong: So eventually we have to use diesel generator.

Dorich: So this is like a government project that you're given?

Wong: Yes.

Dorich: OK. So any questions or final questions? OK, so I just have a couple of final questions, could you suggest any improvements to the construction industry easier for companies?

Wong: Government mindset.

Dorich: Is there anything else you would like to mention about your experiences with waste management in construction?

Wong: They have to have some incentive system, because after all it's the society cost. They need to balance.

Steeves: Now there are those like, wastes by ton or whatever. They seemed very small, like, I don't know the number, but maybe one hundred and fifty. That seems like such, very little.

Wong: I'm not quite sure what you're talking about.

Steeves: So the construction-

Wong: We have to pay for safety system. So if you have an employee to attend a safety training cost, the government will pay to you a certain amount. I think it's about two hundred and fifty. Yet you have to think carefully. The cost, or the labor cost, the daily rate, of that labor, how much is that? Today it's about four thousand. So the government only paying one fourth of the cost. So who willing to do so? No one. So they will do it, because it's the contract requirement, but they are not going to do it. I'm not quite sure, but I guess so. But the rate is not reasonable.

Dorich: I guess he's talking about like when you dispose of waste to landfills, you have to pay so much for ton, and it seemed pretty low, the amount you pay for a ton.

Wong: You mean the trash?

Li: Yes.

Wong: We don't have land at all?

Li: You don't have land?

Wong: Hong Kong, our landfills are all full now. We don't have land at all.

Li: Do you think that is also a problem for you? Like you don't have space?

Wong: But we are not the only case that doesn't have enough space. Singapore. Even bigger countries, like UK, Japan.

Li: Ya.

Wong: They're similar, so what happens there?

Steeves: Ok, maybe they have like Incinerators.

Wong: Exactly. But our citizens to use incinerators

Reklaoui: Is some of the construction waste transported to mainland China?

Wong: No, very few, very few, I mean-

Steeves: Are there recyclable materials that go to mainland China or-?

Wong: Both, both. It depends on the relationship between two organizations, not Hong Kong government, OK? In most countries, including mainland, they have a policy not to accept waste

Li: So how does your company deal with waste? With construction waste?

Wong: We don't have anything that can be recycled. Within our site we can use it, we will do it. However, other than that, we have to send to the landfill, no choice.

Dorich: Is there a large emphasis on reusing things or reducing, trying to reduce the amount of materials used? Like when you're trying to design build a, like a project. Do the designers think a lot about reusing or reducing the amount of materials?

Wong: Yes, that is good point. You know the work return, how much return you can have with your money investment. So the problem is return. On the amount of volume we have, you cannot calculate return. So the easiest way is just send to the landfill, even though we need to pay. Even though we measure what the waste.

Dorich: Mhm.

Wong: So the only way to resolve the issue is from government. They need to set a central collection point, so that everyone can send to the collection point. With the scale, then they can do it. On an individual or along an organization, they cannot, just cannot. Think about your shirt, can you make it yourself?

Dorich: No.

Wong: Why not?

Dorich: I don't have the knowledge.

Wong: I'm not talking about the cloth. I'm talking about the planting. You see my point? You can't do it yourself. If you can do it, it will take you a year or two. It's possible, but not feasible. So that's the thing, as I said. If they have central collection point, everywhere. We got eighteen districts in Hong Kong, so maybe they have eighteen, or more than eighteen. Then we just, say we are in the Eastern District, Hong Kong Island, one collection point nearby, we can send them everything. We can send them everything.

Dorich: I don't know if I missed your point, but the collection point, the waste there?

Wong: I'm not talking about the general thing. General waste you have to do it. Anyway they're doing it. I'm not talking about reusable items, like bottles.

Dorich: collection point and then anything else, who would need to use it could go there and use it?

Wong: Ya.

Dorich: *Finishing Remarks.*

D3: Interview with Mr. Ringo Yu**Interviewee:** Mr. Ringo Yu

Hong Kong Construction Association

*Chairman of the Environmental Committee***Interviewers:** Jonathan Dorich

Yao Li

Lamyae Reklouli

Matt Steeves

Attending: Sarah Choi, representative from the Business Environment Council**Location:** HKCA Conference Room, Wan Chai, HK**Date:** January 14, 2013

Note: Due to the audio quality of the recordings, some portions of the transcript may be incomplete. These sections are denoted by dashes (“-----”) in place of words.

Start of Interview:**Dorich:** *Opening Statements.***Dorich:** And would you like to keep your name confidential or could we use it in the report?**Yu:** Sure, no problem. Quote HKCA not my own company, because I’m representing HKCA to do the interview.**Dorich:** Ok. We’ll do that. So our first question is, how does HKCA assist construction companies in being more sustainable, through like workshops or sessions?**Yu:** We do workshops, like it depends on the hot topics of the industry. Like last year we had two workshops. One’s on ISO 14001, and the other one is green procurement. Ah, and another one, three. Third one was CMP for construction noise, to help them, how to apply to the firm. What is the restriction? And what are the things that need to be done on site?**Dorich:** And for these workshops, do a significant number of SMEs attend these or take advantage of this support?**Yu:** Oh yes. So it’s around 50 to 100. Average. And also we 14,001 that we are doing. 14,001. We are introducing the ISO 50,001 to the, not only to the SMEs, but to the industry.**Steeves:** Now is that 50 to 100 SMEs? Or just employees?

Dorich: So like companies or individuals?

Yu: Just individuals. Some of them are bosses, and some of them are employees. And also we are doing the carbon consumption studies on temporary work in construction industry. So with that search, you know, send this information to the SMEs and to... Actually it's not just focus on SMEs but whole industry.

Dorich: Please discuss with us your knowledge of waste disposal practices at construction sites.

Yu: You mean for SMEs or the whole industry?

Dorich: Let's start with the SMEs.

Yu: Actually it's quite difficult for SMEs because normally their jobs, the contracts are small, and in small area. They do not have places to sort the materials or store the materials. They just go in one and send to the dump yard, or the landfill area. So it's difficult for them to have really controllable area to do works.

Dorich: So to dispose the waste they always don't have space at the construction site to actually sort it out or anything like that?

Yu: That's right. That's right. And they do not have the, you know, the financial background to arrange an area, or a yard, for themselves that they could, you know, store some temporary material there. So what they do is, they dump it. Next time they need it, they buy it again. So that's the problem of Hong Kong. I think it's not only to SMEs. For SMEs because the financial background is weaker, is harder for them.

Dorich: Do you think that-

Secretary: [talking to Yu]

Yu: Oh ok, go back to the, what HKCA have done to.. we have done the best practice guide. We ask the consultant to do it for us. The best practice guide for this one is focus on environmental issue. And we would like the SMEs or all the contractors to have a copy of it. You know go to website.

Secretary: So the a practice guide there is a topic, you know, for waste management. You guys can refer to. There are recommendations and suggestions to deal with waste management.

Choi: Are these for Hong Kong CIC members?

Yu: Of course.

Choi: Ok.

Secretary: Of course.

Yu: But if you ask me I will tell you-

Dorich: So you said that space was, made it difficult for the SMEs to dispose of waste properly. Does even knowledge or motivation also play a factor into that?

Yu: Of course, yes. That also, because they don't have really, of course compared to large contractors, they don't have technical personnel to help them.

Dorich: So now the larger companies, they more easily dispose of waste because they have a lot more area to sort materials out. So the main difference between the SMEs disposing waste and large companies is there's not enough space?.

Yu: Not exactly. Sometimes the problem, not only, for, you know, for SMEs for large contractors too. Like for example if you rent a building next to this building, and you see that Hong Kong, the land is very precious and it's difficult to have, you have to do the work and store the things in a safe small area. So they have a similar problem, but they may have a works area or a large storage area, warehouse, that, you know, somewhere. So they could store their materials there or what they want to use or what they don't want to dispose or could be reduced, they could store in the works area.

