A HAZARDOUS WASTE MANAGEMENT SOLUTION FOR BOGOTA

A Project Report

Presented to

The Faculty of the Department of Anthropology

San José State University

In Partial Fulfillment

Of the Requirements for the Degree

Master of Arts

by

Andrea Arjona Amador

May 2010

SAN JOSÉ STATE UNIVERSITY

The Undersigned Graduate Committee Approves the Project Report Titled

A HAZARDOUS WASTE MANAGEMENT SOLUTION FOR BOGOTA

by

Andrea Arjona

APPROVED FOR THE DEPARTMENT OF ANTHROPOLOGY

_____

Dr. Charles Darrah, Department of Anthropology Date

_____

Dr. Roberto González, Department of Anthropology Date

_____

Dr. Hilary Nixon, Department of Urban and Regional Planning Date

ABSTRACT

The present work has been focused on defining a waste management approach that would enable the design of an affordable, socially responsible, and environmentally sound hazardous waste management solution for Bogotá.

In Colombia hazardous waste mismanagement has become a great concern, particularly to main industrial centers like Bogotá where there is no public infrastructure to safely treat these types of wastes.

Recycling and incineration are two of the most sustainable waste management techniques available today, though generally expensive to implement. One of the main questions addressed in this report was how to make recycling and incineration affordable and appealing to Bogotá's industries. To answer this question the author proposes a strategic planning methodology for this project aimed at reducing costs and increasing compliance. First, to help reduce waste management costs, the proposed solution could design economic and service-based incentives that will help generators pay for hazardous waste disposal and other waste management services. Second, to increase compliance, the proposed solution could design engagement strategies that would help promote demand for sustainable waste management services.

A flexibly oriented business model based on both market and network association forms could help introduce some socioeconomic incentives to encourage hazardous waste generators to adhere to the proposed solution.

Cost-compliance problems and opposition to waste management facilities are

rather common factors among hazardous waste management establishments. Building diverse forms of engagement through service use would be crucial, not just to help reduce waste management costs, but also to address opposition towards hazardous waste management facilities.

ACKNOWLEDGEMENTS

The completion of this project would have not been possible without the support and assistance of my committee advisors at San José State University, and the patience of my dear family.

I would like to express my deepest gratitude to Professor Chuck Darrah, for carefully directing, reading, and editing my work. I would also like to thank Professor Hillary Nixon, for calling my attention towards important literature that became determinant for the development of this project. Thanks are also due to Professor Roberto González, who patiently answered all my questions about how to prepare this manuscript.

To my son and husband, thank you for sacrificing our time together so I could do this work.

TABLE OF CONTENTS

INTRODUCTION

This report discusses the question of how to design a hazardous waste management solution for Bogotá without creating negative impacts to the environment, to neighboring communities of waste treatment facilities, and to the local industrial economy.

The industrial sector in Bogotá produces approximately 75,000 tons of hazardous wastes yearly, but the city doesn't have the disposal infrastructure needed to safely treat these types of wastes. With a participation of 15 percent of the total national hazardous waste generation by industrial classification[1] and with no incineration available,[2] Bogotá has been accumulating over the years a vast amount of hazardous wastes in non-specially engineered landfills and dumpsites (Ministerio de Ambiente 2005:14).

A specific service-based Hazardous Waste Management Solution (HWMS) will be proposed here for Bogotá. This solution should have the capacity to reduce local industrial hazardous waste volumes with environmentally sound practices, mainly through incineration and recycling (the solution is not intended for clean up of contaminated sites). Additionally, the proposed solution should be comprehensive (designed to treat all local industrial waste streams), affordable, and attractive for all ranges of industrial hazardous waste generators. If these conditions of minimum treatment capacity, affordability, and environmental sustainability are met, the proposed

---

[1] Including mining, energy, electronics, agroindustrial, and the services sub-sectors. This solution would exclude the hospital industry, which in Colombia has specific waste management regulations and disposal mechanisms.

[2] Except for a few privately owned incinerators or furnaces operating for individual use.

solution may ensure sufficient demand for its related services and increase its ability to succeed. The main difficulty for this project is that achieving a comprehensive, affordable, *and* environmentally sound solution for Bogotá may not be so easy to accomplish because environmentally sound hazardous waste management involves the use of expensive technological requirements (e.g. waste incinerators, filtering mechanisms, training etc.), which are typically transferred to hazardous waste generators through relatively high waste management fees.

A comparative analysis between hazardous waste management approaches applied in different regions has shown that, even with appropriate regulation and enforcement, high waste management fees can affect some of the wealthiest nations of the world (see chapter 1). If hazardous waste management laws are not enforced and waste management is unaffordable, hazardous waste generators may prefer to keep on disposing or dumping their wastes at the most convenient location. To increase the likelihood of success for a hazardous waste management business in Bogotá this cost/ compliance complexity should be addressed from a project planning perspective. Here it will be argued that the success of a hazardous waste management business in Colombia will be largely determined by the balance of four main elements: comprehensive regulation, appropriate disposal methodologies, reduced waste management fees, and increasing levels of compliance.

The Meaning of Environmentally Sound Hazardous Waste Management

To be designated as hazardous, wastes should exhibit one or more hazardous property including flammability, corrosiveness, reactivity, or toxicity (Basel 2009). These are wastes that in any state or form (liquid, solid, or gaseous) are "dangerous or potentially harmful to human health or the environment," and therefore need special treatment, storage, and disposal (US EPA 2009).

Beyond the principle of introducing special disposal techniques to prevent potentially harmful effects related to hazardous waste treatments, environmentally sound hazardous waste management is about waste minimization. The ultimate goal of applying environmentally sound waste management techniques is to help minimize hazardous waste volumes and waste production whenever possible. Founded on "an integrated life-cycle approach of waste," this form of waste management requires strong controls to waste generation, storage, transport, treatment, reuse, recycling, recovery, and final disposal (Basel 2010). To protect both humans and ecosystems, specific waste treatment *and* waste minimization techniques should be systematically implemented throughout the waste management cycle (generation, separation, collection, recovery etc.). Waste treatment techniques would vary depending on the disposal methodology chosen (e.g. incineration, chemical treatments etc.), whereas waste minimization techniques could be based on the maximization of the re-using or recycling potential for certain waste streams. If waste volumes can be reduced through efficient waste management approaches (e.g. waste recovery or incineration) as well as through the introduction of

changes in modes of production to minimize waste production, it would be possible to diminish the overall amount of industrial hazardous wastes generated.

Hazardous waste minimization cannot be achieved solely by a waste management solution that is partly based on recycling, specially because hazardous waste recycling or reusing opportunities tend to be either scarce or expensive. Applying an environmentally sound hazardous waste management approach in Bogotá would require collaboration between the proposed waste management solution, hazardous waste generators, and environmental agencies. This type of collaboration could help identify inefficiencies in waste recovery mechanisms or certain modes of production, which may lead to the implementation of plausible cost-effective changes that would help gain some control over hazardous waste generation.

Environmentally sound hazardous waste management requires collective action if it intends to minimize waste production and benefit the overall public. Building the grounds for this type of collaboration is one of the purposes of the service-based business model proposed for this solution (see chapter 3). To be able to build partnerships or lead the type of collective action that tackles waste generation and accumulation, the proposed solution needs to be framed as a public service.

Assessing the Public Value of Environmentally Sound Hazardous Waste Management: Minimizing the Risks of Waste Dumping

As in most of the rest of the country, in Bogotá hazardous wastes are frequently stored in inadequate landfills or illegally dumped in unsuspected locations, including

open spaces, streams, and parks. In Bogotá there are several prominent cases of hazardous waste contamination, such as that of the Bogotá River. Environmental authorities in Colombia have estimated that approximately ten percent of pollutant discharges to the river could be attributed to industrial waste (the remaining 90 percent would correspond to domestic sewage discharges) (DAMA 2004). However small this figure may seem, this ten percent of industrial waste is arguably the most damaging to the life of the river. High content of toxic metals in the water, like mercury, lead, and cadmium, have literally killed life in the river, which today has virtually no fish in its mid and lower banks. To give a comprehensive picture of this situation, the reader should imagine a 370 kilometer-long river that drains a surface of approximately 600,000 hectares, but that most of its waters are banned for human consumption or agricultural use (Foundación Verde Vivo 2009). In spite of expensive efforts of stream restoration that have added to about 180 million dollars, mainly for the construction of wastewater capture and treatment plants at its lower bank, the Bogota River is still highly contaminated (Agenda Río Bogotá 2008). For life to get back to the river the city would probably need to exceed this amount of investment in order to have strict control of what goes into the water, including hazardous wastes from adjacent industrial production, and yet wait a few years. Under these circumstances, any effort to build a comprehensive hazardous waste management solution for Bogotá should consider and elicit the plausible positive impacts of hazardous waste control. If the proposed solution achieves important levels of compliance, for instance, enough to minimize waste dumping in places like the

Bogotá River, then it entails great public value and one may argue, could become a public asset to the city. But to increase and elicit its public value the proposed solution needs to build governmental, institutional, and public support. The capacity to build this type of support will depend on the solution's ability to address through project planning and implementation, certain regulation weaknesses, and unintended consequences of policy directions, such as those related to the privatization of public services in Colombia.

About Hazardous Waste Management Policy in Colombia

The Impact of International Agreements on Local Hazardous Waste Management Practices

There are international treaties that provide important guidelines for the management and disposal of hazardous wastes. The most important of these treaties are the Rotterdam, the Stockholm, and the Basel Conventions, which have been all ratified by the Colombian government. The Rotterdam convention, adopted in 1998 and enforced in 2004, promotes shared responsibility and cooperative efforts for the environmentally sound use and trade of hazardous chemicals, leading to the ban of certain pesticides and industrial chemicals for both health and environmental reasons (Rotterdam 2010). The Stockholm Convention, adopted in 2001 and enforced by 2004, requires parties to reduce or eliminate the release of Persistent Organic Pollutants (POPs) into the environment, like PCBs (Polychlorinated Biphenyls), a man-made organic compound commonly used in electrical equipment, coolants, cements, plastics, and paint, and the synthetic pesticide DDT (Dichlorodiphenyl Trichloroethane) (Stockholm, 2008). The Basel Convention

entered into force in 1992 and is the international authority for the control of transboundary movements of hazardous wastes (e.g. illegal waste dumping to other countries). Basel has encouraged governments to shift to cleaner production mechanisms to diminish or replace some waste streams like PCBs. Most importantly, it has helped identify the most efficient or environmentally sound methodologies available today for the treatment and disposal of hazardous wastes (Basel 2010).

The Basel Convention allows member countries to export some of its hazardous wastes *only* when governments do not have the capacity to safely treat them or destroy them at home. As an active member to the Convention and with limited treatment capacity, the government of Colombia relies on other countries' ability to safely dispose some of its hazardous wastes, especially those found in highly contaminated and mostly illegal dumpsites.

One case that could illustrate how this alternative waste management process occurs in Colombia is the one of the municipality of El Copey, in the northern region of the country. Residents in El Copey started correlating an increased number of cancer and birth defect cases within the community to a near illegal dumpsite. Over 200 tons of hazardous chemicals were found at the site, including DDT[3] (Bustamante 2009). These wastes had to be exported to France (in 2005) and Switzerland (in 2009), which are two of the countries with some of the largest hazardous waste destruction capacity in the

[3] Dichloro-Diphenyl-Trichloroethane (DDT) is a synthetic pesticide widely used in the past as an agricultural insecticide and as a disease vector control (e.g. as a mosquito insecticide to control malaria). Environmental and health concerns due to the indiscriminate use of DDT led to its worldwide ban for agricultural purposes under the Stockholm Convention (Stockholm Convention, 2009).

world. Until today no one knows where these chemicals came from and no particular organization or individual has been held accountable for the environmental degradation caused, not to mention the undetermined health impacts generated. In cases like the one of El Copey, taxpayers bear the final treatment and disposal costs while neighboring community members bear the health consequences of waste dumping.

The hazardous waste management business in Colombia is now emerging under two somewhat antagonist circumstances. From one side, there is a new comprehensive regulatory framework under which hazardous waste dumping or mismanagement would be heavily penalized. But, from another side, the country does not have (specially in Bogotá) the infrastructure needed to cover a growing demand for hazardous waste management, so the government neither can fully enforce these regulations nor fully comply with international treaties on hazardous waste control. New or existent hazardous waste management businesses and hazardous waste generators are trying to adapt the new regulations to their current waste management arrangements or to the services available (e.g. non-specialized land disposal). One could speculate that at this point some generators may just continue dumping and hoping a fine will never come. In the mean time, the government is expectant for private investors to come forward and develop the much needed hazardous waste management infrastructure, which would be one of the main incentives to develop the proposed hazardous waste management project.

Today there are in Colombia growing inventories of hazardous wastes per industrial business and identified waste streams per industrial sector, information that

could be readily used for governmental oversight and enforcement. Since regulation and enforcement are necessary conditions to guarantee the potential success of any new hazardous waste management business, it seems that the Colombian government is on its track to building an environment of business opportunity in the realm of hazardous waste management. However, this type of business environment in which the government ensures the necessary conditions for investors to succeed may entail some difficulties.

Hazardous waste management is essentially a public service; whether or not governments are actively involved in hazardous waste management activities, local or central governments exert policy leadership to achieve specific waste management goals, control privately or publicly owned facilities and how they are distributed to ensure the protection of the public and the environment, and in many cases, provide incentives, beyond conventional regulation, in order to achieve environmental or health protection goals (Bowman and Lester 1985). When a private party offers hazardous waste management services, this party would be indirectly delivering and administering certain public functions, like the one of ensuring policy compliance through service delivery, or the one of protecting people and the environment from the potential damages of hazardous waste mismanagement. The difficulty for the proposed business is that it would have to perform a dual purpose: the private hazardous waste management provider would not only have to make its business work by trying to increase the demand for the hazardous waste management services offered, but it would also have to build a capacity for taking care of rather public functions, like environmental protection, or the building

of a needed infrastructure to facilitate compliance of national and international hazardous waste management laws. Here it will be argued that to be successful in this dual function, the proposed business needs to create some social value through the services it will provide. In order to succeed, the proposed waste management solution should be understood not just as a business, but also as a public service.

Common Problems Related to the Privatization of Public Services in Colombia: Plausible Impacts for the Business Development of a HWMS

Today Colombia has a fairly comprehensive regulatory framework to address the growing problem of hazardous waste mismanagement, although it lacks hazardous waste recycling and reusing regulations (see chapter 2). However, as it has been argued so far, the government is not developing the public hazardous waste management infrastructure that would allow the full implementation of these regulations (there is no government-owned specialized system in Bogotá to treat and dispose hazardous wastes). Instead, the Colombian government is continuing to promote a model in which private or mixed (government and privately owned) companies are designing, building, and administrating public infrastructure and sanitary services. In other words, the government is transferring some of its functions (e.g. waste management) to the private sector, a political/economic policy closely linked to what is known as *privatization*.