Dorich: So you've had interactions with SMEs from HKCA right? And is it difficult to interact with them or like contact them or is it hard to motivate them to come to your workshops?

Yu: You could say that. It's a bit more difficult than the other contractors, because they don't have enough manpower. If they come to us they want environment. The problem that the lack of- Usually their projects are very tight. Everybody go to work. They want to do works that are productive. And I don't mean that waste management or this thing are not productive. But if they have priority they would do other works first.

Dorich: Now you think if they were offered like same money. same amount of money. Yeah so if they're offered money to come to workshops? They'd be given money to attend the workshops. Would they be more willing to come to the workshops?

Yu: You mean they offer money to attend the-

Dorich: Ya. They would be given money to attend the workshops. Would they be more willing to attend them?

Yu: Of course. You mean that if they come to the workshop, they get money. I don't think that's the way Hong Kong you know...The best we could do is offer them lunch.

Secretary: Basically it's free of charge.

Yu: We don't charge that actually. We charge very small amount, say 50 dollars. Just one tenth to attend. It's a very small amount. You and say. We charge a very small amount. We just want them to attend.

Secretary: Show up.

Yu: Show up. It's a very small amount.

Secretary: Show up.

Yu: Of course if you say that you offer money to, you know, attract them. But then you may attract, you know, people that are not concerned with the environmental issue.

Secretary: They're concerned about the money.

Dorich: So how does the local government manage construction waste or do they play any significant role in trying to better manage waste, construction waste?

Yu: They, actually a significant amount of our job is government job. If you are doing government job, they have control. Actually 50 percent of our work. If you don't do a good management not only environment, (but also) safety, progress performance. They would performance mark on your companies. And that would affect the tender, because now Hong Kong, for government jobs, 60 percent of the weight (weighting) is on price. 40 percent is on past performance. So they have a very detailed control on how you, you know, do the environmental, like a waste management and noise control, dust control, everything. So they have a small (score) for you.

Secretary: They have ten percent of works- have a know-how. So there's environmental. have an understanding about what the government.

Yu: and for the rest of the project is from the private sector. The environmental management can only rely on what the law says. They are, you know, of course everybody's trying to strike the minimum requirements. Except for very large consultant companies, that they have their own team and they are, you can say, more environmentally-friendly. better image- Of course everybody is trying to environmental. and for you know I think it's only the sizeable contractors, let's say ten or twenty of them in number. And all the others would try to, you know, obtain their optimum, strike the minimum requirements, that's how they do business.

Dorich: So for a lot of the SMEs subcontracted by other companies, what types of contracts are they, or what are some of the types of contracts that they're given?

Yu: All the types that you can think of. Even for a whole, sometimes a whole contract- to a subcontractor or sometimes they chop it into very small piece like piece. maybe 10 subcontractors. It depends on the complexity of the project.

Dorich: So a single project might have anywhere from-

Yu: Especially for building works, they are not quite because too strict. The next time

Dorich: So a lot of these companies subcontracting the SMEs, do they place any requirements on waste management other than government protocols?

Yu: Yes they do, but they're not quite force the subcontractor to comply with the requirement. Because if they are too strict, the next time they would price high.

Choi: How can-(assessment system work?)

Yu: If they- to main contractor to evaluate a subcontractor. First thing is the price is right. The less cost. The second would be, you know, how he control the worker. And the third thing is safety. Environment is the last thing.

Secretary: Usually the big contractors, they should have subcontractors performance assessment in their own company. Usually they have different criteria. I mean - is purpose, quality, and then safety, environment is the last. But anyway there's still a rule.

Yu: So for some, you know, very caring main contractors, they try not to, you know, put the burden on environmental protection to the subcontractors, rather they do it themselves or help them to do it. I think that's the better way, instead of, setting rules for them to follow,

Dorich: So SMEs for having, given the waste and dealing with that appropriately work better?

Yu: You mean-

Dorich: So the SMEs instead of dealing the waste themselves would pass it to would that-

Yu: Don't understand.

Dorich: So you're saying that the, having the, contractor itself rather than large companies deal with all the guidelines instead-. ok

Yu: I think so. I think so, because they are not good at that.

Dorich: So that's- any questions? Well from the earlier interview we had the idea of having central collection point, where you could bring materials that could be reused or recycled. Do you think that would be a feasible idea or would it be effective?

Yu: Yes but you need to have a very large area to store the things first.

Secretary: This idea should be done by the government, we need their support.

Yu: they had more land. So this is the reality. They have more land. Space for sorting waste. This is another question.

[laughing]

Dorich: Is there anything else that you'd like to mention or experiences in waste management in the construction industry?

Yu: I think education, you know, is very important (to) help everybody how to care about the environment. If we could start from that point it would change the mindset of people. And government particularly, for the design, design some things that are more environmentally-friendly or- Let's say a concrete building, the architect can do precast concrete, less waste in the construction and less work of course. You know this is an example of what the government could do.

Choi: precast concrete from China?

Yu: Yes from China, but we're asking the government to, you know, spare some land. Another issue, that could, you know- help to precast in Hong Kong. because that way you don't need the transportation.

Steeves: Now you mentioned education, do you feel that people are in general aware, just money is big of an issue, or do people not know about the environmental impacts-

Yu: For this generation, yes. We hope the next generation is-

Choi: Are they improving?

Yu: Secondary school or primary school, very good, knowledge to the students. But In general it's better than before. It's better than before.

Dorich: So when, in designing a building or project, is there not much of an emphasis being put on trying to reduce materials or is it more of just what's the least cost?

Yu: As far as I know. the government is trying to turn this around. I heard that new building project they let out to ask an architect to attend for consulting. They require architect to have a construction manager. A person that has required education of fifteen years as construction manager in their core team to design a project. and that way because of experience of construction manager. advise architect, the design architect to adopt more, not, just simplify the construction norm, or use some material that would create less waste and more, maybe, you know, environmental-friendly.

Jonathan: So your company's the Fraser Construction Company Limited? OK Let's see.

Choi: Is it an SME?

Yu: Yes, it is. 50 direct employees. About 20.

Dorich: And then, so on the projects that you're involved in, how much of an effort do you, is your company trying to do with sorting the waste, recycling it?

Yu: Yes because I'm doing government project, so I need to forward the specifications and-document. And the government projects have very good control. And we need to do sorting of waste on their construction sites.

Dorich: So what types of waste do you sort?

Yu: The, normally, you see, like the timber (bottom), and the excavating material, and sometimes mixed with concrete that we need to sort. maybe soil, concrete, or still concrete

Dorich: And how much of this waste is just like sent to a landfill or, and how much recycled or something reused?

Yu: Most -

Dorich: So most of it goes to landfills, is there any way you can see them reducing the amount that goes to landfill, recycling, using more of it.

Yu: No. If there is- that could help.

Dorich: Is there any way you can see them reducing the amount that goes to landfill, recycling, using more of it.

Yu: If there is-

Dorich: OK so what types of contracts do you have then?

Yu: Self-stabilization.

Reklaoui: Do you think the type of contract affects the amount of waste?

Yu: Oh yes, of course. There's a large amount of soil that needs to be removed and there will be-

Li: So are you a main contractor or subcontractor?

Yu: Main contractor.

Li: Oh so you have to hire subcontractors for your projects? So usually how many do you have to hire?

Yu: For projects, let's say one contractor that I have done, it's about eighty- and there are five subcontractors.

Li: Five subcontractors.

Reklaoui: And what are the different trades?

Yu: They are of the same trade, because they are contracting many different stocks. Each one takes up-

Dorich: So on these projects, do you have, are a lot of the workers specializing doing one sort of thing or they're just general workers?

Yu: Not quite general because everyone of them needs to know how to do concrete work, and know how to drill soil nails, things like that. So they, you know, know a bit of everything.

Dorich: And then the, what would you say like the average age of your workers?

Yu: 55 60 70 years old. I need to find a special. covered by normal. We are sort of. We still don't want to lose them. One of my staff is 67 years old. I need to find a special insurance for him, to cover his employment, because over 65 is not compensation. We are sort of a personal labor and advising staff in Hong Kong. And he's good, so I need to-

Reklaoui: How about communication? Is it Cantonese or English?

Yu: Cantonese. I have a few-, that is- but very few, just a few of them.

Steeves: Are they like migrant workers?

Yu: Their father was in the British army.

Secretary: They are Hong Kong citizens.

Li: So how many hours they need to work per day?

Yu: From 8 to 6.

Choi: 8am to 6pm

Yu: Too long?

Li: Shorter than I imagined.

Yu: Shorter than you imagined?

Li: Because I feel like they are very busy, working all the time.

Choi: So for your subcontractors are they well established companies or just free people gathering together?

Yu: Sometimes yes. We don't expect- We help them, we have a supervisor to help them.

Dorich: so subcontractors different people every time?

Yu: For me yes, more or less the same group of people.

Li: So how about the salary? Is that like higher than other companies?

Yu: How much do you think? Just give me an imagination

Li: construction field. Is it higher?

Yu: Well now what they get, for general labor, \$650 HK per day. And what they got two years ago was about \$400 HK. substantial increasing, because of the work load. And for very skilled, what they get is \$1500 per day?

Secretary: Over, over \$1800

Choi: A lot of money for wages and no money for the environmental issues. Any more questions?

Dorich: Are you guys all set?

Li: Can you give us some advice like about who can we interview next? construction industry?

Yu: I think you should contact GBC, not Green Building Council, it's the General Building Contractor. All the small contractors.

Dorich: HKGBC?

Yu: HKGBC, General Building Contractor.

Dorich: *Finishing Remarks.*

D4: Interview with Representatives of Shun Yuen Construction Limited**Interviewee:** Mr. David Chiu

Quality & Environmental Engineer of Shun Yuen Construction Limited

Interviewee: Mr. Dan Leung

Quality & Environmental Officer of Shun Yuen Construction Limited

Interviewee: Unknown 3rd Member

Employee of Shun Yuen Construction Limited

Interviewers: Jonathan Dorich

Yao Li

Lamyae Reklaoui

Matt Steeves

Location: Shun Yuen Construction Office, China Trade Center, Kwun Tong, HK**Date:** January 21, 2013**Summary of Interview:**

As requested by the interviewees, the audio for this interview was not recorded. The following is a joint summary of the interview by all members of this report.

Shun Yuen Construction Limited

- Around 100 direct employees

Contract/Projects: repaving, water pipes, underground, resurfacing, CE

- These projects all produce similar construction waste
 - This makes it easier for them to dispose/sort, etc.

Materials

- Inert (stone, backfill, sand waste) -> landfill
 - (Use mainly these backfill materials in projects)
- Non-inert materials -> sorting facility
 - Can also send to sorting facility--cheaper than landfill's penalty by weight
- Rebar, steel recycled
- More complex materials (many parts) also send to sorting facility

- Centralized sorting
 - Send materials from multiple sites to a central point to be sorted and then sent to the correct disposal facility/area
 - Companies they subcontract must dispose of their own waste (i.e. cannot use the centralized center that Shun Yuen has setup)

Business Policy

- subcontractors are to dispose by contract (\$5000 fine otherwise)
 - other violations, per HK ordinance: air, noise (\$2000)
 - \$100k penalty for other bad dumping--into the sea
 - (They seem to find these air/noise pollution ordinances more important than other environmental initiatives)
 - Shun Yuen sets subcontractor waste practices/requirements
 - Government requirements probably have a role in subcontractor requirements as well
- Main contractor encouraged to monitor_waste to government landfills
- Waste Disposal Ordinance
- Encourage SMEs (that they subcontract) to handle their own waste

Business Practice

- Environmentalism always delays company
 - Delivery system: minimize in/out deliveries, and out deliveries by material would be too costly.
- Workers are encouraged to keep site tidy, but organization for waste material would be too much work
 - Even though encouraged to keep site tidy, they often don't (lack the motivation too)
- Company owns large storage site, but own materials still just sorted minimally--rest to landfill
- Owners seem to understand problem, but let workers make choices?

- Company provides training, but only regarding air/noise control because there are more mandates against these pollutions? Environmental trainings are available, and not too expensive per second interview
- Companies pay for environmentalism government needs to take lead
- Try to reuse old fill in new projects

SMEs

- Company resources are essential--but culture should be priority, money seems most restrictive, but workers are not knowledgeable (generation is too old)
- Companies stay in contact with BEC, EPD, NGOs
- Use trip ticket system
- Sustainability is never a “goal”--only profit
- Environmentalism could be improved with incentive, but profit and expanding business are always most important without government support would certainly help

About Business

- High-level contracting
- Contractors encouraged to manage their own waste--but cannot efficiently
- May not even send material to sorting facility
- The laws, regulations are followed but are not sufficient
- Waste Management Ordinance--Chapter 354
- Subcontract all types of trades
- Mostly use government contracts, not private
- Send materials for sorting, according to NGO
- Can develop better management plan--better social responsibility to improve reputation
- Some sustainability initiatives would not even be more costly
- In terms of business, short term investments could even see mid-term improvements
- Business has been penalized for noise

Hurdles

- Decreases profit! (Delays project)
- Culture
 - Lack of Motivation for environment?
- Lack of knowledge of “lower workers”

- Changing culture should be the priority, not resources
 - Promote environment!
 - It's a social responsibility!
 - Can improve reputation of company
 - This can help expand the business in the industry
- Management commitment is essential

Government

- Government policies are effective
 - More people need to follow
 - More worried about profit
 - Gov. need to promote economics (and environmental aspects) of it
- Government policies caused improvement in waste management for Shun Yuen Construction Limited

D5: Interview with Members of the Hong Kong Construction Sub-Contractors Association

Interviewee: Mr. Lawrence S.W. Ng

HKCSA member

Managing Director of the United Marble Company Limited, United Anex Engineering Ltd, Anex (Macau) Ltd.

Interviewee: Mr. Ng Kwok Ming

HKCSA member

Employee of Kingsland Engineering Co. Ltd.

Interviewee: Mr. Tse Chun Yuen (Eric)

Permanent Honorary President of HKCSA

Interviewee: Dr. Sammy K.M. Wan

Secretary of Labour & Safety Committee of HKFEMC

Manager (Quality, Safety, & Environment) of Analogue Group of Companies

Interviewers: Jonathan Dorich

Yao Li

Lamyae Reklaoui

Matt Steeves

Location: HKCSA Office, Ping Lam Commercial Building, Wan Chai, HK

Date: January 23, 2013

Note: Due to the audio quality of the recordings, some portions of the transcript may be incomplete. These sections are denoted by dashes (“-----”) in place of words.

Start of Interview:

Reklaoui: *Opening Statement*

Reklaoui: How does the Hong Kong Construction Association help companies in being more sustainable?

Lawrence: You already have a meeting with HKCA? Hong Kong.

Lamyae: Yes.

Lawrence: How we help ourselves. HKCSA.

Dorich: We meant your association, how does your association help SMEs.

Lamyae: So HKS- HKCSA

Wan: Do you have any to discuss on Hong Kong CSA.

Lawrence: No we don't have special committee in discussing the environmental protection.

Discussing with the environment council is also involved in our sustainability. I think it's quite important for the sustainability of the SME. not that fair. SME is not in the position to repossess or pay terms. But in this case, actually Construction Industry Council is more helpful. contract condition. because nowadays most of the subcontract between the main contractor. different company. and SME is not in the position to repossess or pay terms. but in this case actually Construction Industry Council is quite helpful. They have a committee on subcontracting.. working on contract condition. so i think this is also one of the major topics that we are working on in the coming one to two years. I think this is also one of the major topics that may help for the sustainability of the SME in contradicting.