According to Megginson and Netter (2001), Privatization refers to "the deliberate sale by a government of state-owned enterprises or assets to private economic agents" with the purpose of making them more efficient or profitable through the mechanisms

available by the market economy (2001:1). The way the proposed hazardous waste management business would develop in Bogotá could roughly fall in the category of what is known as *privatization from below*, which is when the government allows an almost unconstrained development of the private sector to promote the development of certain industries, address economic transitions, or increase efficiency in some industrial or public service sectors (Yarrow and Jasisnski 1996: 36-37). According to Megginson and Netter this process has been rather common in Eastern Europe, Russia, China and Latin American countries (2001:18). In Colombia, unconstrained development of industries that may generate important environmental impacts such tourism, waste management, or port management, are arguably nowadays rare. Lessons from the past have led to a form of encouragement of the private sector (or a form of privatization) more in tune with current environmental concerns and to the country's acquired environmental protection agreements. One example is the current attempt to encourage an emerging hazardous waste management market under somewhat strict environmental regulations. However, unconstrained development in the form of regulation voids, tax breaks, discounts, and loans to private investors for "selected" industries such as mining (coal, oil, gold, and nickel), banking, public works, and healthcare, has been one of the most criticized aspects of the current administration (Kalmonovitz 2010). Most worrisome for this project, an unconstrained development of hazardous waste management businesses could take place if hazardous waste management regulations are not fully enforced sooner than later, which could plausibly encourage the continuing growth of the current companies

that offer hazardous waste management services under poor or non-existent waste management standards.

As long as comprehensive regulation is being enforced, privately owned hazardous waste management businesses could be as efficient and profitable as any other public service provider in Colombia, and even more, especially considering the relatively high levels of corruption at the government level (World Economic Forum 2008). Even so, the most striking effects of privatization are not issues related to efficiency or profitability, but the extent to which a private business with public functions will have to resolve environmental, social, and political conflicts. Such conflicts typically arise in Colombia when public sanitation services are privatized.

Privatization of public services (e.g. wastewater treatment, waste management) or public goods (e.g. water and electricity) has been rather controversial in Latin America. Critics have argued that some of these processes have triggered the development of natural monopolies in many countries (i.e. when a single supplier takes over a market, (Howe 2009)). Such monopolies are not necessarily efficient in the distribution of public services, and when there are high private investments involved in the building of new infrastructure, prices of commodities such as water and electricity can increase substantially, potentially affecting other sensitive sectors, like agriculture. According to Howe (2009) this is what happened in Chile, where “the sudden privatization of water resources resulted in a high degree of monopolization of water supply by the national hydroelectric generating companies to the detriment of the agricultural sector and cities

that must pay exorbitant prices for added water supplies" (Howe 2009: 47). According to Kessler and Alexander (2006), essential services like water, electricity, and waste management, are public goods because their benefits "extend well beyond the particular individuals who consume them [...] Because essential services contribute directly to livelihood, health, and dignity [...] the decision to deliver those services through private providers should be subjected to a threshold requirement: the improvement of social equity and poverty reduction" (2006:1-2).

The truth is that there are many interests involved in the privatization of public services, which makes it inherently a highly politicized process. Governments are interested in transferring the burden of building expensive public service infrastructure to private investors, or to avoid the cost of subsidizing public services to make them more affordable (or fairly priced) for potential users. Private investors are mainly interested in making long-term profitable businesses, while intergovernmental panels (like UNEP), agreements (like Basel) and individuals in the line of thought of Kessler and Alexander (2006), are concerned with environmental protection, social justice, and poverty reduction.

Although no transnational or national study about privatization of hazardous waste management services in Latin America was found throughout this research, it is fair to approximate that its impacts could be similar to those studied for wastewater treatment and other sanitary infrastructure services (Howe 2009). A sanitation project like the HWMS proposed here would require costly and specialized infrastructure, as in the

case of other public services such as wastewater treatment. If these costs are transferred to hazardous waste generators, it could have a domino effect over some local industrial sub-sectors (if regulations are strict), or it could lead to more dumping. Regulation could make a difference if it prevents the potential abuse of dominant positions in the market through anti monopoly laws, by promoting competition and establishing minimum quality standards. However, this report already recognizes that there is a void in terms of recycling regulation, which is actually leading to the development of natural monopolies in Bogotá (at least for the recycling business) (see chapter 2). Understanding how the development of natural monopolies are a typical consequence of a privatized public service should help anticipate how to avoid becoming illegitimately (or illegally) dominant in the market, which could generate all sorts of conflicts, or how to minimize plausible impacts from the already existent dominant positions of competitors.

Perhaps the most important aspect that should be taken into consideration here is that, as in other sanitation infrastructure projects explored in this report, the clashing of multiple interests, so common during privatization processes, could lead to conflictive situations for the proposed solution. Two common conflictive situations for a privatized public service like the one proposed here are NIMBY (Not In My Backyard) attitudes towards waste management facilities, and what is called here *political project opposition*.

NIMBY attitudes are common to almost any hazardous waste management project in the world, public or private. Nonetheless, one may argue that when the service supplier is a private investor, NIMBY attitudes entail more difficulties because the private

investor has a for profit interest in such a project. Examples of other sanitation projects in Colombia reviewed in this report have shown that when private investors are involved, NIMBY conflicts are typically not addressed from the project's inception and therefore tend to result in lawsuits and money settlements that can lead to project failure (see chapter 2).

Political project opposition is significantly different. Through the examination of similar projects in Colombia, it became clear that institutions, elected officials, individuals, or communities of interest, tend to oppose to privately run sanitation projects when these are perceived as altering competing systems to the approved or accepted socioeconomic arrangements already established in a region. This type of opposition is referenced here as "political" because it mainly originates from a variety of rather political issues, like the questioning of the legal or governmental legitimacy to conduct and administer such a project, or issues of property or land development rights. For the proposed business, this type of opposition would mean that, in the absence of a public hazardous waste management establishment, the problem of encouraging compliance of current waste management laws would be increasingly difficult to deal with. Hazardous waste generators, relevant institutions, or the public, may not perceive the proposed solution as a public service, but rather as a competing or disrupting business with little governmental oversight, which may facilitate non-compliance of hazardous waste management regulations and lead to this type of political opposition.

Quintana's study (2008) about environmental conflict related to potable water service in rural Colombia shows that in the absence of public administration of sanitary establishments, governmental oversight and thus, compliance of water and waste management laws, is rather poor. According to Quintana, this situation is evidenced in the environmental conflict between two models of sanitary service present in rural Colombia. The first one would be the main business-service supplier, which would be the one that complies with current regulations and typically charges higher fees. The second one would be what Quintana calls a *collective* service supplier, which refers to the arrangements made by residents to obtain their own water or any other sanitary service from alternative sources (e.g. distributing collected stream or rainwater, building their own landfill sites etc.) (Quintana 2008). Although Quintana's study is specific to potable water service in Risaralda-Colombia, the author's findings are relevant to the proposed project. Conflicts between a main hazardous waste management service supplier and other *collective* service suppliers may very well develop in Bogotá. In fact, borrowing Quintana's term, up to date there are mainly collective arrangements for hazardous waste management and disposal in the city. The establishment of a private hazardous waste management operator that may charge higher fees (compared to what generators have been used to pay, or not pay), may be viewed as an altering competing waste management system, thus threatening the ability of a privately owned hazardous waste management solution to be accepted and succeed.

A Plausible Solution: Implementing Hazardous Waste Management Through Flexible Service Delivery

How to Elicit Public and Social Value for the Proposed Waste Management Business

One may argue that the main difficulty with the model of privatization of public services currently being applied in Colombia is that, though it creates the right normative environment for private operators to succeed, private operators still need to solve the problem of user compliance, which may lead to some companies to losses over several years before the service is fully accepted and valued by a determined community. Simply put, the fact that regulatory conditions are given does not solve the sort of conflict that Quintana (2008) exposed between different public service arrangements.

To minimize opportunities for both political opposition and NIMBY conflicts, the proposed HWMS could design and develop inclusive services that are flexible enough to enable it to perform both as a public service provider and as service-based hazardous waste management business. To build such flexibility and inclusiveness, the proposed solution would have to understand and address stakeholders' concerns via services. Plausible concerns such as high waste management costs or pollution from waste incineration, will not only need to be addressed or mitigated for through project planning and implementation, they should also be tackled through service delivery. For instance, air pollution may be already a concern in the area where the proposed hazardous waste management facility will be established (in fact, air pollution is a concern anywhere in

the city). The proposed solution could therefore design services that further address this community concern, for example through the implementation of green infrastructure developments that could help mitigate impacts from alternative sources of air pollution (see chapter 4). One may argue that when solutions for stakeholders' concerns are delivered via value added services, there are more opportunities for collaborative relationships that could lead to the resolution of conflicts and perhaps, minimize project opposition.

The form of collaboration and stakeholder engagement sought for this project needs to be linked to a flexible service-based business platform that would allow different forms of business association and thus increase opportunities for service delivery. This flexible business platform would be based on network and market association forms that could take place concomitantly or independently. Network association forms would help engage as many stakeholders as possible (generators, public, environmental agencies, neighbors, etc.) as business partners, customers, or supporters of the proposed solution. Ideally, these network association forms (when plausible), would be supported by market-based mechanisms that would help make hazardous waste management services more affordable. When network associations are unattractive or inconvenient, services that take advantage of market mechanisms could be designed, and vice-versa. This type of service-based business flexibility is expected to help increase regulation compliance.

Developing the proposed project through a flexible business architecture based on both network and market association forms would be crucial to increase engagement

opportunities and thus, increase the number of potential customers for the proposed solution. This flexible business platform would also enable the design of strategic hazardous waste management services. The greater the benefits those services entail, the greater the plausible support to the proposed solution.

Chapter Overview

To identify the most suitable hazardous waste management approach for Bogotá this report begins with a comparative analysis of hazardous waste management approaches applied in different regions. Identifying which hazardous waste management approaches have worked, where, and why would be crucial to define a hazardous waste management strategy for Bogotá. Following this analysis, issues that pertain the hazardous waste management business in Colombia were examined using business macro-environmental analysis techniques. This type of analysis helped identify and understand the variety of factors that may affect or determine a hazardous waste management business in Colombia and the variety of plausible stakeholders involved in this project. Understanding the range of stakeholders that could be involved in the proposed solution was crucial, not only to define the range of services that the proposed solution could provide, but also to determine which business association forms would be most likely to support the delivery of hazardous waste management services.

Chapter 1 examines the conditions under which environmentally sound hazardous waste management practices and approaches have evolved in different regions. The purpose of this analysis is not only to identify plausible concerns that may be common to

hazardous waste management projects worldwide, but also the characteristics that define and differentiate successful hazardous waste management approaches applied in different countries. Lessons form other regions helped identify the conditions under which environmentally sound hazardous waste management would be more likely to succeed in Bogotá, which enabled the definition of a strategic planning methodology for the proposed solution. This methodology is supported by policy and stakeholder analysis, land use planning techniques, and theories of evaluation and development anthropology.

Chapter 2 is focused on the contextual environment in which sanitation infrastructure projects develop in Colombia, like, but not exclusively, hazardous waste management. To successfully design and implement the proposed solution is important to have a clear understanding of what aspects in the contextual environment (political, legal economic, social etc.) may interfere or support an environmentally sound hazardous waste management approach. This type of analysis is aimed at understanding not just the specifics of the hazardous waste management market in Colombia but also the common problems that affect sanitation infrastructure projects locally.

Chapter 3 analyzes business-planning methodologies that would support the delivery of hazardous waste management services in Bogota. A service-based solution would require an understanding of which business organizational forms would be more likely to facilitate service delivery for a wide range of hazardous waste generators and stakeholders. The main theses here is that once there is a good understanding of the generators and stakeholders that would be affected by the proposed solution, it would be

possible to develop strategic services that would ensure the sustainability of the hazardous waste management business. Flexible business association forms, mainly based on market incentives and network advantages, would support service delivery.

Chapter 4 studies plausible site development problems and considers how these could be addressed through project design, planning, or implementation. Given that the core of the methodology applied here is supported on urban planning tools and anthropological theory, the discussion in this chapter will be centered on issues of stakeholder engagement and how to minimize site development impacts. Some other problems related to more technical issues (e.g. technology malfunction, economic impacts, etc.) were identified in this report but not specifically studied. These issues should be fully analyzed later and correlated to the sociopolitical and site development problems already investigated.

Chapter 5 explores the advantages of using anthropological forms of inquiry to understand the interconnections between political, social, technical, and environmental issues that locally affect major infrastructure projects like the proposed hazardous waste management solution. It is perhaps this understanding of interconnections what ultimately enables a practitioner or researcher to successfully help design and develop these types of projects.

CHAPTER 1

Problem Statement and Methodological Approaches

The main purpose of this work is to identify a hazardous waste management approach that would be applicable to Bogotá's regional socioeconomic circumstances in order to design a Hazardous Waste Management Solution (HWMS) to treat industrial hazardous wastes. Such an approach should be consistent with the criteria of environmentally sound management to ensure human health and environmental protection. Here it will be argued that to identify the best approach it is necessary to determine how waste management costs, disposal methodology, regulation and compliance may all have an impact on such a solution.

The Impact of Waste Management Costs, Regulation and Compliance on Environmentally Sound Hazardous Waste Management

Waste management costs are the costs related to waste treatment, handling and disposal. These costs are determined by the number of users of a particular solution (the number of generators that comply) and the disposal methodology chosen, which can range from recycling, neutralization (when a substance can be added to neutralize the hazardous component), land disposal, or incineration (among other chemical and combustion related treatments, Basel 2007). Efficient and cost-effective disposal methodologies are usually available when there is a strong regulatory framework that compels businesses and industries to manage their hazardous wastes safely, which should include laws, procedural guidelines, agreements, and capable enforcement authorities.

Regulations regarding hazardous waste management usually correspond to broader environmental goals such as stream restoration, biodiversity preservation, greenhouse gas abatement and human safety. A successful hazardous waste management approach should therefore achieve a high level of compliance in order to have a positive environmental impact and help reach those goals.

Hazardous waste management can be very expensive. Previous efforts to "export" the problem indicate that these expenses are perceived as a burden even for the richest industrialized regions of the world, partly because production sectors have been using natural resources at no cost to generate wealth, and partly because to manage hazardous wastes safely there are a number of sophisticated technological and human resource requirements that need to be met. Waste management costs, disposal methodology, regulation and compliance are all factors of the hazardous waste management cycle (i.e. waste classification, transportation, storage and final disposal). These factors are dependent on one another and, as such, they need to be balanced to develop a cost-effective solution.

According to the Basel Convention's criteria, *"*to achieve environmentally sound management of hazardous wastes, a number of legal, institutional and technical conditions need to be met," particularly in terms of compliance with pertinent laws, adequate technology standards, pollution control, monitoring and training[4]. Damages to the environment from industrial production that need to be reversed to comply with

[4] Basel Publications. Environmentally Sound Management. Available in http://www.basel.int/pub/environsound.pdf

current environmental protection laws came to be known as *externalities*. In general economics, an externality is an impact caused by external factors from a particular business transaction that may generate an additional cost.[5] Hazardous wastes are generally understood in a business equation as an externality that no business wants to pay for, unless such a business is strongly grounded on principles of environmental protection and social responsibility. Some regions have learned to *internalize* the cost of hazardous waste management under a stringent regulatory framework and a political environment committed to abide by international agreements to prevent illegal dumping. To internalize hazardous wastes implies that someone throughout the business transaction needs to pay for polluting, to minimize pollution rates or to eliminate the pollution caused. Some of the tools that have been successfully applied to shift the balance from hazardous waste dumping to hazardous waste management are the development of recycling rates, taxes and the implementation of cleaner technologies and processes to reduce waste volumes. Nonetheless, most of the worlds' regions still struggle to achieve a balance between waste management costs, disposal methodology, regulation and compliance. The problem is that an imbalance diminishes a nation's ability to meet the Basel Convention's criteria for environmentally sound management and its ability to protect both human and other forms of live.