Wan: I joined this interview because I come from another association in Hong Kong. I come from Federation, Hong Kong Federation of Electrical and Mechanical contractors. In our federation, we have belonged to. As mentioned by Lawrence, we also have some committee to In our federation we have different kinds of electrical and mechanical associations. we also have some committee to join CIC committees. We give some feedback and also in our federation we organize some seminars. Environment is very important for our electrical and mechanical sectors in our. Also in our contracts, in many. comply with the Hong Kong BEAM, and also the LEED requirements. That's why we provide some. quite demanding. For example, Hong Kong Bank, HSBC, or MTR, should comply with the and also the LEED requirements. Training, or seminar, to understand the requirements. I think at this moment we do not have any training materials because I remember in Hong Kong. The association has some material for environmental. in our association we are considering this kind of materials for our members, member committees. So I think the sustainability more in our association and I think we will consider some assistance or our contractors later.

Lawrence: Maybe I should have more introduction because today we got invitation from BEC, Sarah, and she told me that people are coming from the United States with us. among the SME topics and that's why I also invited our friends to come here because he's representing the Hong Kong. Actually Mr. Wan is also the representative of HKFEMC. In Hong Kong, to my understanding, there's three major organizations, one you already met before, HKCA. we are the sub-contractor association. all the members are main contractors. And then we are the subcontractor association. And then there's another association, which is quite HKFEMC, Hong Kong Federation of Electrical and Mechanical Contractors Limited. They are working on the, and we're working on So actually I'm the main contractor. So this time, for the time being, on SMEs. Then in fact I

don't know your schedule when will you go back to your home?

Reklaoui: March 2nd.

Lawrence: March 2nd. So you still have a long time in Hong Kong. Exchange students? You come for exchange students? In that case, Mr. Wan, necessary we may ask Mr. Wan to arrange another meeting.

Reklaoui: Thank you.

Lawrence: They are- and the contract situation. Most of them. Do you have any idea between contractor, I mean the contract relation between the contractor and subcontractor?

Reklaoui: The main contractors hires the subcontractor.

Lawrence: in the market. Normally. They have exist now between, especially if Development Bureau. Housing Department, MTR, some big employer we don't have any relation with the employer. I mean different main contractors will have their own contract condition in their contract and even type of contract. and we just mention the contract is one of the very important factor for our sustainability. actually as Mr. Wan mentioned, CIC is a very important place for all these to join. And have you heard of CIC in Hong Kong?

Reklaoui: Yes.

Lawrence: So CIC, members, from different sectors to join together. We have our council. Apart from the council, there's six different divisions, committees, underneath the council. finance, The committee. environmental protection and manpower training, subcontracting, size safety, and the procurement. Procurement is quite similar to the subcontracting committee, but the procurement is mainly on those for bigger company. The contract between employer to main contractor or employer to subcontractor, like. In our contract, we'll. And in this different committee, so we have different members to join the. So most of, apart from the contract condition, we also consider the size safety because if we're talking about the sustainability. money, environment, safety, because actually now in Hong Kong the safety make the whole industry money. And we should pay more attention to the safety, and also time and money. So for the sustainability, actually safety is one of the major topic of the whole industry. sustainability of the whole industry, try to explore our concern in the industry, especially representing the SME.

Reklaoui: Thank you for your-

Lawrence: Because your, your question is global, it's a very global question. I don't know how to identify. You're doing a project for survey?

Reklaoui: We're focusing on waste management, environmental aspect of sustainability. So could you please discuss with us your knowledge of waste practices at construction sites?

Lawrence: At construction sites, actually Mr. Wan just mentioned, because it's a kind of. reach the requirement then they can't get the BEAM Plus Award, benchmark, OK? Benchmark. Actually it's already quite clear requirement on the job site. condition. maybe Mr. Wan can-

Wan: Supplement. And for our subcontractors, we always need to comply by the contract requirements, for example Hong Kong Beam Plus, or LEED. As I mentioned, contract requirements. If we do not need to comply with these requirements. open up building account with EPD, Environmental Protection Department. And also if we are the principal contractor. For example we are employed by MTR. MTR is separate contract. So first of all we have to open an account to identify the EPD. because in our SME sometimes forget to open this account. But EPD always uses a very serious approach if you cannot open this building account within 21 days they will consider to prosecute. So this is a hurdle, in my perspective. And the second one is, after we open account, or site management pay, because we need to consider the site arrangement for storing waste material. because in our electrical or mechanical construction, we have some chemical waste. According to the requirements, we have to EPD as chemical waste producer, is another requirement for waste. And this kind of petition is quite easy. another hurdle is we need to store the chemical waste. Because according to the requirement, to ensure all the chemical should be stored properly, without any contamination. And in some cases, because we are SMEs In some case it's not easy because mainly constraints by the contractor at the site areas, this is a second hurdle. Then after we have prepared and approved our environmental pay, then we need to regularly monitor the transportation of the collection waste. And in our site we always arrange a supervisor. We need to store the. We need to separate the waste into inert and non-inert. For the inert, we need to store the waste and then dump proper fill areas. For the non-inert, we, in some contract conditions, the government or the client encourages us to have sorting, for example the bamboo, plastic, or timber. They want us to have sorting. And if the materials can be reused or recycled, they encourage us to recycle, or reduce. Also causes another hurdle because we need to employ a worker or supervisor to separate or sort the consumed waste, some of them can be recycled, some of them can be. properly, we need to arrange a truck to disposal of the consumed waste. and we need to we have some ticket, a field ticket. if we have arranged the construction waste on a truck, we need to have a ticket and give to the driver, and the driver will go to the dumping site, landfill. and after the driver ticket to the operators of the landfill. And then, we always need to have a, drop the ticket, as evidence to show that we have a really properly disposal of this consumed waste, because in the previous time, some truck drivers may dump the consumed waste illegally. So, and in our management we always need to client, main contractor to demonstrate that disposal of the consumed waste, is evidence. For the chemical waste, we need to store all the chemical waste properly, designated area. As I mentioned before, a container. contamination, and we will arrange regularly disposal of the chemical waste. We need to employ a registered waste chemical waste collector, and then request the driver to transport the chemical waste disposal area to dispose of the chemical waste. I

think hurdle, of course we need to arrange a designated person to have a management. For example, we need to have to register our chemical waste record, consumed waste record. I think SME to comply with all these requirements.

Reklaoui: Just to introduce ourselves quickly, we're the Green Construction team. And we're investigating the waste management practices in the construction industry in Hong Kong.

Lawrence: Mr. Eric Church, he is our honorary president.

Reklaoui: Thank you. So you mention-

Wan: I want to add something because in some ... We need to comply with the , LEED requirements or Hong Kong BEAM requirements. to achieve some.... If we need to comply, we need to divert the consumed waste around seventy percent or eighty percent. For SMEs it's not easy to arrange that, because it really depends on the areas of our construction site, and also the management, the design management of the site, because if we do not have area, or suitable area to store the consumed waste. And also. another hurdle is we cannot find a proper contractor to recycle something, because, for example, if we want to recycle or divert, we need to find company to recycle our materials. For the metal, it's ok. but for some materials, demolished materials, you cannot find recycling committee. LEED requirements.

Reklaoui: You mention before bamboo, what are materials are generated at the construction sites?

Wan: So it's not easy for us to comply with for example. very often contractor will elec. chemical waste. for example, or some adhesive, chemical waste. in some case, radiation for some whole restore some smoke- smoke detector. we need to properly handle the waste and chemical waste. plastic and some packaging materials. for our electrical and mechanical contractors, we seldom have. landfills, for example. but for the HKCSA, for example concrete, cement, some cables or some metal.