---

[5]Externalities can be positive or negative as they may increase or decrease cost and gain margins. In environmental economics the term is used to refer to pollution (Wikipedia, Caplan 2008).

Lessons from Industrialized Regions

One of the countries that have implemented a hazardous waste management approach with some success is the United States. In this country the EPA and other state regulatory agencies are in charge of ensuring that states adopt and implement Hazardous Waste Programs according to the Resource Conservation and Recovery Act (RCRA), which are intended to protect public health and natural resources[6]. Some states make remarkable efforts. In Massachusetts, a state law known as the Toxics Use Reduction Act (TURA) has been implemented to promote safer and cleaner production and minimize the use of toxic materials and the generation of hazardous wastes in manufacturing processes (University of Massachusetts 2009). In general, the main incentive for adhering to these programs has been to avoid taxes, fines or costs per amount of waste generated (Sigman 1994).[7] Incineration has generally been unpopular in this country due to expected release of harmful emissions, and this has resulted in the proliferation of landfills as a preferred disposal method[8]. Because waste is accumulated rather than reduced or transformed (i.e. energy) as in incineration processes, this tendency has led to an exponential waste growth[9]. Furthermore, previous studies (Daniel 1981, Morrison 1981, Montague 1981, Skinner 1980, and Langerman 1983) have indicated that "landfills can be unsafe repositories for liquid and solid hazardous wastes" due to leakage, even in the most

---

[6] U.S Environmental Protection Agency. *Hazardous Waste Regulations*. Available in http://www.epa.gov/waste/laws-regs/regs-haz.htm

[7] Hillary Sigman (1994). Taxes on Hazardous Waste: the US Experience. Public Finance and Management.

[8] U.S Environmental Protection Agency. Hazardous Waste Treatment and Disposal. Land Disposal. Available in http://www.epa.gov/osw/hazard/tsd/td/disposal.htm

[9] With a 30% increase in hazardous waste generation between 2003 and 2005 it is plausible to estimate that landfills will eventually saturate (EPA 2007)

impermeable soils and especially engineered sites.[10] In lieu of this situation, one may argue that the US government has favored in the past a disposal methodology that is difficult to monitor, threatens the environment, and ultimately increases waste management costs due to the growing need to decontaminate sites to protect the public and recover natural resources. It must also be noted that attempts to locate waste incinerators near minority groups, schools or agricultural land have not been a successful siting approach, which may explain the preference for landfills and why there is such a strong opposition to incinerating facilities in this country. In a recent case, Waste Technologies Incorporated (WTI) built one of the largest hazardous waste incinerating facilities in the US on a flood plain 300 feet away from homes and 1,000 feet away from a 400-student elementary school in East Liverpool, Ohio (Environmental Justice Case Studies 1997). One may argue that a siting approach that places incinerating facilities away from human settlements and near pollution sources (even though land in industrial areas might tend to be more expensive) would have made incineration less controversial in this country.

Other regions, such as Europe and Japan, have put in place strong regulatory frameworks that encourage industries to minimize waste production. Additionally, they have successfully implemented top of the line incineration technology (e.g. temperature control, emissions filtering, waste to energy technology, etc.), in many cases reducing the risk posed by harmful emissions and minimizing the need to decontaminate sites.

---

[10] Paul Langerman (1983). For Hazardous Waste Policy, Washington is The Real Hazard. The Heritage Foundation. Available in http://www.heritage.org/research/energyandenvironment/bg273.cfm

In the case of Japan, there is a Recycling Law and an Ecology-Based Factory Initiative in place commonly known as *Ecofactory*. Under this law, industry sectors in Japan are required to abide to specific recycling rates according to materials and byproduct recyclability assessments. The law is then reinforced by the Ecofactory initiative, which requires industries and businesses to invest on research and development programs to develop next-generation technologies that will help them achieve common environmental goals (National Academy of Engineering 1994:38-39). Still, political commitment in Japan to abide to international agreements has been rather week. In 2000 the Japanese government was forced to ship back to Japan an illegal cargo of tons of hazardous waste exported to the Philippines in clear violation of the Basel Convention.[11] This and other subsequent violations has led to some sanctions to the Japanese government from the Basel Convention and growing reluctance in some Asian countries to ratify free trade agreements with Japan.[12] In the case of Japan, environmental laws are being enforced but hazardous waste trafficking continues, which indicates that the cost-compliance cycle is still critical for this region. Even though important policies were enacted and appropriate disposal methodology was put in place, there is still an imbalance between costs, regulation and compliance that may indirectly increase hazardous waste management costs due to fines and the need to reinvest on international cooperation.

---

[11] Basel Action Network. Basel Non-Compliance Notification Report. Country Violation: Japan. March 12/2007.

[12] Greenpeace (2007). Japan "Twisting Arms" of Asian Neighbors to Take Toxic Waste. Available in http://www.greenpeace.org/seasia/en/press/releases/japan-twisting-arms-of-asian

In the case of the European Union, legislation regarding hazardous waste management is consigned under the Hazardous Waste Directive, which is very similar to the Basel Convention's hazardous waste management guidelines, and as such one of the most comprehensive legislations regarding the matter.[13] Procedures are not yet standardized for all countries (as for many other issues in the European Union due to its relatively recent inception), but some countries have made important investments towards incineration to minimize pollution.

In France, for instance, incineration has become key to waste management since 2003, when the government initiated a modernization process with over 130 incinerating plants to comply with the European Union's environmental standards specified under the Hazardous Waste Directive. Additionally, the government implemented a material and energy recovery program that allowed the re-use of about 80 percent of the bottom ash that results from waste incineration for road construction (produced by hazardous and non-dangerous waste) and the ability to sell electricity and heat recovered from incineration processes to public and private companies.[14]

One of the most noticeable technological advances in incineration technology have been applied in Germany, where hazardous wastes are actually being imported from all over the world to be destroyed in what is reputedly one of the safest and most efficient

---

[13] Europa (2007). Controlled Management of Hazardous Waste. Council Directive 91/689 ECC of 1991. Available in http://europa.eu/scadplus/leg/en/lvb/l21199.htm

[14] Erwan Autret, et al. (2006). Incineration of Municipal and Assimilated Wastes in France:Asesment of Latest Energy and Material Recovery Performances. Available in http://www.sciencedirect.com

incineration facilities available on the planet.[15] Although this is a new "eco-business" trend that has become rather controversial,[16] other countries with fast growing industries, such as China, have chosen to implement Germany's technological advances to address the pressing environmental concern of treating hazardous wastes.

Outside of the European Union, Switzerland, home of the Basel Convention, has 28 incineration facilities that generate enough electricity to power 250,000 homes without creating important environmental impacts (accounting both municipal and hazardous wastes), but in fact reducing its imports of oil products to produce energy.[17] Four of these incinerating facilities are dedicated to treat and dispose all of the non-recyclable hazardous wastes produced within the country's borders.[18] However, it must be noted that hazardous waste incineration in Switzerland is performed in "state of the art" facilities under the most stringent monitoring conditions and using expensive filtering devices to minimize dioxin emissions from incineration combustion (dioxins are the most worrying type of emissions produced by hazardous waste combustion). Additionally, Switzerland has few (if any) mining activities or heavy industry, which would minimize the amount of hazardous wastes to be treated and the contaminants produced through hazardous waste

---

[15] Federal Ministry of the Environment, Germany (2005). Waste Incineration. A Potential danger? Bidding Farewell to Dioxin Spouting. Available in http://www.seas.columbia.edu/earth/wtert/sofos/Waste_Incineration_A_Potential_Danger.pdf

[16] The Environmentalist (2005). Safer Hazardous Waste Disposal? Springer Netherlands.

[17] Swissworld. Incineration. Available in http://www.swissworld.org/en/environment/waste_management/incineration/

[18] Swissworld. Hazardous Waste. Available in http://www.swissworld.org/en/environment/waste_management/hazardous_waste/

combustion. It would be extremely costly to a country like Colombia to catch up with Switzerland, Germany, or France.

A Hazardous Waste Management Approach for Bogotá

One of the economic rationales for this project is that there is a limited offer of facilities for hazardous waste management in Bogotá as opposed to the overwhelming rise of hazardous waste generation. Today Bogotá does not have a single hazardous waste incinerating facility, only inappropriately managed landfills (Ministerio de Medio Ambiente 2005a: 11). Nevertheless, this economic rationale gets hindered by the fact that manufacturing industrial activities in Colombia have been functioning in the absence of fees, taxes and penalties regarding hazardous waste production, management and disposal. If business is kept as usual and such fees and penalties are waived or ignored through lack of enforcement, generators would perceive hazardous waste management as expensive and unnecessary.

The problem of managing hazardous wastes while complying with current international environmental standards and agreements in developing countries like Colombia is constrained by the high costs of hazardous waste management and the lack of a strong regulatory framework that enforces an acceptable level of compliance. This situation causes a downward spiral effect because the less a particular solution is being used because of lack of enforcement, the more expensive it will become.

In addition to the minimum costs related to hazardous waste disposal, environmentally sound hazardous waste management as promoted by the Basel

Convention requires the adaptation of rather sophisticated technological procedures to ensure minimum safety standards of waste transportation, laboratory testing, and final disposal. Taking into consideration these aspects, to design a less costly and environmentally sound solution for Bogotá it is particularly important to find a balance between waste management costs, disposal methodology, regulation and compliance. The working thesis here is that to find such a balance where regulatory frameworks and funds are rather scarce, requires the design of a solution that would a have a positive impact on all affected parties, including waste generators, governmental institutions, taxpayers (who end up paying for cleaning up dangerously contaminated sites and resources), and of course, waste management providers.

The hazardous waste management approach that leads the proposed solution should maximize recycling or reusing opportunities to reduce waste volumes, environmental impacts and disposal costs. The evidence reviewed here indicates that incineration is potentially [19] one of the safest and most environmentally friendly methodologies available today to dispose of non-recyclable hazardous wastes (Basel 2002). As it can minimize environmental and health related threats when compared with other large-scale disposal methodologies, the proposed solution will be based on incineration technology.

A broad review of policy and socioeconomic factors for this project suggests that a private sector HWMS for Bogotá based on incineration and recycling will not succeed

[19] "Potentially" here means that this statement is true as long as the incineration process is being carried out under the most stringent environmental safety standards to minimize pollution emissions.

independently, not even with an unlimited amount of resources and capital. In other words, it would be possible to build an incinerating facility similar to those built in Germany or Switzerland, but if it is not being used, it will not help reduce the threat of growing hazardous waste volumes and it will not be a profitable enterprise. However, if the hazardous waste management methods chosen here (incineration and recycling) are implemented through partnership relationships, then the proposed solution is more likely to support and maximize compliance and help reduce environmental and health related threats from hazardous waste accumulation.

Given a minimum enforcement level (in the presence of fines and penalties for non-compliance of current laws), the partnerships sought for this solution would be based on common goals among stakeholders. Evidently, one such goal is to reduce hazardous waste disposal costs among generators to promote the use of the proposed solution. For this purpose, the solution would offer economic incentives to its partners (generators) to make it easier or cheaper for them to comply with hazardous waste management regulations. This particular partnership (which involves waste management providers, generators and the public sector) would help consolidate the proposed HWMS while increasing enforcement capabilities of pertinent governmental institutions.

The nature of this and other partnership forms will be dependent on the strategies sought to consolidate the HWMS, which will be defined in following chapters. What must be noted at this point is that the purpose of working in partnerships with governmental institutions and hazardous waste generators is to get sufficient support to

achieve an acceptable level of compliance (and thus users) to reduce costs for all parties and to fulfill common environmental protection goals.

In Colombia, a regulatory framework that supports environmentally sound hazardous waste management is finally in place, and as explained in the next chapter, growing legislation demonstrates there is sufficient political will to start implementing it. Given these minimum legal and political conditions, the methodological approaches developed here are focused on the following research question: How would it possible to establish an affordable offer of environmentally sound hazardous waste management for Bogota's industrial generators in order to increase the number of potential users of the proposed solution?

The Strategic Planning Approach

A Strategic Planning approach was used to design a HWMS for Bogotá that balances waste management costs, disposal methodology, regulation and compliance under the criteria of environmentally sound waste management.

Goodstain, Nolan and Pfeiffer (1993) define Strategic Planning as "the process by which the guiding members of an organization envision its future and develop the necessary procedures and operations to achieve that future, [providing] both a direction in which the organization should move and the energy to begin that move" (1993:3). Taking into consideration this concept, two organizational goals are defined here to guide this strategic planning exercise. The first one, is to find a hazardous waste management approach for Bogota that would ensure a high level of compliance to enable the design of

a profitable solution under environmental safety standards. The second one is to use this analysis to support the development of an organizational structure that can lead to the launch of a company dedicated to hazardous waste management.

The strategic planning methodology applied here is intended to provide sufficient foundation for the advancement of expert analysis to support the development of the proposed HWMS (e.g. economic feasibility, vendor-technology selection, facility planning and design, environmental impact analysis, etc.). Moreover, this methodology helped identify a number of factors that would determine the reach of the proposed solution. Further analysis of these factors helped envision the solution's plausible impacts on Bogota's current situation of hazardous waste mismanagement.

The factors that are analyzed here include health, environmental and socioeconomic issues, the policy environment and the legal framework for hazardous waste management, and an exploration of technological requirements for environmentally sound hazardous waste disposal. The results of this analysis will be reported in the following chapter as PESTEL macro-environmental analysis (Political, Economic, Social, Technological, Environmental, and Legal analysis), and further discussion regarding the impact of such factors will be framed as SWOT analysis (acronym used for describing the Strengths, Weaknesses, Opportunities and Threats to the established organizational goals). Additionally, this report explores a site development approach that would help identify issues of concern and how to address them in order to establish a hazardous waste management facility along Bogota's most important industrial corridor.

Methods

The methods and tools that support this application of strategic planning are policy analysis, stakeholder analysis, land use planning and evaluation and development anthropology.

Policy Analysis

According to Colebatch (1998), articulating policy in organizations has to do with looking sideways (who are the relevant others and what are they doing?) as well as with looking forward (where do we want to go?) (1998: 6) For a project that deals with hazardous waste disposal, looking sideways in terms of policy means looking at other people's interests, such as environmental protection, neighborhood revitalization, health betterment, profitability and job opportunities. Additionally, it means complying with legally binding procedures that are intended to protect others. As for looking forward, it means defining goals and assessing alternative courses of action to achieve them. Here it will be argued that looking forward, that is, defining goals and alternatives, does not make much sense if it is not articulated with an understanding of what others want and how it can be achieved. The policy analysis proposed here explores ways of relating genuine social and environmental concerns and the legal framework that addresses those concerns with specific organizational goals. The strategies sought here from the strategic planning methodological analysis are expected to formulate routes to connect organizational goals with community goals from a policy perspective.

It must be noted though, that such a strategic planning approach is cumulative, not just an outcome of expert analysis; it rather is a continuing evaluation process of plausible alternatives. Colebatch noted that while *"*organizations have goals, it is not always clear in practice what they are, how they have been chosen or [which] organizational activity is best explained as an attempt to achieve these goals…policy inquiry appears to be about interaction and negotiation rather than about scientific detachment" (1998: 83). To avoid such "detachment", strategies sought for the development of this project should be consistent with the alternative evaluation criteria.