Dorich: Now you mention are those easy to recycle?

Wan: electric cable or some metal materials, very easy for us to recycle or sell to the recycling committees. But for the, I think timber-

Wan: Timber is OK.

Wan: In Hong Kong, for example if we have a contract, addition, or renovation site, we need to demolish some, it's not easy for us to find, to recycle the materials. We always dump as inert waste. So I think in Hong Kong there's some constraint. has a very small open market. If we do not have. it's not easy for the recycling company to survive. so i think this is one of the hurdles in the industry. We agree that the government subsidies is very minimum. the government location land for the recycling company to establish the

business in Hong Kong:

---: So for the time being, by the government, we need a lot of the land location, we need the system from the government. But now still waiting for their planning. That's the problem.

---: the government encourages the designer. design, green idea

Wan: The government has some incentive scheme, comply with the requirements. some incentive for the area of the calculated cross area. to encourage the designer or contractor to think environmentally-friendly.

Reklaoui: And could you describe how firms of different sizes manage the waste?

Lawrence: You mean the-

Reklaoui: For instance an SME that employs

Lawrence: According to the definition of SMEs in Hong Kong

Lawrence: number of employer. management. so really small one. especially for those subcontractors, even in the SME, fifteen to twenty-five people. I think maybe not too . seventy to one hundred.

Wan: For our electrical and mechanical, I think

Lawrence: We're talking about because a lot of labors, hundreds of labors. general staff, maybe some, make more than that. because for subcontracting, a lot of labors, hundreds of labors. project basis.

Reklaoui: OK. And in addition to the hurdles you mentioned earlier, are there other factors like lack of knowledge or space that play a factor?

Wan: I think Knowledge. our contract, if our engineer is not aware of the requirements of the Hong Kong BEAM. requirements. reason why we have some engineer to have BEAM Professional condition, comply with some. but the awareness is poor at this moment, but for the. I think it's still ok because EPD has some seminars, or websites, you can visit EPD website. important for SME. But as I mentioned before we do not have a dedicated person to look after the environmental matters. environmental officer, need to the contract. safety, environmental matters. SMEs. So we don't have a dedicated person. And for SMEs so it really depends on the project manager to research or attend the seminars so that they're aware of the requirements. If the government, or some coordinator for us to before the commencement site. because the commencement website, we need to agree on all requirements for SMEs. because the project manager may project some application of their forms. For example application for building. application for chemical waste producer. application for according to air pollution audience. and also we have some different kinds of requirements, for example we need to apply for. so SME in some case

we may forget. And so that's why the knowledge awareness is very important, and also the resources. We have some sharing platform for SME because it's easier for us to share the forms, because there are many different kinds of forms we have to fill in, also there is guidance, because in our SME some people may not be familiar with English or Chinese. geographical representation of some instructions.

Reklaoui: And what is the size of HKFEMC? How many employees do you have?

Lawrence: In our federation, all our members are contractors, air conditioning, fire, electrical, and also environmental engineering projects.

Li: So most of them are subcontractors?

Wan: Ya. In our federation, some contracts by the. Because it really depends, in some case, domestic subcontractor. We are always the subcontractor. In some contract. really depends on the of our contract. For example, MTR contracts, they have many separate contracts. electrical and mechanical contractor. main contractor

Lawrence: some of the contractors. the major scope of work is involved, of our builders' works. E&M contractors, and they will gather some main contractors become their reference. It's not very. Maybe some special facilities. still main contractor handles project. especially subcontractor, even have, their independent. but still, in the contract form. It's not really direct contract arrangement with the client. Still we have main contractor. Still barrier by underneath main contractor.

Reklaoui: And what is the size of HKSCA?

Lawrence: HKCSA you mean. What do you mean?

Reklaoui: Number

Lawrence: I will have some brief introduction about our association. Our organization is quite close to. our association, actually, we can name it federation OK? Underneath we have twelve different associations among different kinds of trade. because in Hong Kong it's not like U.S. We have subcontracts. This kind of subcontract culture in Hong Kong, successful, because can control the cost. we can control the subcontract industry and be exempt. and go back to our association, we have it's about electrical, fire, water pumping, something like that. And for us fossil works, marble works, crane, bar bender, and work, and scaffolding, something like that. It is twelve different associations, for a particular trade. together. why we have this association. the reason is that because if we are in trade association we can only discuss the matter restricted in trade. subcontractor. that is more global. for example, talk about representing the whole subcontracting stakeholders. and we're talking about working in different layers.

Reklaoui: And based on your observations, how does HKCSA approach waste management?

Lawrence: Actually let me introduce. For the waste, the principal control is under main contractor, just like even. That is maybe the requirement for BEAM Plus, something like that. But what we, because in the construction industry, the domestic subcontractor organization lot of people. as i say some of those they only for five people, some twenty five to thirty people. in that case they don't have enough resources to. initially the main contractor also understands that they need to. usually the main contractor. to all those practical works. according to their requirement. what we face is only small part of total, and most of the work arranged or handled by main contractor.

Steeves: Just to clarify that would be mostly not government contracts. requirements I guess.

Wan: Pardon, can you repeat your question?

Steeves: So you say that these are from like private contracts or are they like private works?

Lawrence: It's all the same, it's not the background of the contract. still we have to, according to the requirements of the main contractor. of course for the main contract, the employers have different requirements. for example, usually like or housing. MTR. or some hospital, school. They will have a higher requirement on construction site waste. And For the private work, it depends on what incentive the employer can get from the arrangement. if they can get more, pay more effort. and because it's a commercial decision, between the contract and main employer also the condition is subject to their benefit behind. motivate the employer to put more effort on environmental protection. in that case main contractor, they will also push the subcontractor to follow the requirement.

Reklaoui: And could you tell us a bit more how the local government manages waste.

Dorich: Does the government have any like manage waste rules

---: you mean the government

Wan: I think different legislative requirements, chemical waste. Hong Kong. In some government contract, we may have additional requirements. government contract incentive scheme. In Hong Kong, pay for safety for the contract. in other words, some item, environmental item, the government can pay the contractor because you have achieved something. because you follow the requirements and this is quite different. in hong kong incentive for the contractors. I would like to clarify something. our association, or our members committee and the subcontractors. we always need to. if the contractor do not have and, or they manage waste poor, in this case it's not easy for us to follow. they need to arrange suitable areas for us to store the waste. sort the waste, manage the waste, provide some briefing for the site management. so the feasible contractor, training not easy for us to find.

Dorich: So the incentive scheme by the government, do you think that's ?

Wan: incentive scheme

Dorich: Do you think effective?

Wan: In public contract, in the safety, pay for safety environmental scheme, always emphasize safety matters, or safety items. for the environmental, only few items. also environmental supervisor. you employ someone, they will pay the contractor. for this contract, totally sizeable subcontractors. because there are some requirements. according to the government requirements. you are entitled to apply the payment, because the, I mean this scheme-

Lawrence: Paid to the because that means main contractor, or principal contractor. the payment cannot to the subcontractor or even the. actually we are now discussing the government bureau and try to persuade them some item to compensate for subcontractor. it's not easy because the main contractor is the beneficiary. until now all the money is to the owner. if we want to, because now not major on the environmental protection, but also on safety side as explained by Dr. Wan. the major item is on safety. and some of the is for environmental but even for the safety there's no room or subcontracting. but actually because of the main contractor is only the. so how to move the works ahead, or how to do the practical works become the responsibility of the subcontractor. but usually, i just mentioned before, the problem in the subcontract between the. not in a fair basis. so even during the in public works that will not involve in your own tender price. answers to. that means some unknown factors, some certain expenses, it's not clear. because in the contract already mentioned. information from the main contractor and will not get anything because include in the price.