Stakeholder Analysis and Community Engagement

Implementation of most strategies developed for the HWMS are dependent on community engagement. *Community* here refers to governmental organizations, private businesses, the industrial sector that generates hazardous wastes, neighboring communities to hazardous waste management facilities, and any other community of interest. On the other hand, *engagement* refers to a collaborative level or degree of community participation that supports the development of the proposed solution. In a collaborative relationship *"*the responsibility, authority and decision making are shared more evenly than on other forms of participation. There is often an agreement between the parties to share risks [e.g. hazardous waste management costs] and benefits [e.g. environmental protection]" (Ministry of Social Development, New Zealand 2009).

Typically, project developers choose beforehand a level of participation according to particular needs. These may be to inform communities about a specific project or

activity (to provide them with information about problems and solutions), to consult them (to obtain their feedback), to involve them (to ensure their concerns and aspirations are considered and influence decisions), to make them collaborators of that process (working together to formulate solutions), or to empower them (when decisions rely on the public or under community responsibility) (IAP 2004). If implemented, the HWMS discussed here will become an infrastructure project that would require of a collaborative level of participation to support engagement strategies that would ensure the success of the proposed solution. Stakeholder analysis can be used as a tool to plan community participation strategies aimed at achieving such specific objectives (Renard 2004).

Why Collaboration?

Community participation along infrastructure projects in Colombia has been largely focused on consulting with groups and individuals that may be affected by such projects, but leaving all fundamental decision making to the developers themselves. This approach has proven to be unsuccessful because it usually fails to address people's most pressing concerns and because the process is not viewed as a fundamental project component but rather as an expense incurred to comply with current regulations (Colombian Congress 1993, 1994 and 2000. International Water and Sanitation Centre-IRC 2004).[20]

[20] Congreso de la República de Colombia: (1) Law 99 of 1993 about forms and procedures of citizen participation, which gives citizens the right to intervene in environmental administrative procedures. (2) Law 13 of 1994, about citizen participation mechanisms. (3) Law 563 of 2000, which defines community oversight and citizen representation mechanisms.

Insufficient or poorly done community participation results in lack of support from communities of interest and strong criticism from scholars, governmental and non-governmental institutions and even development agencies (World Bank 2001). In some cases this situation leads to project failure. One example in Colombia is the hydroelectric project developed by URRA S.A in 1994, a mixed organization funded with private and public investments that built one of the most controversial engineering projects in the country's history because of widely known objections form affected communities living around the projected area. URRA S.A blames its poor performance to the millions of dollars it was forced to pay to compensate these communities after a constitutional court ruling, but independent researchers (Molano 2008a and 2008b, Correa 1999) and governmental organizations (CONPES 2008)[21] agree that the company's failure resides in its refusal "to allow the affected communities to participate in the decision making about the construction of the dam" (Correa 1999).

According to the International Water and Sanitation Centre (IRC), the situation of URRA is typical of Colombia's water and sanitation sector (which comprehends infrastructure constructions such as sewers, landfills, aqueducts etc.). To the IRC this approach to community participation "did not produce the expected results: a sense of ownership and responsibility by the communities. The lack or minimal participation of the users in the planning, design, construction and management of the systems is considered the main reason for this failure" (IRC 2004).

---

[21] Consejo Nacional de Política Económica y Social, CONPES. Document 3519

Lessons from the past have led to more comprehensive approaches of community participation where stakeholders are engaged from a project's design through its completion and cyclic monitoring and evaluation activities (Fraser 2005). This approach to participation has been successfully applied in Colombia to urban planning issues, such as in The Municipal Development Plan for the Islands of Providencia and Santa Catalina, where a collaborative community participation approach successfully led to the banning of big development projects in the islands. Islanders perceived such projects as a threat to their economic security and cultural integrity, favoring instead a more sustainable and locally based ecotourism industry (Mow 2005). This approach will be of special interest to the HWMS because of the urban planning methodology explored in this chapter for the development of the proposed solution.

Even development agencies long criticized in the past by their aid approaches, such as USAID (Hornberger 2003, Andean Information Network 2008), now report that "encouraging [project] beneficiaries to identify their most pressing needs and take an active role in the selection, design and construction processes [enabled the successful implementation of] 200 social infrastructure projects in Colombia" (USAID 2006).

Taking into consideration previous experiences of community participation around local sanitation infrastructure and urban planning projects in Colombia, it will be argued that the community engagement component for this project should not be based solely on policy requirements, but rather on a principle of inclusion that would lead to a less costly and more sustainable solution. This is a process that requires competent

stakeholder analysis to identify affected communities, assess issues of concern and plan engagement strategies that can lead to solutions.

Most importantly, the level of community participation sought for this project should be directly related to the strategic planning goals established for the HWMS, which are to reduce waste management costs and to increase the potential number of users of the proposed solution through partnership efforts. This particular collaborative level of engagement has the purpose of supporting the strategic planning approach proposed for the HWMS, which is based on the coordination of a number of services. It must be noted though that different partnerships with a diversity of purposes are expected to take place, such as for information sharing, service delivery and capacity building. To develop different sorts of partnerships with different purposes implies that a partnership focus (such as health and environmental issues), governance (they could be governed by legal entities or contractual agreements), range of participants (stakeholders), timeframes (short or long term partnerships) and funding agreements (e.g. subsidies or discounts) will also vary. Framed differently, different levels of engagement may take place according to different stakeholders' interests.

The purpose of using stakeholder analysis methodologies is to support the planning of community engagement strategies that would allow interested or affected parties by the HWMS to become partners of the solution itself. As partners, stakeholders are not only expected to express concerns and to participate on decision making processes, but also to collaborate with the HWMS to design solutions for common

problems and help customize services that could be provided to reduce costs and better serve potential customer needs.

The following preliminary stakeholder identification and analysis techniques were applied to enable the development of strategies that would engage stakeholders as partners. Later, these strategies will be the focused on the development of services that the solution could provide to partner with potential customers (see chapter 3).

Identifying Stakeholder Groups and Individuals

This method consists of listing plausible stakeholders (or communities of interest) along with a description of how they may influence the HWMS, what the proposed solution may need from them and what can be done quickly to satisfy them (Bryson 2004). This methodology would be supportive of other forms of inquiry that may be needed later to develop community engagement strategies, such as participatory research.

Participatory research is a process where "experts" and "communities" identify a problem and work together to take corrective actions to improve processes or find solutions (Wadsworth 1998, Wallerstein, and Duran 2003). This type of research, most commonly known as Participatory Action Research (PAR) or Community-Based Participatory Research (CBPR), may be of particular interest for the development of the HWMS as it may help elicit issues of concern according to stakeholders' own perspectives. Because the nature of this type of research incorporates ongoing evaluation of activities, participatory research may help as well to test new ideas and solutions.

Some authors criticize the applicability of participatory research as a planning methodology because its process may be politically motivated from a powerful stance configuring relationships that are hardly equal (Chambers 1994, Escobar 1995, Mansuri 2004). However, critics and proponents tend to assume that stakeholder groups that may be affected by a project would invariably be represented by less powerful or influential groups, perhaps because these are the environments where participatory research approaches actually developed (Fals Borda 1986). Using stakeholder analysis techniques would help identify who those groups actually represent and where do they stand from a power or influential perspective.

Typically, participatory approaches use "methods to structure group processes in which non-experts play an active role and articulate their knowledge, values and preferences for different goals" (Van Asselt and Rijkens-Klomp 2002:169). The type of community participation sought here slightly differs from this statement as it introduces rather expert involvement of highly powerful and influential stakeholders (e.g. high government officials and industrial groups along with their pool of experts) with the purpose of supporting partnerships that are strategic to the development of the solution itself. This does not mean that less powerful or influential players will not be accounted for and that their knowledge and partnerships would lack importance. Less influential and powerful stakeholders not only refer to the lay public, but also to a pool of experts such as chemical engineers and environmental scientists with high concerns but little influence or power. Equally, highly influential and powerful stakeholders may actually be

unknowledgeable about hazardous waste incineration and its potential benefits and risks. Both powerless and powerful experts and non-experts are crucial to the development of the engagement component and the building of partnerships. The purpose of introducing the concept of participatory research here is to deepen the understanding of how stakeholder analysis methodologies can be adapted to further stages of research to help identify and involve a wide range of stakeholders in order to build a variety of partnerships aimed at achieving very specific goals.

Determining stakeholder interest and influence levels

This method consists of refining the stakeholder identification process to recognize stakeholders' interests and their ability to affect certain issues. For this purpose, Eden and Ackerman (1998) developed the "Power versus Interest Grid", which is a two-dimensional matrix (power vs. interest) where one could place stakeholders according their level of interest and their power stance regarding specific issues.

A close examination of a power versus interest grid should provide enough information about stakeholders in order to plan community engagement strategies. Through this process it would be possible to identify who are the most influential stakeholders and how they may influence one another (Bryson 2004).

Stakeholders' issues of interest that would be addressed through community engagement may range from increasing monitoring emissions capabilities, designing alternative strategies to reduce waste management costs or minimizing potential health threats from hazardous waste combustion. The purpose of using this tool is not just to

anticipate the issues that may rise, but to identify which different stakeholder groups are more likely to advocate for specific goals to enable the design of solutions.

Identifying stakeholders and understanding their environmental, social, health, economic, political or any other concern is crucial to the development of a community engagement strategy that leads to the establishment of partnerships. If stakeholders are not fully identified and their concerns addressed, it may limit the ability of the HWMS to succeed.

Principles for Developing Engagement Strategies

So far it has been established that identifying stakeholders is crucial to plan participatory strategies that would lead to the proposed collaborative level of community engagement. Since the main goal of community engagement is to build partnerships with the purpose of achieving specific economic, social and environmental goals, it is important to find common grounds among stakeholders to enable such level of collaboration.

It would be hard to speculate at this point what issues or goals may constitute common grounds because issues vary among stakeholders and they constantly change with their interests (it could be argued that environmental protection is a common goal, but it may not be in the top list of some stakeholders' interests).

Instead, engagement strategies that intend to involve hazardous waste generators, waste management providers and all other communities of interest could be guided by a principle of social responsibility that commits parties to work towards positive change or

actions. If partnerships among stakeholders are invariably related to efforts aimed at generating positive impacts, the HWMS can be perceived as a public service. The idea of public service developed here refers to a range of services the HWMS will directly or indirectly provide to communities of interest and the general public (which differs to the typical use of the term which refers to the services provided by a government to its citizens). Here it will be argued that from a public service perspective, common grounds could be easily found.

Choosing social responsibility as a guiding principle not only makes sense because the proposed solution defines itself an environmentally concerned enterprise that intends to protect human and natural resources, but also because it can help pave the road to the development of a HWMS that can actually be understood as an enterprise that generates public value. When the HWMS is perceived as a valuable public service it increases the likelihood that community engagement strategies will be sustainable when stakeholders' faces change and issues evolve.

The idea of social responsibility discussed here has been developed around ethical theories of human behavior, specifically related to business or corporate ethical behavior (Visser et al. 2008). According to Kotler and Lee, corporate social responsibility can be defined as *"*a commitment to improve community well being through discretionary business practices and contributions of corporate resources" (2005: 3). Some authors criticize the pursue of stakeholder satisfaction for mere economic reasons as opposed to making efforts to "do good" and prevent wrongdoing (Donaldson and Preston 1995,

Harrison and Freeman 1999). Other authors even argue that the term has become a token with empty meaning when used in "disingenuous ways" without concrete objectives and oversight (Cheney, Roper and May 2007). To these authors, "unchecked corporate power is problematic" and counter producing to the development of socially responsible actions (2007:3).

Corporate or business social responsibility has two main streams of opposition. From one side, critics fear that corporate discretionary actions or resources delivered to the public will not bring economic returns. From another side, critics argue that corporate discretionary actions and resources aimed at doing "good" generally lack social efficacy (Visser et.al 2008). To address both streams of criticism, Valor (2007) developed a theoretical model that relies on community involvement and project accountability. To the author, "ongoing dialogue with stakeholders and continuous monitoring and reporting of economic and social impacts of implemented projects" is key to ensure the efficacy of socially responsible actions and programs (Valor 2007: 280).

The proposed community engagement component is supported by this type of theoretical approach that grounds collaborative efforts to socially responsible activities that are outcome oriented and depend on monitoring and oversight. In accordance to this, the solution proposed here should enhance and maximize opportunities for managing hazardous wastes responsibly to minimize current danger posed to society by hazardous waste increasing production and accumulation in a way that it can introduce positive change and generate public value.

Managing hazardous wastes has a tremendous public value, but such value is usually hindered by further social and environmental concerns related to risk perception and the negative connotation of "burning" hazardous residues, an unfortunate but real inheritance of improperly done hazardous waste incineration and inefficient incineration technologies applied in the past (Tangri, 2003).

According to Bryson *"*strategic management processes that employ a reasonable number of competently done stakeholder analyses are more likely to be successful- that is, meet mandates, fulfill missions and create public value- than those that do not" (2004: 26). For the proposed HWMS, public value could be built through the engagement of a wide spectrum of communities of interest as collaborators of the proposed solution. This approach may be more efficient and solid in the long term if compared with a social marketing approach focused solely on making sure people understand the good being done. Nevertheless, community-based social marketing may help create public awareness about the importance of environmentally sound hazardous waste management, which in turn could facilitate engagement strategies (McKenzie and Smith 1999). The Community engagement component proposed for this project is not just aimed at facilitating service design, but also at ensuring that stakeholders' concerns are being successfully addressed.

Building community engagement is a cumulative process. It begins before the project is conceived and it continues throughout the organizational cycles. Overall, stakeholder analysis would help understand the range of parties that may impact the

proposed solution, which will shape the partnerships sought and the services the solution may provide.

Additionally, this methodology informed the present research about legal, technical and environmental issues that may be represented by different stakeholder groups, which supported further analysis about plausible strengths, weaknesses opportunities and threats to the HWMS.

Land use planning

The range of issues that may arise from siting a hazardous waste management facility should be addressed both from a policy and an urban planning perspective. This is particularly important because these issues may include aspects of environmental justice and other health and socioeconomic impacts, such as decreased home values and increased health risk from the proximity to such a facility. Although most experts now agree that proximity[22] to a properly operated and efficient hazardous waste incinerator poses no major health threat (especially when compared with other more socially acceptable sources of pollution, Bergquist and Marsh 1998), some psychologists point out that risk perception from living near an incinerator can adversely affect mental health and thus cause physical detriment (Lima 2004, Roberts et.al 1998). These issues need to be addressed and mitigated through project planning and development. Implementation

[22] Air dispersion models and local meteorological data are usually used to determine how far the incinerating facility should be to avoid air pollution dispersion on population centers, major environmental features (creeks, rivers etc.) or major food resources (Rogers and Willis 1992).

of urban planning methodologies based on community engagement can help identify and mitigate some of these impacts.

The ability of the HWMS to engage neighboring communities will largely depend on the community's perception of health and environmental risk. Ballard and Kuhn (1998) examined an open approach for siting hazardous waste incineration facilities centered on community engagement to address aspects of risk perception. To the authors, focusing "primarily, but not exclusively, on social and political aspects rather than on technical and engineering aspects" (1998:3) will help engage communities and facilitate the siting process. On the other hand, Ringquist (2003) explored common causes of environmental inequity in the disproportionate distribution of polluting facilities. He criticized the fact that engineering and economic arguments tend to be the only ones invoked in choosing the location of these facilities, which are typically established near minority or depressed neighborhoods.