Wan: Important point, because according to the scheme, we need to recognize the subcontractors, or our electrical and mechanical contractors. because we pay a form, but according to scheme main contractor, but the scheme

Lawrence: We already proposed to the environment bureau to start, examine this process, whether they approve to extend the payment, safety. and it took some time I think. I hope they can start working on that.

Reklaoui: What types of contracts are you involved in?

Lawrence: For me, you mean? as I told you in our association, twelve different scopes of trade. stone subcontracting. but limited to stone works, marble works. and Mr. Eric, he's Mr. is the chairman of the

---: Service, repairing, erection, or dismantling. you know the material handling. material from the ground to the roof, ot the roof to the ground. now in these days.

Wan: For me I'm now working in electrical and mechanical contractor, engineering contractor, involving quite comprehensive company. air conditioning, environmental engineering

projects, quite comprehensive company.

Reklaoui: How do sustainability initiatives affect your business?

Wan: For the sustainability initiatives, I think is a direction because when we. There are some requirements for the sustainability and requirements. In our company establish sustainability policy. We want to comply with the tender requirements. not very in this area because if I ask our colleagues sustainability, they cannot answer. I think the education is still not very sufficient in this area but for the sustainability because if I ask my colleagues. I think for the direction for our contractor to think environmentally friendly in our construction and also we need to care for the workers, because direction. and also hazard safety items I think is very important.

Reklaoui: And are there any reasons why sustainability should not be a goal in the construction industry?

Wan: Should not be a goal?

Reklaoui: Ya. Are there any reasons why sustainability should not be a goal?

Wan: Because we need to have a smart objective labor, or other issue. in other words, in our construction safety target objective. for example, other issue, to interpret. because sustain our business. is also some goal for us to comply for in order to sustain our business.

Reklaoui: And could you suggest anything that would make sustainability easier?

Lawrence: You mean construction waste?

Reklaoui: Yes.

Lawrence: I think for the construction site waste, try to improve the, the most important is the resources. Resources means cost, money, so if we can pay more resources contractors. That means the employer, has to pay more. How they can finish all this in the contract, to. It depends on how the employer, is it the . They think they're responsible for society, but honestly most of them consider. But anyway I think we got some rules and regulation because we want it better, pay more.

Wan: In my opinion, sustainable construction. For example, we have some Building Information Modeling, or some other device for us to simulate so we can prevent. as a tool to simulate the process. construction waste at the site.

Reklaoui: Is there anything else you would like to share with us about your experience with waste management? Or if you would like to clarify anything else about waste management?

Dorich: *Finishing Remarks.*

D6: Interview with Representative from Kum Shing Group

Interviewee: Anonymous

Assistant Environmental Manager of Kum Shing Group

Interviewers: Jonathan Dorich

Lamyae Reklaoui

Matt Steeves

Location: Business Environment Council Office, Kowloon Tong, HK

Date: February 6, 2013

Note: Due to the audio quality of the recordings, some portions of the transcript may be incomplete. These sections are denoted by dashes (“-----”) in place of words.

Start of Interview:

Dorich: *Opening Statement*

Dorich: What is your role in the Kum Shing Group? so you are the system environment manager. What do you do?

Anonymous: I take care of protect environmental management duties of the whole contract group, I handling some... in Hong Kong. China Light Power company is one of our two companies in Hong Kong, one is CLP, the other is Hong Kong Electric, so we are the contractor to help them to do some, cable laying.. Some MTR companies are also our clients, we help them to do some work, so my duty in the company is to take care of environmental management system ...as well as provide some legal advice to the ..how to comply the environmental laws in Hong Kong waste management, noise, air pollution. also, we will handle some audit activities as well as handle some side work in the contract. also, I need to take care of maintain ..as green as possible, maybe some area regarding IETO as well as how to yeah....another area is ..something like that.

Dorich: Please discuss with us your knowledge of waste disposal practices at construction sites. What are some methods for sustainable waste management?

Anonymous: We got some waste management plan, the document, to identify all the procedures and what requirement we have to address or we have take care of to specific contract, so we develop some waste management plan as well as some guideline and procedure.... is proved by clients sometime government department depends on what kind of project, I mean the project is public works or private works, if it is public works, it needs to be proved by government, as well as some consultants. ..simple general handling of construction waste ,the second one is chemical waste, something which can be reused or recycled, say, some timber some plastic eg. So in Hong Kong, we got construction waste disposal charging scheme. In Hong Kong, once the contractors or some developers have

to pay for the charge to government. They need to open an account to environmental building development to cater for each individual project, that means if our company has saying twenty projects, we will have twenty account, so the government can monitor waste disposal performance. The charge is different depends on where I dispose waste, for example there is three kinds of facilities in Hong Kong, one is landfill, the second one is ? , The third one is something for sorting facilities. For construction waste, they can be divided in to two categories, inert waste, and also non-inert waste, for inert waste, we usually dispose in sorting facilities or public fill because they can be reuse, concert aggregate? Non-inert waste all disposed in landfills. The charge would be something like 125 dollars per pound ton, try to do on site sorting on construction site so we can reduce the charge of waste disposal. But we may face some problem for on site sorting, our construction site is not an enclosed construction site. we always do construction work in road, road work construction site we can call them....the site area is narrow, not very large ares for on site sorting, and also we try to reuse you know the soil from under ground, we use them as far as possible so that we can try to reduce the amount of waste we generate. That is for construction waste, and for chemical waste, we just follow the instruction from EPD, we will apply to or make application to department so that we can become a construction waste producer for specific construction waste, so that we can call some construction waste collector to try to collect our construction waste to the disposal facilities, otherwise always administrate by the EPD. We have to set up storage area for specific construction waste because there is some standards and you can find them for set up. Beside, we also use some for centralize handling level? because some company will set up their construction waste collection port in each constructions site but we didn't. We use ... centralize collection port then will implement the construction waste. .. those for chemical waste. For those reusable or recyclable materials, we try to engage some suppliers to collect those materials for the recycle purpose, and try to ask them to give us some certificate for instance for our submission to our clients, try also be concern about how can we handle such materials, environmental-friendly practises.

Dorich: From your experience, what are the challenges of doing sustainable construction? You have mention that a lot of road site project, limited space of sorting. is that the biggest hurdle is just space or are the other types of...

Anonymous: Space is a problem, and also our awareness of .. what they want to do is just try to finish the project as fast as possible, they try to finish the target, so we need to we don't want to get it, ares is a problem as well as awareness.

Dorich: What about for like recycle reusing material?

Anonymous: Also got some challenge, for example we have some waste plastic ...not very much suppliers will welcome to collect such materials plastic may have very low value for recycle. Recently EPD have set up a Eco Park, they are social suppliers together to provide different kinds of recycle.. which is helpful for us. Otherwise...they are welcome to collect our waste.

Steeves: You mentioned work awareness, are they aware of like environmental consequences?

Anonymous: They are aware, but always they need some reminder, the formers need to remind them always, otherwise they will forget it only focus on work, try to finish all the things as fast as possible.

Dorich: How does the local government manage construction waste in Hong Kong? they have mention EDP as well, like a guideline do you think this is effective at reducing construction waste goes to landfills or could they be more.

Anonymous: For construction industry is effective I think because once a day they introduce charging scheme, as I remember the total amount of construction waste in landfill has been dramatically reduced but I am not sure whether they....but effective .. the media also says the landfill will be open road or closed also because some domestic waste still can not be reduce...

Dorich: Now some questions towards small or medium enterprises in construction industry. For your projects, do you subcontract to SMEs?

Anonymous: Sure, yes.

Dorich: Based on your observations, how do they approach waste management in a sustainable manner? Do they not have any focus on it?

Anonymous: They will follow our instructions and do their best, it depends on management of main contractors. Some main contractors may not focus on this area, their subcontractors will not perform well.

Dorich: So main contractors provides requirement and guidelines for waste management , and if not give them requirement, the SMEs will not have any care about how the management is?