From an engineering, economic and environmental protection perspective, hazardous waste incinerators should be placed near pollution sources to avoid extra costs and higher environmental risks related to transporting these types of wastes (DeMott 1998). In fact, previous risk assessments have determined that the highest risks of managing hazardous wastes are related to transportation incidents (Asante-Duah 1993). If a truck containing hazardous wastes has an accident and waste containers are damaged, the probability of public exposure increases. Similarly, the range of the damage will increase with higher population densities or major environmental features along

transportation corridors. Due to the poor state of some roads and highways in Colombia (not to mention the national security situation in rural areas where paramilitary and guerrilla groups operate), transporting hazardous wastes by land beyond Bogota's surrounding region would increase these risks exponentially. Similarly, transporting hazardous wastes throughout a densely populated city like Bogota with more than 6.7 million inhabitants (DANE 2007) could be just as risky.

For a hazardous waste incinerator to be placed in Bogotá, political, economic, and environmental factors are determinant because there are limited areas available for activities related to hazardous waste management and disposal. A hazardous waste incinerator could not be placed on or near Bogotá's surrounding valley, which includes agricultural and preservation areas and its neighboring urban-rural communities. This valley, known as the Savannah, is considered to be one of the most fertile in the country. It is comprised by a system of natural lagoons and wetlands that function as water regulators that "absorb" water from the Bogotá River and other streams, providing flood control, water filtration, food security and biodiversity protection to Bogotá and its surroundings. This not only implies that the land in this location would be more expensive than in other areas, but also that there is a strong regulatory framework that prevents industries to develop here unless they are related to low impact activities and controlled agricultural production (Ministerio de Medio Ambiente 2007).

Because Bogotá's Savannah became such a protected and expensive land, most heavy industry developed in what is known today as the Bogotá-Soacha Industrial

Corridor. Soacha is a city and a municipality connected to Bogotá through this southern industrial corridor, which is surrounded by working class neighborhoods. Another reason why heavy industries developed in this area is that historically this was a mining district and one of the most dryer lands[23] in the region, making it less suitable for agriculture and more suitable for mining (i.e. extraction of construction materials) and industrial production (Viana and Gonzalez 2003).

The characteristics of the Bogotá-Soacha industrial corridor make a siting approach difficult. From one side, there are technical, economic and environmental considerations that indicate that a Hazardous waste Management Facility (HWMF) should be located next to the source of pollution. But on the other side, this siting approach equally considers environmental justice and human health protection criteria to avoid proximity to human settlements and major natural resources. Ideally, all of these conditions should be met, but given the surrounding Savannah (with no land available for this type of development) and the geographic challenges of this Andean region (that makes transportation of wastes risky and difficult), the HWMF is likely to be developed at the end of the industrial corridor on Soacha's outer border, which is the least densely populated area at the source of pollution. It must be noted though that proximity to human settlements is still variable. There is an old mining district at this geographic

[23] The soil in Soacha is comparatively dryer than in the rest of the surrounding Savannah. Although it rains less in Soacha than in other parts of the Bogota greater region, the municipality is still located between two main river basins (Soacha and Bogota) at an elevation of 2,566 meters over the sea level in the Andean region, which means it still rains a lot. Soacha is located in a medium-high precipitation area compared to the different types of geographic areas in the world (Plan de Ordenamiento Territorial-POT-, Alcaldia de Soacha 2001)

location where old quarries used to operate at a distance of three to five miles from the nearest homes (google earth 2009). Because safe proximity depends on distance and on emission dispersion patterns according to specific meteorological conditions in the area, this location will be analyzed later as a plausible development area.

Given the particular conditions anticipated for siting a HWMF in Bogotá, it is important to design strategies that minimize exposure to health and environmental risks. Furthermore these strategies should help identify and mitigate broader pressing community concerns. Here it will be argued that the core of some mitigation strategies should rely on urban planning tools that are potentially effective in addressing particular socioeconomic and environmental concerns such as neighborhood decay, home price values and environmental risk perception than typical economic incentives such as increased job offer to neighboring communities, which affects positively only a few residents. Additionally, these strategies would be connected to the services the HWMS could directly or indirectly provide to neighboring communities, such as flood control and urban renewal.

Using urban planning tools to address environmental and socioeconomic impacts and risk perception

After hazardous waste dumping and air pollution, stormwater runoff and flooding are perhaps the most pressing environmental concerns for the Bogotá-Soacha Industrial corridor because it is located in a medium-high precipitation area with poor sewage capacity due to abnormal and illegal settlement patterns (Cámara de Comercio de Bogotá

2005:25-27). Although no specific data of water runoff composition was found for this particular area, one could estimate that it contains more pollutants and chemicals than other residential areas. These pollutants are washed off when it rains and are carried out to the combined sewage system to be treated and released again in the Bogotá River. This is of special concern because some illegal settlements that are not connected to the local utility company use the Bogotá River water for human uses before the water is properly treated. Combined sewer overflow is also an issue during the raining seasons (March-April-May and September-October-November), when in average rains 105 millimeters 18 to 20 days per month and channels are blocked creating floods and unusual traffic congestion (IDEAM 2009).

One of the urban planning tools that are expected to help minimize this environmental concern is the use of *Green Infrastructure.* In urban planning and architecture, green infrastructure is the term used to describe low-impact development practices that mimic natural absorption and filtering mechanisms for stormwater management. These mechanisms can be supported through the replacement of cement constructions and impermeable surfaces (roofs, sidewalks, street, highway and parking pavements) for porous surfaces that can naturally store and filter stormwater (green roofs, permeable pavements, and vegetated swales[24]). Stormwater runoff is a concern because it adds chemicals and pollutants into combined sewer systems that need to be treated,

[24] "A vegetated swale is a broad shallow channel with a dense stand of vegetation covering the side slopes and bottom. They are designed to trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff" (EPA 1999)

increasing the costs of water treatment and the possibility of leakage of hazardous components in potable water. Green infrastructure mechanisms are more efficient and less costly to build and maintain than typical water treatment infrastructure because they can "reduce, capture and treat stormwater runoff at its source before it can reach the sewer system" (US EPA 2009). Furthermore, maintenance costs for this type of low impact development are usually related to irrigation of green infrastructure systems (to keep vegetation alive and working for filtering and water retention purposes), but since there is plenty of rain in this area, irrigation would not be a problem unless there is a strong draught caused by a natural phenomenon.

Green infrastructure mechanisms and designs applied to the construction of a HWMF would help mitigate construction and some operational environmental impacts (at the very least it would help prevent flooding in the surrounding area and would make the facility look less invasive to the local environment). Additionally, green infrastructure could provide natural air filtration mechanisms to help absorb common air pollution. It could be easily maintained, and such maintenance and monitoring performance could be oversight by concerned stakeholders, such as resident neighbors. It should be noted though, that the decision to implement green infrastructure strategies should be shared with stakeholders, who might be skeptical about the efficiency and benefits of this methodology.

Combined with green infrastructure design, urban renewal strategies could be implemented as well on the neighboring landscape and nearest neighborhood to the

HWMF to mitigate loss of home price values and mitigate or reverse an area's physical decline and create open space for community enjoyment. Urban renewal has been rather controversial in the United States and other regions of the world because it usually refers to the renovation of architectural design and the reorganization of urban space to address urban decay and crime issues, which has often led to gentrification (Uzun 2003, Hampson 2005). However, the urban renewal approach taken here is based on green infrastructure design, which includes infilling (that is, building vegetated sidewalks, porous roads and vegetated parks that could absorb and filter rainwater), planting trees, and creating enjoyable open space beyond the buffer area to the proposed facility. Helping communities implement low cost urban renewal strategies related to green infrastructure design with the help of other partners that may be interested to support local communities could help achieve this target. There are NGOs and governmental environmental organizations already involved in urban planning projects, some of them aimed at improving and strengthening community participation strategies in Soacha (Camara de Comercio de Bogotá 2005:63-65).

In Colombia, urban renewal or revitalization plans are institutionalized from an urban planning perspective but they are not common practice and they have no fix fiscal budget (Colombian Congress, Law 388 of 1997). When performed, they are rather ad-hoc projects that are part of bigger city planning objectives (Alcaldia Mayor de Bogota, Empresa de Renovacion Urbana- ERU 2009). As they are so scarce, common problems related to urban decay are rarely discussed in a public forum with long-range access such

as in city council meetings in the US. Nonetheless, community engagement is mandatory for urban planning projects or major infrastructure works that may affect a neighborhood appearance or safety,[25] but as some authors have pointed, the range of engagement depends on the discretion of the local urban planning authority in charge of verifying the permitting process and issuing the building permits, as well as on the "power" of communities to identify plausible problems and sue projects to protect their rights (The World Bank 2008). Participation processes are therefore viewed more as a strategy to be done "quietly" to avoid project opposition. However, well-done community engagement strategies have proven to be efficient to solve environmental issues and make important decisions regarding urban planning projects. Good stakeholder engagement techniques can help communities identify with an urban planning project, not only preventing opposition, but also improving the process itself through idea creation.[26]

The engagement component previously analyzed can be fully developed through the application of urban planning techniques such as the ones explored here. This effort would allow the interested public to have access to decision making processes. Neighboring communities to the proposed HWMF would be able to partner with the solution by participating on green infrastructure development projects.

Although this solution intends to implement an important buffer area to minimize risk, neighborhoods on the proximity should be engaged. This process will help gain

---

[25] Congreso de la República de Colombia. Law 388 of 1997. Articles 23, 24 and 25.

[26] International Association For Public Participation (IAP2) (2008). Case Studies. State of The Practice Report. Available in http://www.iap2.org/

acceptance of the HWMS through siting as well as strengthen the relationship with governmental institutions by supporting current zoning through a green infrastructure urban renewal plan. This plan would develop at the very least a natural open space border to the proposed HWMF that would prevent flooding and the expansion of illegal settlements on unsuitable areas for human habitation such as in this old quarry location.

Evaluation and development anthropology

The HWMS proposed here is based on the development of a number of strategies that are goal oriented in two directions. In one direction, these strategies should help meet organizational goals, while in the other they should also meet community concerns, especially those related to hazardous waste management costs and risk perception. Project and program evaluation would be at the core of the proposed solution to identify concerns and objectives, define courses of action, identify alternatives and enable implementation of changes for the different strategies developed here so they can help meet both organizational and community goals.

Because the HWMS is in many ways a development project (it is expected to improve the lives of people by reducing the risk posed by hazardous waste dumping), an anthropological perspective of development would provide a detailed analysis of the characteristics of the stakeholders involved and the social significance of their stance towards particular issues, such as waste management costs, increased or decreased income (whether you are a new worker to the proposed solution or a generator that has to comply) and risk perception. For the proposed solution, having detailed qualitative

information about stakeholders would put into perspective the main macro-economic or environmental factors that would be part of the equation during project planning and development, such as economic aggregate measures (e.g. per ton waste disposal costs) engineering aspects (e.g. incinerating technology efficiency) and sociopolitical considerations (e.g. regulation impacts and environmental risk perception).

This anthropological perspective of development would provide the proposed solution with an interpretation of impressions and experiences of stakeholders to inform the strategic planning approach developed here. According to Mosse (2005), an understanding of stakeholders should be accompanied by an understanding of their cultural significance, which in this case, may be embedded on age, gender, income or political or environmentally driven concerns. Stakeholders' interests would be viewed here in this larger context and understood as a product of their interactions.

Furthermore, an understanding of these interactions would help develop an evaluation criteria for project planning and development that would relate main macro-environmental factors (political, economic etc.) with stakeholders' interests and concerns to identify a plausible range of threats and opportunities to the HWMS. The purpose of this type of evaluative analysis is to, once identified, take advantage of opportunities to strengthen the proposed solution. In the same way, threats could be "solved" through the development of strategic services. This means that evaluation criteria for strategies, solutions and services would be based on whether or not they effectively address or solve

stakeholders' interests and concerns while they support the development of the proposed solution.

Having an anthropological perspective of development implies that one must look at larger policies and social changes to facilitate the understanding of communities and how to approach them. Understanding communities of interest and the environment and interactions that shape them will help improve methodological field research tools that may be required later, especially those concerned with monitoring and evaluation of health and environmental quality.

It must be noted though that some of the strategies sought here may not alleviate some perceived impacts. According to Little (2005), there is enough evidence that indicates that investment and development benefits alone do not solve larger social inequities. Understanding those inequities may help approach social concerns, but, as Squires argues, "one must take the influence of ideal cultural values on perceived wants and desires compared to the actual or real needs of the work setting" (2005: 83). To be able to focus on actual needs related to the project's impacts, it would be necessary to put in place some sort of social impact assessment, analysis and monitoring program. This implies that such program must be accompanied by a participatory approach so as to "interpret" changes on both human and natural environments (Branch and Ross 2000). Monitoring is a major component of project development, and in many ways is an evaluation tool to assess procedures and outcomes. Further analysis of major project

components is intended to be consistent with the alternative evaluation criteria so strategies would be constantly adjusted to meet objectives and goals.

Business Tools: PESTEL and SWOT analysis

Since the project is ultimately supporting a business proposal, the minimum equivalent of business analysis and reporting techniques was required. The configuration of the analysis results into a PESTEL model and the use of SWOT analysis to develop strategies correspond with the project's intended audience.

A review of business strategic planning methodologies and web-based business services with broader applications of strategic planning techniques provided a comparative framework of analysis.

In terms of specific strategic planning methodologies, Aguilar (1967) analyzed the way external factors affect managerial decisions and determine the future direction of a company. Through interviews and the review of some case studies, the author developed a theoretical framework of what he called information "scanning" according to a classification of the type of information sought for specific purposes. Aguilar was one of the first authors that understood the impact of information systems to design businesses and define their course of action. He was a pioneer in understanding the business environment through what he called ETPS (Economic, Technical, Political and Social analysis). Other authors developed similar environmental analysis with different components, which would modify the correspondent acronym (PEST, PESTLE, STEEP, etc.). Fahey and Narayanan (1986) evaluated different taxonomies of PEST analysis

(Political, Environmental, Social and Technical) when additional factors, such as the natural environment, might be applicable to a variety of business scenarios. PESTEL, the particular taxonomy used here (Political, Economic, Social, Technological, Environmental and Legal analysis), has been fully developed by Gillespie (2007) who explores the applicability of this type of macro-environmental analysis in different scenarios.

Other authors have developed specific emphasis of macro-environmental analysis. Allison and Kaye (2005) examined strategic planning issues pertinent to non-profit organizations that are applicable to some of the issues analyzed for this project, such as addressing stakeholder anxieties and developing client-oriented strategies. On the other hand, Bradford and Duncan (2000) offered a strategic planning approach based on the analysis of external factors such as markets, competition, technology and regulations. Overall, these authors and resources provide a better understanding of the possibilities and limitations of strategic planning in diverse business scenarios.

While the PESTEL analysis provides an understanding of an organization's role in relation to its external environment, further analysis is needed to translate how those external factors will impact that organization's future path. According to JISC InfoNet, a web-based business development center fostered by Nurthumbria University in the UK, "A traditional SWOT analysis would take the context of the PESTLE and analyze how these factors may emerge/impact" an organization. In addition, some authors argue that both PEST and SWOT analyses are fundamental tools to be able to formulate business

strategies. Channon (2005) includes both types of analyses in an encyclopedic article that describes 10 steps of the strategic decision-making process. Houben et al (1999) argue that a good SWOT analysis can provide information about the complexities within an organization and the environment in which it operates. To these authors, knowing this information is essential to perform long-term planning: "As a first step in the development of a strategic planning system, business managers should therefore commence with the identification and evaluation of these strategic [external and internal] factors which assist or hinder the company in reaching its full potential" (Houben et al 1999: 125).

In spite of the popularity of SWOT, other authors question the relevance and applicability of this type of analysis. Hill and Westbrook (1997) reviewed 50 companies and evaluated their use of SWOT and other strategic planning techniques. The authors found that companies that applied SWOT tended not to prioritize internal/external factors but rather generated descriptions that were never verified or acted upon. The authors found that in most cases results of SWOT were costly and irrelevant: "The most worrying general characteristic was that no one subsequently used the outputs [of SWOT] within the later stages of the strategy process. The continued use of the SWOT analysis, therefore, needs to be questioned" (Hill and Westbrook 1997: 46). Similarly, Armstrong (1982) evaluated the value of formal planning for strategic decision-making by analyzing information from a sample of companies. He found that objective setting, monitoring and stakeholder involvement are particularly useful, but questioned other formal planning

approaches. In terms of SWOT analysis, the author later criticized the popularity of the technique "because it mixes idea generation with evaluation [thus likely reducing] the range of strategies that are considered" (Armstrong 2004: 1). In later articles the author reaffirms conclusions drawn from his previous work, which advocates for a process centered on setting objectives, generating and evaluating strategies, monitoring results and gaining stakeholder involvement.

It must be noted that most criticism reviewed here regarding the usefulness and value of SWOT analysis is related to the marketing field. Other authors have successfully used SWOT analyses in a variety of applications. Arsian et al (2007) used SWOT analysis to evaluate the safety of activities related to the carriage of liquid chemicals. Once safety issues were identified, the authors used an analytic hierarchy process to measure the importance of each factor quantitatively, so *"*the SWOT approach can provide a quantitative measure of the importance of each factor in decision making" (Arsian et al 2007:903). From another field, Halla (2006) used SWOT analysis to evaluate the urban management approach for the planning process of Dar es Salaam City in Tanzania. The SWOT methodology chosen allowed the author to compare the urban management approach to earlier urban design approaches, such as the master-planning paradigm. Kulshreshtha et.al (2004) used stakeholder-based SWOT analysis to do a community participation study for a municipal public solid waste management project in Lucknow, India. In this case the authors successfully implemented SWOT to

formulate strategic action plans to coordinate a collaborative effort between the community and the new waste management supplier.

The series of professional settings that have successfully use the strategic planning tools discussed here, especially those in the area of waste management, provide a broader understanding of the methodological possibilities for the development of this project. The different perspectives offered by these authors, in terms of applicability scenarios, criticisms, and the development of structural models, will help construct a particular business analysis model that can both organize the information gathered as well as identify the project's goals to generate strategic ideas for long-term planning.

SWOT structures are widely used in diverse professional settings. For the fields that concern this project, SWOT analysis has been applied to the waste management and chemical engineering field to determine risk, as well as in the planning field to determine design opportunities and consequences. From a business perspective, the combination of SWOT and PESTEL analyses are arguably fundamental strategic tools to determine an organization's course of action. Since these techniques represent a common language for the parties that may be involved in the development of this project, the results of the current analysis will be framed and developed under these models of business strategic planning.

CHAPTER 2

A Hazardous Waste Management Solution For Bogotá
The Contextual Environment

To define the strategy for a hazardous waste management solution for Bogotá (HWMS) it is important to analyze the main macro-environmental factors that would have an impact on such a project. This analysis would help identify potential risks that may undermine planning, development, or operability aspects for the proposed solution, such as dealing with potentially weak enforcement authorities or encountering opposition to project development. Similarly, an analysis of macro-environmental factors will help identify advantageous situations that could be seized to support the development of a HWMS for Bogota, such as the current strengthening of hazardous waste policies (Ministerio de Medio Ambiente 2005a).

Factors analyzed here are consistent with a business strategic analysis model known as PESTEL (Gillespie 2007), which refers to Political, Economic, Social, Technical, Environmental and Legal aspects related to environmentally sound hazardous waste management. The purpose of using PESTEL to frame this analysis is to enable the development of a strategic planning approach that is focused on keeping an organization competitive and profitable (Cowly and Domb 1997). Classifying issues that typically affect businesses, such as taxes, interest rates, and legislation, into established macro-

environmental categories would help focus the current analysis on the definition of a business competitive position[27] based on organizational goals.

The PESTEL analysis helps identify the strengths and weaknesses of a business activity. These can be analyzed later to develop strategies that support organizational goals and protect an organization from potential threats that may limit its profitability or efficiency. This process, also known as SWOT analysis (Gillespie 2007), will be explored later in this chapter.

Macro-Environmental Analysis for Environmentally Sound Management of Hazardous Wastes

Issues identified through the PESTEL analysis are here juxtaposed with principles of environmental justice and protection. The purpose of emphasizing these principles is to ensure adherence to environmentally sound waste management practices and avoid a siting approach where poor and minority populations are unequally exposed to hazardous wastes, toxic releases and related hazards (Tiefenbacher 1999, Saad 1999, Ringquist 2003).

Environmentally sound hazardous waste management relies in great part on technological advances. Regardless of the actual distance to human settlements, a hazardous waste management facility should be able to manage wastes safely to avoid an exchange of environmental pollution. This would be the case if there is less hazardous waste dumping but there is an increase in air quality emissions and particulate matter

---

[27] "A position a firm occupies in a market, or is trying to occupy, relative to its competition." Business Dictionary http://www.businessdictionary.com/definition/competitive-position.html

from hazardous waste incineration. To manage hazardous wastes safely and avoid environmental hazard exchanges it is necessary to standardized operating procedures and use the latest technology available to minimize pollution.

Managing Risk. The Significance of Technology and Standard Operating Procedures (SOP) For Hazardous Waste Management

To achieve a socially and environmentally responsible approach the proposed solution should be based on technological advances that help minimize pollution. In the previous chapter it was argued that the success of a HWMS would largely depend on project acceptance by neighboring communities. Any initial success in terms of siting a hazardous waste management facility in Bogotá can be hindered if there are any visual emissions, spills, new odors, or any other perceived environmental threat or damage from hazardous waste management activities such as incineration, waste transportation and waste storage.

According to the Basel Convention's technical guidelines on incineration on land, incinerators should be designed "according to the types of wastes they burn. Therefore, understanding the characteristics of different waste streams and hazardous constituents of wastes is necessary to ensure proper selection and design of the thermal process to be used" (Basel 2002:6). To design a hazardous waste incinerator appropriate to Bogotá's industrial wastes with the latest technology available does not necessarily require the most expensive device on the market. According to environmental protection agencies in Hong Kong and Taiwan (which have explored alternative technological procedures to

minimize costs for environmentally sound hazardous waste incineration), similar results from filtering mechanisms and expensive incinerating devices can be achieved by controlling incineration temperature and waste mixes to reduce the amount of harmful chemicals produced during the combustion process (EPA Taiwan 2005, and Environmental protection Department, Hong Kong 2006). The same Basel Convention technical guidelines conclude that "the primary method of controlling air pollution should be to use a well designed, constructed, managed, operated, monitored and maintained incinerator appropriate to the waste being burned" (Basel 2002:10).

Hazardous waste incineration is a relatively small known source of Persistent Organic Pollutants (POPs), which are "chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment."[28] Formation of any type of POP is of great concern because many of these chemicals are considered to be toxic and likely carcinogenic to humans.[29] The forms of POPs that are most difficult to destroy are known as dioxins and furans, which are toxic organic chemical compounds present in many types of hazardous wastes, but are relatively easy to destroy at very high temperatures (Cooper 1998). Major dioxin and furan emission sources are known processes such as metal production, motor-vehicle fuel combustion, uncontrolled combustion of landfill sites (and backyard burning), chemical manufacturing and municipal and medical waste

[28] United Nations Environmental Program (UNEP). Persistent Organic Pollutants. Available in http://www.chem.unep.ch/pops/

[29] Academies N.R (2006). National Research Council of the National Academies. Health Risks from Dioxin and Related Compounds. Evaluation of the EPA Reassessment. The National Academies Press, Washington.

incineration (US EPA 2005). Hazardous waste incineration with today's new generation combustors is estimated to produce only a fraction of the total amount of these chemical emissions (Basel 2002). In Germany, for instance, it is estimated that incinerators (of hazardous and municipal wastes) contribute only to 1% of the total dioxin and furan emissions in the country since the year 2000 (Federal Ministry for the Environment 2005).

However, the destruction of dioxins and furans through hazardous waste incineration has a disadvantage. According to Gotaverken Miljo, a Sweden energy efficient solution specializing in waste energy recovery and dioxin and mercury destruction, "under stable combustion conditions, dioxins are almost completely destroyed during [hazardous waste] incineration, but are reformed to some extent by de-novo synthesis during the cooling of the flue gas and during dust separation."[30] The resulting dioxins are considered minimal compared to other common sources such as car exhausts, but any level of dioxin emissions could be perceived as harmful. This could be a very sensitive issue for the proposed solution because there is no clear scientific evidence about a dioxin emission level that would be unquestionably safe to humans (Academies 2006, Roberts et al 1998).

To minimize dioxin and furan emissions there are destruction and filtering mechanisms that prevent re-formation of these chemicals, including the introduction of heat systems that maintain the temperature at which dioxins cannot be reproduced, as in

---

[30] Gotaverken Miljo (2009). Energy efficient solutions for minimized environmental impacts. Facts about dioxins and dioxin emissions. Available in http://www.adiox.se/eng_faktaomdioxiner.htm

energy recovery systems. There are other commonly used mechanisms such as flue gas (i.e incineration emissions) treatment and cleaning processes. One of the most common flue gas cleaning systems is the electrostatic precipitator, which is a filtering device that captures small particles from air and gasses (specially metals, dioxins and furans) through electrostatic attraction.[31]

In addition to cleaning and filtering mechanisms that could be applied, most experts argue that "formation of these chemical compounds can be minimized with good combustion of precursors [chlorines and organics] in the incinerator [at over 1,800 degrees fahrenheit]" (Cooper 1998. See also Carroll 2003 and Zuboff 2003). Since furans and dioxins are typically formed and resist lower temperatures, these are more of a problem in municipal hazardous waste incineration, which uses less than half the temperature of a hazardous waste combustor (Cooper 1998).

Regardless of the expert analysis reviewed here about hazardous waste combustion minimal dioxin and furan emissions (US EPA 2005, Academies 2006, Carroll 2003, Zuboff 2003 and Cooper 1998), if operational procedures fail (i.e wastes are incinerated at a higher or lower temperature than needed because of technology malfunction or human error), filtering mechanisms would prevent the release of harmful emissions on human populations or on the nearest environment to them, which would prevent the risk of transferring these pollutants to the food chain.

---

[31] Neundorfer (2006). Electrostatic Precipitator knowledge Base. http://www.neundorfer.com/knowledge_base/electrostatic_precipitators.aspx

In addition to developing adequate combustors for the types of industrial wastes generated in Bogota, the proposed solution should put in place the most efficient filtering devices available on the market to capture and destroy dioxin and furan emissions because of their importance to preventing environmental damage and health detriments. Additionally, it would be necessary to build a specially engineered landfill to dispose of bottom ash when necessary (i.e when the resulting ash is a hazardous material itself), and to spend the necessary resources to the maintenance of these systems to ensure their long-term efficacy.

With a minimum of technological requirements for environmentally sound hazardous waste management, standard operating procedures (SOP) are perhaps one of the most important factors that help minimize risks related to hazardous waste management. SOPs can be defined as "a set of written procedures explaining how to safely work with hazardous chemicals and hazardous processes" (San Diego State University 2008). SOPs should be defined for handling, storage, transportation, laboratory testing, material combustion compatibility, incineration procedures, ash recovery and disposal and emissions testing. Appropriate training in SOPs would be required to minimize risk of accidents, spills and incineration emissions. As it will be explained later in this chapter, there is already a public institution in Colombia specializing in technical training of local and international protocols and procedures for dealing with hazardous materials and wastes. Alternative procedures will be explored here as well, such as using empirical analysis to test waste reactivity in the absence of

laboratory testing at the source, which may be the reality for some industries that emit hazardous wastes in Bogota but still don't have the capacity to invest in laboratory testing.

The technological and operational aspects that will be explored in this chapter have been chosen to ensure that the proposed solution will minimize pollution and not be an alternative source of it. Here it has been argued that focusing on the political and socioeconomic aspects of hazardous waste management is crucial to manage risk perception (see previous chapter). Now it must be noted that this approach should be based on solid technological advances and defined operational procedures to support the stance that environmentally sound hazardous waste management is possible and beneficial. This is an issue of balance, because the use of the latest technology and appropriate standardization of procedures alone will not solve potential siting problems that are common in the realm of waste management in Colombia.[32] The reality of the local political environment is that issues of environmental protection and justice may, and most likely will arise. Therefore the solution itself, and its social, environmental and economic strategies (not only its technical aspects) need to be focused on how to prevent and mitigate environmental and human hazards. Further analysis of economic, political, legal, environmental and social factors for this project will be focused on identifying opportunities to support socially and environmentally responsible practices so as to prevent risks and develop the capacity for mitigating damages. Principles of social

[32] See "Analysis of the Political Environment" in this chapter.

responsibility based on a solid technological background will guide the analysis about how to solve issues of risk and risk perception, and how to find solutions that would prevent human and environmental stress or damage.

The PESTEL Model Applied to Waste Management in the Colombian Context

There are many factors in the macro-environment that can change the course of strategic planning of an organization and affect managerial decisions. The PESTEL model categorizes those factors to facilitate the analysis of the issues that would affect a business activity in a way that it can be adapted to its particularities. For the contextual environment of a hazardous waste management solution for Bogota, the issues conveyed by PESTEL are slightly different from those pertinent to a business like the manufacturing of commercial products, specially for issues that raise social concerns. The social environment here is not concerned with consumers' wants, needs, or trends (demand), but on the social impacts that may be exerted over neighboring communities by hazardous waste transportation, storage and incineration, impacts that should be prevented and mitigated for during project planning and development.

Issues of offer and demand will be analyzed as economic factors through an anthropological perspective. This perspective would give social meaning to economic aspects such as pollution taxes and fines, centering the analysis on how to increase potential demand through economic incentives. No organization has yet been established, so this report does not analyze actual waste management costs and the impact of inflation, Gross Domestic Product (GDP), and other economic factors on the proposed

solution. Further analysis of economic aggregate measures such as interest rates, income growth and cost per ton of hazardous waste treated should be guided by the present analysis. These aggregate measures should be analyzed later under a business feasibility/ market analysis approach because they will ultimately determine a generator's capacity to pay for waste management. Simply put, this type of analysis would determine later the economic feasibility for the proposed solution.

PESTEL Macro-Environmental Analysis

Political, economic, legal, social and environmental aspects analyzed under the criteria of environmentally sound hazardous waste management are summarized under the previously discussed macro-environmental categories.

Analysis of the Political Environment

The political environment refers to the government policies and decisions that would have an impact on the proposed hazardous waste management solution. According to Gillespie (2007), issues that should be considered here include policies related to subsides, quality and available infrastructure, the political decisions that may affect business support such as workforce education or infrastructure improvements, political incentives for certain goods and services, and the economic and sociopolitical stability of a nation.