Anonymous: They need some guidelines or penalty....

Dorich: Now does the your company provide assistance to the companies that subcontract when for waste management or do you need them to manage waste by themselves?

Anonymous: The disposal charge will.. when we provide some administrative support, for example, we assist them to contact EPD, and they will provide training for them, so they only need to pay is the charge for waste disposal.

Dorich: So the training, do they have requirement to do the training or it is an optional training?

Anonymous: Some of training is compulsive but as well as some internal training are also provided, encouraging them to

Dorich: How many direct employees you have?

Anonymous: Around 700.

Dorich: What types of project you offer?

Anonymous: Utility, such as electricity ,cabling, as well as draining system.

Dorich: So a lot of workers specific in one area or general workers?

Anonymous: General workers. Most of them are general workers.

Dorich: How do sustainability initiatives affect your business specifically?

Anonymous: It is important for business develop, particularly the CLP, MOTOR they always put as well as environmental protect as top... So once main contractor or contractor do well in these one area, they will ... by all, we are representing them in the community.

Dorich: Do initiatives work as intended?

Anonymous: Yeah, they will provide some advice or guidance as our initiatives.

Dorich: Are there any that are counterproductive?

Anonymous: (not related)

Dorich: On the company website, I saw the environmental production road map was here ways to improve sustainable environment, could you explain more about that?

Anonymous: ...we try to develop our ...each year for our staff to understand what we are try to focus in our company. we will hold some road show each year delivered by our chief..., elaborate what kind of environmental initiative or course as well as we view the result of ...so what we want to include some ... as well as some ... because just focus on legal compliant level ... we have to do better than legal requirement. So we meet the expectation...of legal course ...for example, the government want to reinforce or try to sell the course regarding the food waste, so they introduce the facility in our office, just like washing machine besides our staff can put waste from lunchbox, give them a charge if they try to feel how the food waste changing, so they mention the programme for the awareness. Each year we try to meet the standard of the community us well as some update requirements.

Dorich: Your company try to go above the requirements for environment protection because of try to provide better image of the company or because of possible increase of the profit?

Anonymous: Image is the first one. If our company weak image, then it easy to ..lose some project. Because in tender document , there is always section for the performance of environment protection....there a programme to evaluate whether they can do well in the

protection, got some marks of the tender score. So if you can do better design environmental protection, you can have good image, as well as can better help us to get project.

Dorich: Are there any reasons that sustainability should not be a goal in construction projects? For example, too costly?

Anonymous: We always believe that environment needs to be paid, pay for the environment, believe this concept. Because, for example, if you need to do some environmental friendly equipment need to be paid, the cost is little higher than normal one, it all depends on commitment... if they feel OK, then go ahead, it is quite critical for company to do better in environmental protection.

.... I think government can do better for launching for example, they can provide more...for company to implement training course because have source for suppliers to have training course in construction industry because some material have some special specification. Otherwise, it is difficult to say why can not.

Dorich: Could you suggest any improvements to the construction industry that would make sustainable construction easier?

Anonymous: Government start to do something in the legal part is one of the quite helpful part because it centralize all the supplier, recycle industry in one area so that we can them easily and those supplier still confident ...so trust they will be better, trust they will handle the waste environmental friendly way...

Dorich: Do you think main-contractor can help SMEs or subcontractor do better in waste management practise?

Anonymous: Sure the main-contractor can help them to do better, they provide some guidelines, good samples as well as information. Otherwise, they will feel difficult to because they don't have land...equipment resources.

Dorich: Any questions?

Steeves: Do you think the short term investment a... method?

Anonymous: Some of them are not quite simple collection facility some of them may be long term investment, but for waste management, it is not high of course, for some equipment it may be cost.

Steeves: So it's paid off?

Anonymous: Yes.

Dorich: Construction industry pay a lot to attention to environment?

Anonymous: Yes, they pay a lot of attention. The most hot topic now is green building how to ... been standard.

Dorich: Is there anything else that you would like to mention about your experiences with sustainable construction?

Anonymous: That's all?

Dorich: *Finishing Remarks*

APPENDIX E: SURVEY**E1: Survey in English**

*Please email responses to bec@wpi.edu
or fax to the Business Environment Council, Ms. Sarah Choi at 2784 6699*

**Survey on the Practices of Waste Management in
Hong Kong's Construction Industry**

We are students from Worcester Polytechnic Institute (WPI) in the United States researching small and medium enterprises (SMEs) in the construction industry. Our sponsor is the Business Environment Council (BEC) and our goal is to investigate the waste management practices of subcontractors in Hong Kong's construction industry. We would greatly appreciate your participation in our survey.

This survey is completely anonymous and your information will not be shared with anyone. The identities of any of our participants shall not be disclosed when our results shall be published in the future

This survey should take you less than 15 minutes to complete.

We would first like to gather some information about your construction firm. Please provide us with as much information as possible.

- 1) What is the size of your construction firm? Please enter the number of direct employees working for your company.

- 2) Which of the following contract type(s) does your construction firm typically receive?
Please check all that apply.

- Lump Sum
- Unit Price
- Cost Reimbursement
- Design-Build
- Other—please specify: _____

3) Does your firm operate under government or private contracts?

- Government
- Private
- Both—please specify approximately how much of each:
 - Government: ____% Private: ____%

4) Specifically, in which part of the construction sector do you work?

- Civil Engineering
- E & M (Electrical and Mechanical Engineering)
- RMAA (Repair, Maintenance, Minor Alteration, and Addition works)
- Other—please specify: _____

5) Which trades do you employ? Please select all that apply.

- Bricklayer
- Carpenter
- Concreter
- Demolition Worker
- Electrician
- Fire Protection Technician
- Floor Layer
- Glazier
- Heavy Equipment Operator
- HVAC Technician
- Mason
- Mechanic
- Metal Worker
- Painter
- Plumber
- Other(s)—please specify:

The next set of questions is also related to your construction firm and the practices that you employ in your projects. Please answer the following to the best of your ability.

6) Select all of the materials that your firm uses in its daily operations.

- Concrete/Asphalt
- Sand
- Wood/Bamboo
- Glass
- Ceramics
- Steel
- Other materials: _____

7) Select all of the materials that your firm recycles or reuses in its daily operations.

- Concrete/Asphalt
- Sand
- Wood/Bamboo
- Glass
- Ceramics
- Steel
- Packaging Materials
- Other materials: _____

8) My firm DOES NOT recycle or reuse the recyclable materials because (if there is any, or check all that apply):

- The materials are not valuable
- There is no space for storage
- My clients do not allow me to do so
- There are no such requirement from clients
- The workers are reluctant to do so
- Other—please explain:

9) Does your firm keep a record of the quantity of waste that you dispose of?

Yes

No

10) Does your firm allot money for recycling, such as for transportation of materials?

Yes

No

11) Does your firm keep a record of how much money is spent on waste disposal?

Yes

No

12) Does your firm have a position designated for recycling (or other environmental issues)?

Yes

No

13) My construction firm had made an effort to collect and recycle construction and demolition waste.

Strongly agree

Agree

Disagree

Strongly disagree

14) My construction firm collects and recycles construction and demolition waste because of:

Contractual requirement

Self-initiation of my firm or workers

Pressures from business competitors

Response to Government's promotion

Other—please explain:

15) Please describe more on how your firm manages construction and demolition waste, such as reusing materials or saving them for recycling.

16) If you recycle, please describe more on why you recycle, especially why certain materials may be more preferable to recycle than others.

17) Does your company further subcontract to other companies? If so, do your contracts require any recycling or reuse practices of the subcontracted firms?

- Yes, we subcontract other firms and require them to recycle or reuse materials.
- Yes, we subcontract other firms and do not require them to reuse materials.
- No, we do not subcontract other firms.