Economic and Sociopolitical Stability in Colombia

Colombia is a country of contrasts. It is considered one of the most stable economies in Latin America and at the same time, one of the countries with most socio-

political instability. Between 1972 and 1996 the Colombian economy was the fastest growing in the South America with a 4.5% growth average (Ogliastri 2007). Although it has never achieved a spiked growth like Chile, it has maintained a stable pattern for the last seventy years with constant positive GDP growth and under control inflation, a scenario that has not existed for so many consecutive years in any other country in Latin America (Rincon 2000). This situation continues to develop in spite of the current U.S mortgage crisis,[33] the state of violence and insecurity brought upon by armed illegal militias and the inherited international image of war zone brought upon by drug cartels' fighting during the 1980s.

According to the economists Rincon (2000) and Kalmanovitz (1994) Colombia's relative economic success is based on free market policies that supported the exports of highly valued commodities. These authors estimate that exports of oil and mining products alone have brought a diversity of businesses, most remarkably in the areas of financial services and construction. Nonetheless, unemployment remains high at 11.7% (DANE, 2009), and according to the World Bank, "the most problematic factors for doing business [in Colombia] are policy instability, tax rates and corruption" (World Bank 2008a).

For hazardous waste management and its related activities, aspects of policy instability that may interfere with the proposed solution are related to the complexity of local business regulations and their inconsistent enforcement. Additionally, there are

[33] The U.S is Colombia's first trade partner.

insufficient recycling policies that encourage cleaner production and support related environmental policy measures.

Because of too much flexibility in the interpretation of some laws as well as lack of enforcement of business and environmental rules and ethical norms, it might be difficult to operate a waste management business in Colombia under a fair competition environment.

Fair competition "is based on the factors of price, quality and service; not on the abuse of near-monopoly powers, competitor bashing [or] predatory pricing," among other ethically questionable and sometimes illegal business practices (Business Dictionary 2009). Fair competition is a principle to the World Trade Organization (WTO), which supports rules specifically designed to secure fair trade conditions between parties (WTO 2009). Although Colombia is a full member of the WTO and there are clear local regulations that define unethical business behavior punishable by law (Congreso de la República 1996), unethical behavior may occur.

A recent World Bank news article reports "Colombia is a global leader in reforming business regulations" to facilitate doing business in the country (World Bank 2008b). This is a positive policy stance that may be seized by new businesses and investors. However, this policy also allows the development of unfair competition because it enables businesses to lobby for expedited new requirements that would prevent competitors to participate in a specific market. In a GLOBE study (Global Leadership and Organizational Behavior Effectiveness Research Program) about organizational

behavior in Colombia, Oligastri (2007) points out that when there is political opposition to projects, authorities may have specific requirements or permits only applicable to the proposed activity, and when there is political support, there is a lot of flexibility in the enforcement of the norms. This situation has a great impact on the development of a fair competition environment for any market. Although Oligastri's study was based on middle management behavior of three industries (finance, telecommunication and food processing), his analysis is applicable as well to the realm of waste management.

Policy Concerns: Legal Ambiguity, Unfair Competition and Socio-Political Distress

According to the previous discussion about political instability aspects in Colombia relevant to the waste management business, it is possible to identify two main policy concerns for the proposed solution: First, there is not enough legal support to promote recycling to minimize hazardous waste production. Second, there is a possibility that there would be no fair access to the hazardous waste management market.

A third aspect that must also be considered is that socio-political distress around waste management projects in Colombia is rather common. Previous examples discussed and some others that will be explored in this chapter indicate that this situation is not an isolated issue or unique to the particularities of projects, but rather a pattern typically generated by issues of political instability and by Not In My Back Yard (NIMBY) attitudes towards waste management facilities.

Insufficient and Inadequate Recycling Laws in Colombia Facilitate an Environment

of Unfair Competition

Colombia is a country with relatively strong environmental protection laws, but there is a policy void regarding waste recycling. There are separation guidelines for waste managers and clean production policies that encourage material re-use and more efficient production processes, but there is no policy statement specific to recycling wastes. This may be problematic because rules may change in a way that may affect recycling strategies designed for the proposed solution and because the void may allow the development of an environment of unfair competition as others may try to fill that void with tailored regulations that benefit particular interests. A recent example illustrates how a situation of unfair competition around the recyclable waste market in Colombia can easily develop.

The Case of the Recyclers

Until very recently recycling collection in Colombia was carried out mostly by poor individuals known as *recyclers* ("recicladores"). They, as scavengers, collect, transport and resell recyclable wastes for a very low price, offering a valuable service to businesses that don't have to pay for disposing of some of their wastes and allowing recycling companies to obtain recycling materials at a very low cost. This dynamic allowed recycling companies to maintain high revenues, while recyclers' incomes were quite low (ANR). When economists calculated that informal garbage collection in places like Buenos Aires, Mexico City, or Bogota could reach revenues of millions of dollars (Civisol 2009), there was an awareness of the importance of the recycling market and

additional players, mostly entrepreneurs, have benefitted as well from the recycling business. However, the entrance of new players in the recycling market in Colombia has been constrained by several attempts to displace recyclers from the market (Habitat II 2004, RLR 2009). One may argue that the most recent of such attempts derives from a new law that criminalizes informal transportation of recyclable wastes. In 2008 Law 1259 came along as a congressional decree, establishing a sanction scheme for transporting recyclable wastes in inappropriate vehicles and containers.[34] Far from constituting a statement that promotes recycling as an environmental target or that promotes technological efficiency, the only law that has been produced in Colombia specific to recycling simply determines fines for inappropriately handling and transporting recyclable wastes. To the Latin American Network of Recyclers this law was designed to prevent recyclers, who typically use horse carriages to collect wastes, from making a living (RLR 2009).

Law 1259 seemed to be specifically tailored for Residuos Ecoeficiencia SA, a waste management company co-owned and managed by the two young sons of the President of Colombia. When the law became effective in December 18 of 2008, Residuos Ecoeficiencia was the only waste management company apparently prepared to legally handle recycling wastes, which has enabled them to acquire contracts with major companies such as Coca-Cola and Saab-Miller. Ecoeficiencia has ever since been highly criticized by the local media (Leon 2009, Coronell 2009). Furthermore, important

[34] Congreso de la República de Colombia. Ley 1259 de 2008.

economists and political scientists (Kalmanovitz 2009, Mockus 2009) have claimed that the new law was, at the very least, legally questionable: "Their first advantage, as partners of the Canadian waste treatment company Residuos Ecoeficiencia S.A that competes against thousands of miserable recyclers, is that they [the sons' of the president] call the businessmen to offer their services, and these favor them because they think that eventually they will receive something in exchange from the government"(Kalmanovitz 2009, translation).

Law 256 of 1996 that stipulates norms of fair competition clearly prohibits unfair exclusivity pacts that would limit competitors' access to the market or that monopolize the distribution of products and services (Congreso de Colombia 1996). To the Constitutional Court, this new law that prevented poor families from collecting and selling recyclable wastes, and that consolidated Ecoeficiencia as the only company in capacity to do so, was violating this fair competition law and several regional solid waste management master plans and decrees that mandated the inclusion of recycler families in any enterprise or project related to recyclable wastes (Corte Constitucional 2009a). Decree 1505 of 2003 (Ministry of Environment 2003) and the law 142 of 1994 (Congreso de Colombia 1994) mandate the participation of recycler families in any recycling waste management business and related profitable activities. The Constitutional Court Sentence T-724-03 of 2003 (Corte Constitutional 2003) ratified this law, mandating the inclusion of this clause in local waste management plans. This has prevented Ecoeficiencia from managing wastes for municipalities or collecting solid recyclable hazardous wastes from

landfills. When Ecoeficiencia won a contract to manage wastes for the city of Cali, the recycler association sued and a constitutional court ruling reversed the contract (Corte Constitucional 2009a). The preliminary court ruling is that the superintendent of public services cannot adjudicate a contract to private parties without including the recycler families that used to lead the business and whose inclusion is a legal prerequisite. Cali's Recycler's Association, which supports and organizes recyclers through the funding of several organizations, claims that Ecoeficiencia took advantage of privileged information and lobbied for this new law to take over the recycling business (Corte Constitucional 2009a).

Mitigating Issues of Unfair Competition and Sociopolitical Distress Through Community Participation

It is important to consider the situation of the recycling business in Colombia because there are limited resources (laws and regulations) designed to promote fair competition and that encourage ethical and legal behavior around the waste management business. The most enforceable legal resource available to people and organizations is perhaps to submit a Constitutional Court recourse, which as seen from previous examples, typically favors constitutional rights over business interests.

Environmental conflicts related to waste management need to be framed within Colombia´s broader sociopolitical conditions. Given the numerous human right violations and population displacements brought upon by years of militias' fighting, in Colombia many organizations (governmental, international and non governmental) are involved in

the resolution of environmental conflicts that are closely linked to other sociopolitical issues, which makes unlawful or unjust issues around waste management particularly visible. Corruption may be an issue in Colombia, but environmental protection is high on the political agenda.

This description of the political environment in Colombia around the waste management business illustrates how important it is to address sociopolitical issues to prevent political or community opposition to waste management projects, and the importance to act with respect to fair competition and a sense of ethical conduct to avoid lengthy litigations. Given the pattern of socio-political distress around waste management projects in Colombia, one may argue that community participation is a determinant project component for any hazardous waste management activity. The previous example illustrates how lack of community involvement to fulfill legal requirements of inclusion of vulnerable populations does not help secure a fair competition environment and can adversely affect waste management firms and end projects. Another recent example illustrates how important it is to introduce community participation strategies and sometimes, the need to implement "state of the art" community participation programs to avoid siting problems.

The Case of Nemocón

The residents and political leaders of Nemocón, a municipality north of Bogotá, has opposed the construction of a municipal waste landfill that was planned for the year 2003. The proposed project would be located in an abandoned brick factory, and

according to the environmental authorities that approved the project (Corporación Autonoma Regional, CAR) the landfill will use the latest technology and safety standards to prevent any damage to local communities and their environment (CAR 2008).[35] However, through a plebiscite that took place in 2006, the community of Nemocón opposed the project by 97% (Semana 2009). Neither Nemocón's residents or its leaders ever participated in issues of project design and development, yet the environmental license was ratified. Because the community perceived lack of involvement and consultation in the process, local political leaders with the public's support tried to legally stop the project. However, the latest court ruling (a constitutional court decision) found that the community´s claims were insufficient to deny the construction of the landfill. To the constitutional court, the proposed project complied with all legal, technical, social, and environmental prerequisites mandated by law (Corte Constitucional 2009b). But before this court ruling came along the local government managed to change the zoning for this area, which now doesn´t allow the construction of a landfill. This zoning change will delay the landfill´s construction, at least until the zoning is revised. To make matters worse, some residents have invaded the land where the landfill would be located and the mayor is not interested in removing them. The issue has been in dispute for the past five years and there is no clear timeframe for when the landfill will be able to be constructed. As a local politician commented on a recent article: "Tecnoambientales [the waste management company] failed in its communication strategy, as it acquired the land and

[35] CAR. Confirmada Licencia Ambiental A Relleno Sanitario de Nemocón. Available in http://www.car.gov.co

environmental licenses without informing what all of this was about, a steering that put all the community against them. As things are going, before three or four years we wont have a landfill (Semana 2009,Translation)."[36]

In this case, although no technical, legal or constitutional rights are apparently being shattered (the waste management company Tecnoambientales informed the public through community meetings to fulfill with community participation legal guidelines), lack of community involvement and consultation has stimulated opposition and the community has stopped the project successfully for over five years. This community opposition may be just a NIMBY reaction that local politicians are taking advantage of to secure the coming elections. On the other hand, part of the reason for the public's rejection is that the landfill will not only serve Nemocon, but mostly the fastest growing regions (suburbs) around Bogota. The issue of locating waste management facilities far from sources of pollution because of technical, environmental and economic factors without taking into consideration social implications is one of the typical sources of resident's opposition. On a recent blog in Facebook, Nemocon's residents complained about having to treat other people's wastes and having to pay for a perceived environmental or health detriment for others' actions.[37]

From this example one can see that the technical and environmental aspects that govern waste management facilities siting approaches has a socio-political component that should be explored through project planning and implementation. These aspects will

---

[36] Revista Semana, June 17, 2009.

[37] "No al basurero que contamina a Nemocon y a Bogota" Available in http://www.facebook.com/nemocon

be analyzed closely during the present analysis as part of the social environment for hazardous waste management in Colombia.

Policy Contributions that Promote Environmentally Sound Hazardous Waste Management

The most important policy achievement that supports the proposed solution is consigned in an Environmental Policy Statement for Hazardous Waste Management prepared by the Colombian Ministry of Environment (Ministerio de Medio Ambiente 2005a: 11), where it is recognized that there are few economic incentives to promote hazardous waste recycling and formal disposal. To remedy this situation, the Colombian government set forth an Action Plan to mitigate impacts related to uncontrolled hazardous waste generation and mismanagement (Ministerio de Medio Ambiente 2005a: 35-50). This plan established specific deadlines to develop a strong regulatory framework for mandatory hazardous waste management, which should be fully enforced by 2010 for all industry sectors identified as hazardous waste generators (chemical, metallurgic, food production etc.).

Furthermore, the plan contemplates political incentives to encourage private investors to develop specialized facilities to safely manage hazardous wastes. These incentives include the "establishment of regional or local commissions to help plan infrastructure projects related to environmentally sound hazardous waste management and the introduction of legal adjustments that would establish the necessary market conditions to encourage the demand for environmentally sound treatment and final

disposal methodologies" (Ministerio de Medio Ambinete 2005a: 45, translation). Instruments established in the Action Plan intended to support the realization of these goals include government funded studies that report detailed characterizations of hazardous wastes generated in the country (per geographic area and per industrial sector) as well as market research and evaluation studies that explore current offer and demand for specialized hazardous waste management services. Additionally, environmental authorities, NGOs and the academia are encouraged to establish agreements with generators and waste management providers to facilitate regulation compliance. Activities expected to help achieve this objective include facilitation of goal-oriented meetings and agreements that define needs for investment in environmental monitoring related to hazardous waste generation and treatment, and the facilitation of knowledge base channels to develop environmentally sound hazardous waste management solutions.

The Plan also contemplates tributary benefits, but up to this date no tax benefit has been defined specifically for choosing an environmentally sound hazardous waste management solution over any other solution available, nor there are any additional tributary benefits apart form the ones already established for firms dedicated to waste management.

Policy Implications. The Need For Enforcement

The success of political instruments to control hazardous wastes in Colombia, which basically rely on pollution fines, are an important and decisive requirement for establishing a business that supports environmentally sound hazardous waste

management. But such policies must be accompanied by appropriate enforcement, which is the element that would trigger the necessary economic incentives to shift hazardous waste generators' behavior towards environmentally sound waste management practices.

Recent regulation related to the hazardous waste environmental policy statement discussed here leave a window of opportunity for private businesses to engage in a socially responsible hazardous waste management solution and make a profit (see legal macro-environmental analysis).

Although these new laws are expected to increase enforcement capabilities, enforcement should also correspond to the country's socio-economic reality (i.e. small industries may not be able to comply with fines or invest in expensive laboratory testing). This raises two important questions: First, how can the proposed solution support local government's enforcement capability to engage generators in hazardous waste management? And second, how can the proposed solution promote compliance among generators without exacerbating plausible negative economic impacts to their industrial activities?