18) My workers/sub-contractors are competent enough to handle the construction and demolition waste in an eco-friendly manner.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

19) My workers/sub-contractors are willing to handle the construction and demolition waste in an eco-friendly manner.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

20) If you are willing, please disclose how much your firm spends on collecting and recycling construction and demolition waste each month, on average.

\$ _____

This set of question covers some general information regarding the construction industry.

21) The current practices for disposing of waste from construction projects pose a problem for Hong Kong.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

22) Too much construction debris is being disposed of in landfills right now.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

23) Finding more eco-friendly means of disposing of waste should be a goal in the construction industry.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

The final set of questions addresses some initiatives in Hong Kong that have been used to control the production of construction waste. Please fill it in as completely as possible.

24) What kind of impact have construction waste disposal charging schemes, based on the amount of waste produced, had on the construction industry overall?

- Mostly Positive
- Mostly Negative
- No impact
- I am not aware of charging schemes

25) What kind of impact has the Waste Management Plan for public works had on the construction industry overall?

- Mostly Positive
- Mostly Negative
- Mix of positive and negative
- No impact
- I am not aware of the Waste Management Plan

26) What kind of impact have training sessions, provided by trade associations, for proper waste management had on the construction industry overall?

- Mostly Positive
- Mostly Negative
- Mix of positive and negative
- No impact
- I am not aware of these trainings

27) What do you see as the challenges of practicing sustainable construction in Hong Kong?
Please check all that apply.

- Cost
- Lack of knowledge
- Lack of motivation
- Government policies
- Size of worksites
- Other—please specify: _____

28) Please describe the primary challenge that makes eco-friendly waste management difficult for companies like yours.

Thank you for participating in this survey. The information with which you provide us will greatly help us in our research as we identify challenges to sustainable construction and waste management in Hong Kong's construction industry. Once again, all of your responses will be kept anonymous. If you would like to be sent a copy of our final report, please provide your email address or other contact information.

E2: Survey in Chinese

請將填好的問卷發郵件至 bec@wpi.edu

或傳真至商界環保協會蔡小姐2784 6699

「香港建築業廢物管理情況」調查問卷

我們是來自美國伍斯特理工學院的學生，我們現正進行一項有關「香港建築業中小型企廢物管理情況」調查。此項目由香港商界環保協會贊助。

此次調查問卷為匿名問卷，並且我們不會透露關於您的任何信息給其他人。問卷結果發布時所有參與者的身份不會被公開。非常感謝您參與我們的調查。

此次調查問卷只需要佔用您不多於15分鐘的時間便可完成

首先，我們希望能了解一些 貴公司背景資料，請盡可能提供以下資料，謝謝。

1) 請問貴公司的直接僱員人數：_____

2) 請問貴公司所得到的工程合約是以以下那種建築合約？

- 總價合約
- 按量數付款工程合約
- 退還成本合約
- 設計建造合約
- 其他，請列舉_____

3) 請問貴公司的工程合約是政府合約還是私人合約？

- 政府合約
- 私人合約
- 兩者都有，請寫出各自所占百分比：政府合約____% 私人合約____%

4) 貴公司主要業務是：

- 土木工程
- 電子和機械工程
- 維修、保養、改建及加建工程
- 其他，請列舉_____

5) 請問貴公司主要招用什麼種類的員工，請選擇所有適用的種類。

- 磚瓦工
- 木工
- 混凝土工
- 拆除工人
- 電工
- 防火技術人員
- 地板工人
- 玻璃工
- 重型設備操作工
- 空調技術員
- 砌石工
- 機械工
- 金屬焊接工
- 油漆匠
- 水管工
- 其他，請列舉_____

以下幾條問題也是關於貴公司以及閣下在工程項目中的工作方式。請盡可能提供準確資料，謝謝。

6) 請選擇出所有貴公司使用的材料

- 混凝土 / 瀝青
- 沙
- 木材/竹子
- 玻璃
- 陶瓷
- 鋼鐵
- 其他，請列舉_____

7) 請選擇出所有貴公司會回收或再利用的材料

- 混凝土 / 瀝青
- 沙
- 木材/竹子
- 玻璃
- 陶瓷
- 鋼鐵
- 包裝材料
- 其他，請列舉_____

8) 貴公司沒有回收或再利用可回收材料是因為（如果情況一致，請選出所有適用的選項）：

- 材料都沒價值
- 沒有足夠空間儲存材料
- 承包商不允許我這麼做
- 承包商不需要我這麼做
- 工人不願意
- 其他，請寫出原因_____

9) 貴公司是否對所處理的廢物數量進行了記錄？

- 是
- 否

10) 貴公司有否分配資源作廢物回收，例如用於回收的材料的運輸資金？

- 是
- 否

11) 貴公司是否對廢物處理的費用進行了記錄？

- 是
- 否

12) 貴公司是否有專責同事處理廢物回收（或者其他環境問題）而設置的？

- 是
- 否

13) 貴公司致力收集和回收建築及拆卸廢料。

- 非常同意
- 同意
- 反對
- 非常反對
- 其他，請寫出原因_____

14) 我的建築公司因為以下原因收集和回收建築廢物：

- 合約要求
- 公司或工作人員自發
- 商業競爭對手的壓力
- 對政府宣傳的回應

15) 請補充更多細節關於貴公司如何管理建築廢料以及拆卸廢料，例如廢物重利用或者回收：

16) 如果貴公司進行廢物回收，請具體指出回收的原因以及為何只選擇某些材料回收：

17) 請問貴公司有否分判項目工程給其他公司？如果是，您的與分包商的合約有否包含任何廢物回收或再利用條款嗎？

- 是的，我的公司分判工程項目給其他公司，並且要求他們進行廢物回收或再利用
- 是的，我的公司分判工程項目給其他公司，並不要求他們進行廢物回收或再利用
- 不，我的公司不進行項目分判

18) 我的工人/分判商能使用環保的方式處理建築和拆除廢物。

- 非常同意
- 同意
- 反對
- 非常反對

19) 我的工人/分判商樂於用環保的方式處理建築和拆除廢物。

- 非常同意
- 同意
- 反對
- 非常反對

20) 如果上一題您選擇的是同意/非常同意，請指出平均每月貴公司在處理建築廢料以及拆卸廢物的使費
港元_____

以下幾條問題有關閣下對本地建造業的看法。

21) 現時建造業處理廢物方式是本地廢物的管理的一大難題。

- 非常同意
- 同意
- 反對
- 非常反對

22) 現在太多建築廢料堆積在堆填區。

- 非常同意
- 同意
- 反對
- 非常反對

23) 尋求更加環保的處理建築廢物方式是建造業應該達到的。

- 非常同意
- 同意
- 反對
- 非常反對

24) 基於產生量而徵收的建築廢物徵費計劃對建造業整體有怎樣的影響？

- 積極影響比較多
- 消極影響比較多
- 沒有影響
- 我不清楚收費計劃

25) 工務工程所列明的廢物處理計劃對整體建造業有怎樣的影響？

- 積極影響比較多
- 消極影響比較多
- 沒有影響
- 我不清楚垃圾處理計劃

26) 工會提供有關廢物管理的培訓對建造業整體有怎樣的影響？

- 積極影響比較多
- 消極影響比較多
- 積極消極影響都有
- 沒有影響
- 我不清楚這些培訓

27) 你認為在香港實施可持續建造有哪些挑戰？請選出所有你認為符合的選項。

- 費用
- 缺乏知識
- 缺乏積極性
- 政府政策
- 建築工地規模
- 其他，請列舉_____

28) 請指出對於貴公司或與貴公司有近似運作模式的公司，尋求有效的廢物處理方式最大的挑戰是什麼。

感謝您參與本次調查。您所提供給我們的資料對我們認識香港建造業可持續發展和廢物處理的挑戰有極大的幫助。如果您想收到一份我們最終報告的副本，請提供給我們您的郵箱或其他聯系方式。

電郵地址: _____