Addressing Problems Through A Service Oriented Initiative

These questions can be approached from a service-oriented perspective that helps promote compliance of hazardous waste regulations while increasing the demand for hazardous waste management.

Understanding Services

According to Hill (1999), services are not simply intangible goods outside of the manufacturing, extractive or agricultural industries, but rather a "change in the condition of one economic unit produced by the activity of another unit"(1999: 441). This distinction between services and goods (tangible or intangible) is important because it clarifies that services are dependent on relationships and interactions, therefore their production and distribution does not occur separately but concomitantly through use. According to Hill, "the economics literature is full of statements to the effect that goods are material or tangible, whereas services are immaterial or intangible…in practice, intangible products deserve more serious attention because they play a major role in the information economy…[and] consist of additions to knowledge and new information of all kinds [that can be reproduced and traded] (1999: 438)…They are quite different from services (1999: 426.)… Services involve relationships between producers and consumers" (1999: 441).

This distinction supports the concept that a collaborative level of community participation is necessary to enable the development of effective services, which should be defined, produced and delivered concomitantly through partnership relationships.

Building Integrated Services Through Partnerships

Teboul (2006) gives an innovative perspective to the concept of services that further supports the service approach for the proposed HWMS. To this author, the difference between services and goods is nowadays a question of degree since all business activities involve the delivery of services. Therefore the difference between

services (i.e when one economic unit transforms the other) and goods (i.e when raw materials are transformed into products) should be understood in terms of what the author calls *back stage* or *front stage* operations. To Teboul, backstage represents a transformation process of raw materials or information components, whereas front stage represents performance through direct interactions between a firm, its employees, its customers and all the people involved through the service production and transaction process, that is, through the use of a solution. Services would be mostly front stage whereas goods would be backstage, but they would both imply the other. The author argues that although services are mostly a front stage experience, they need some backstage or preparedness to process the "product" (e.g. information and components).

Taking into consideration Teboul's theoretical contributions regarding service science, services that would be developed for the proposed hazardous waste management solution are based on the design (backstage) of a strategic planning approach aimed at minimizing hazardous waste management environmental and socio-economic costs. Such a backstage would be supported by the current macro-environmental analysis for hazardous waste management. However, the proposed solution would only be fulfilled and perceived as a service through experience. In other words, the proposed solution would only materialize as front stage develops and service performance is evaluated. Further analysis about the service perspective that supports what could be called here a

service oriented business architecture[38] for the proposed HWMS will be analyzed in the following chapter.

The purpose of bringing this discussion at this point is to establish that under a service perspective, a feasible answer to the problem of increasing compliance and demand for environmentally sound hazardous waste management would be to support current legislation through the design of services aimed at reducing waste management costs. This implies that a hazardous waste management solution should include services that can help generators achieve policy compliance through cost-saving mechanisms. These mechanisms would be framed as services that could be offered to help generators meet mandatory hazardous waste reporting inventories and increase their recycling and environmentally sound final disposal capabilities (and their capacity to pay for these solutions). Therefore, to engage generators into environmentally sound hazardous waste management implies that partnerships are necessary to tailor services and monitor their performance. For this purpose, it would be necessary to establish direct relationships between the hazardous waste management providers, governmental institutions in charge of establishing the rules and enforcing current hazardous waste legislation, hazardous waste generators, and other actors involved in the service production/transaction. The nature of these relationships and the range of services that may be constructed through them is the focus of the following chapter.

---

[38] Bob Gluschko (2006). Service Oriented and Global Service Delivery Models. Lecture Notes, UC Berkeley School of Information.

Policy Considerations For Business Support. Workforce Training and Incentives for Goods and Services that Minimize Waste Production

Another policy factor that may interfere with a hazardous waste management approach aimed at reducing costs of waste disposal and increase demand is related to institutional constrains of technical, sociopolitical and economic order.

Technical constraints are reflected by the limited training capabilities in hazardous waste management procedures and operations, which makes difficult the standardization of processes for hazardous waste collection, recycling, storage and disposal, increasing the risk posed by its related activities. Sociopolitical constraints refer to the lack of institutional capabilities to monitor hazardous waste generators and determine social and environmental responsibility for damaging industrial activities. This situation is worrisome because it limits the government's capacity to enforce hazardous waste management regulations. Finally, economic constraints refer to the government's limited ability to economically support businesses (through programs and tax exemptions or credits) as they introduce changes aimed at hazardous waste minimization or recycling.

Workforce Training: Towards a Standardization of Procedures

The Action Plan developed by the Ministry of Environment of Colombia (Ministerio de Medio Ambiente 2005a) indicates that there would be political and economic incentives for the development of research and training for hazardous waste management. Attention has been focused on making readily available a wide range of publications and research papers from the academia and current international operating

procedures standards through meetings and lectures, which are mainly organized by governmental institutions. A recent example is the past International Congress for Hazardous Waste Management held in Bogota on November 2008, which was organized by the central government and brought together a wide range of experts and interested parties from different countries (Ministerio de Medio Ambiente 2008). Additionally, the National Learning Center SENA (Servicio Nacional de Aprendizaje) is making efforts to develop training programs aimed at covering knowledge gaps regarding hazardous waste management. Some of these programs are already available through the SENA's National Training System (Sistema Nacional de Formacion para el Trabajo) and its Center for Industrial and Environmental Management (SENA 2009). At the very least, training in protocols for handling hazardous wastes have already been implemented, such as in the training programs for Solid and Hospital Waste Management. However, there is no program currently available specifically for hazardous waste management and disposal (through SENA or any other local institution), which implies that there is a limited standardized training capacity for a future workforce specifically targeted for the development of this industry.

Impacts of Policy Inconsistency: Insufficient Incentives for Goods and Services that Minimize Hazardous Waste Production

There are limited incentives in Colombia that encourage industrial sectors to make environmental protection investments and use cleaner technologies. As previously explored, recycling itself is not an institutionalized policy (there are clean production

policies that could cover some aspects of recycling, but not all of them), which may limit the efficiency of incentives that should be readily available to minimize hazardous waste production through recycling. Similarly, there are no special levies for products and processes that pollute in excess, except for the ban on imports of goods with known ozone depletion potential, agreed through the Montreal Protocol, the ban to DDTs, agreed through the Stockholm Convention, and other bans related to international agreements (Ministerio de Medio Ambiente 2002).

There are some tributary benefits available to companies that make environmental protection efforts, but according to a CEPAL study (Barbosa et al 2005),[39] an evaluation of the benefits available for environmental protection investments in Colombia indicates that policy efforts should still be made to articulate programs for cleaner production with waste management objectives, especially those concerning hazardous waste minimization. According to this study, the problem in Colombia is that the government has included the concept of recycling as an aspect of "integral waste management" but it has not developed the necessary legal modifications and economic incentives to position recycling or reuse mechanisms as main factors of the hazardous waste management policy.

According to the current tributary policy in Colombia, companies or organizations can apply for tax deductions of up to 30 % of the amount invested on environmental

[39] The United Nations Economic Commission for Latin America and the Caribbean (ECLAC), most commonly known as CEPAL for its Spanish acronym (Comision Economica Para Latinoamerica y el Caribe).

improvements, especially reforestation, environmental protection (i.e biodiversity, stream restoration etc), renewable energy production, and environmental monitoring, as long as these investments do not exceed 20% of the company's income (Estatuto Tributario, 2003) However, this benefit does not cover investments made to comply with regulations, such is in mitigation strategies ordered by environmental protection agencies or mandatory hazardous waste management. These tributary incentives would not cover hazardous waste generators for complying with the law (they would not be able to deduct what they spend on environmentally sound hazardous waste management). Incentives available to hazardous waste generators would include VAT exemptions for investments in cleaner technologies and processes, or for purchasing environmental quality monitoring equipment and laboratory-testing technology.

Similarly, waste management providers are exempt from VAT duties for imported machinery for waste management and treatment and for environmental quality monitoring equipment. Waste to energy production would not have any tax deduction. The current tributary policy does not consider waste a renewable energy source, therefore investments on hazardous waste energy recovery systems do not qualify for a VAT exception. For the proposed HWMS, green infrastructure investments for stormwater management would be eligible for a tax deduction if they constitute an environmental quality improvement effort and not a mitigation strategy (Ministerio de Medio Ambiente 2004).

Another issue that should be considered is that applying for these tax exemptions and deductions requires a rather complicated and long validation process. According to Barbosa et al (2005), a common problem in the applicability of tax exemptions is that there are no unified criteria for evaluating eligibility to these benefits between environmental protection agencies and fiscal authorities. This results in lack of coherence in the distribution of benefits and inadequate monitoring of environmental protection efforts. Economic impacts of the tributary policy will be further developed through an analysis of economic factors for the proposed solution.

Analysis of Economic Factors

According to Gillespie (2007), an analysis of economic factors should include interest rates, taxation changes, economic growth, inflation, exchange rates, and any other economic change that could have a major impact on a firm's behavior.

An analysis of the economic environment for a business activity generally begins with a macroeconomic emphasis. This means that such an analysis would be centered on macro variables like world demand for certain goods, Gross Domestic Product (GDP), exchange rates, and taxation policies. As the analysis moves forward, it usually shifts towards microeconomic determinant variables, which simply means that the focus of the analysis moves towards specific market conditions like prices, opportunity costs, local offer and demand, and other non-aggregate economic factors and financial conditions that typically trigger managerial decisions (Hoag 2002). Since the proposed HWMS neither has been defined as a business nor does it represent a typical business activity as in the

case of telecommunications, financing, or the manufacturing of products, the analysis here will be centered on plausible economic impacts of some macroeconomic variables for the development of waste management infrastructure projects in Colombia. These variables roughly include economic impacts of environmental protection policies, tributary policies, and the potential effects of variable exchange rates on industrial activities, which may determine the available income for environmental protection investments like hazardous waste management. The only microeconomic variables that would be considered here are related to local demand for hazardous waste management services and infrastructure and technological investments that may be needed to support the development of the proposed solution.

From the previous analysis of the policy environment it is clear that it is crucial to secure a demand for environmentally sound hazardous waste management given a policy scenario of medium to low enforcement capabilities. Much of this analysis will be centered on how to increase such demand. Other economic factors that would have an effect on budgetary issues for the proposed solution such as wages, inflation, cost per ton of waste disposal or interest rates are arguably dependent on the current analysis and should be analyzed later to determine the economic feasibility for the proposed solution.

The Impact of Variable Exchange Rates on Industrial Revenues

According to Piana (2001), the exchange rate "expresses the national currency's quotation in respect to foreign ones…it is a conversion factor, a multiplier or a ratio, depending on the direction of conversion" (2001:1). In Colombia the nominal exchange

rate[40] is based on the US dollar because most foreign transactions are made in that currency (Biblioteca Banco de la República 2005). Since Colombia's monetary foreign exchange policy is based on a flexible regime (the exchange rate can freely move with the market), there are limited intervention mechanisms that the government can implement to maintain monetary stability. These interventions are taken by the central bank and usually include buying or selling foreign currencies when the exchange rate exceeds a 5% deviation from the last 20 days' average, or by modifying the interest rate differential to control appreciation or depreciation of the local currency (for example, by increasing local interest rates so there would be a differential between the rates available for the two currencies, encouraging foreign investors to buy the local currency to take advantage of higher returns (Banco de la República 2009a).

Understanding the effects of variable exchange rates for different industrial sectors is crucial for determining how sensitive and vulnerable some sectors are to price changes and variable income. These aspects may have an important effect on hazardous waste generation and on demand for hazardous waste management and disposal.

In 2007 Colombia experienced a strong appreciation of the peso against the dollar, which at the time affected negatively the exports of some commodities such as flowers and coffee (oil could be considered an exclusion since crude prices have grown exponentially in the past years).

[40] Determined by monetary foreign exchange markets (FOREX).

A strong appreciation of the Colombian peso against the dollar would affect positively a firm's ability to import equipment for environmental monitoring (which suddenly would be less expensive), but it would also affect its ability to receive the same revenues for exported products (since the dollar would worth less against the peso, their income in pesos would decrease as well). This means that exports of manufactured products would also be affected, making it harder for manufacturing industries to keep their revenues and limiting their ability to pay for hazardous waste management. However, manufacturing industries that import raw materials would be able to acquire them for less, increasing their ability to improve their revenues and pay for waste management, especially when profits are dependent on the local market and transactions are made in pesos. Whether or not a firm or an industry would be willing to pay for environmentally sound hazardous waste management would depend on this sort factor and on the level of national income growth (the higher the income, usually the higher the consumption level and the industrial revenues, but also the amount of wastes produced to be treated). This would require additional analysis, such as a detailed characterization of hazardous waste emitting industries, the location and destination of their products and services, costs of raw materials, the interest rates available to them, etc.

What must be noted here is that exchange rates may determine a generator's available income for investment on environmental protection efforts and environmental regulation compliance, like paying for hazardous waste management. According to the National Department of Statistics (DANE), industrial sectors with the largest impacts on

Colombia's Gross Domestic Product (GDP) are the mining sector (which includes oil production), agro-industrial activities, manufacturing (textiles, chemicals etc.) transportation, construction, telecommunications and financial services (DANE 2009b). According to the Ministry of Environment (Ministerio de Medio Ambiente 2005a) these are also the sectors that generate most hazardous wastes by sub-categories. The most polluting industries would be, in descendent order, chemical, metallurgic, non-metallic minerals, food production, textiles, printed press, and wood extraction. Industries dedicated to the manufacturing or imports of electronic components and products are not yet classified, but the growth of the world's demand for these products, like cell phones and personal computers, is evident.

Common and frequent changes in exchange rates, as in the case of Colombia for the past two years, may cause negative impacts to the national trade balance (the difference between exports and imports) as it was the case in 2007, when the value of imports exceeded the value of exports, an economic indicator of financial deficit and distress (Banco de la República 2009b). Up to this date, there isn't a complete analysis available that estimates the impact of the latest variable exchange rates per industry sector for the past two years. However, there are many articles available that speculate about the impacts of revaluation on exports and industrial performance in Colombia and explain the policy directions that have been taken (Portafolio 2008, Carvajal 2007, Presidencia de la República 2009). Judging from past interventions from the central bank, as well as economic stimulus plans developed by the central government to secure jobs

and support companies that were affected by the latest revaluation (Presidencia de la República 2009), it is reasonable to believe that this is a very sensitive point for exporting industries registered as hazardous waste producers in their allocation of funds for hazardous waste management.

Understanding how exchange rates affect hazardous waste generating industries may help define appropriate engagement strategies for specific industrial sectors. This type of analysis would help identify which sectors are more prepared to pay for environmental protection efforts at a given time, which would facilitate the development of services that encourage a growing demand for environmentally sound hazardous waste management.

Tax Policies as Economic Incentives for Environmentally Sound Waste Management

Now that most societies want to internalize the costs of using natural resources in business equations, sanction norms to prevent and mitigate the impacts of contaminating activities became fairly common. These norms are typically enforced through environmental taxes, pollution caps, or fines for non-compliance.

Tax rates are a concern for businesses in Colombia because they tend to be high and tax credits are limited. According to a recent World Bank study, the amount of taxes that a medium sized company must pay in a given year over its profits in Colombia is

about 78.4 percent, a much higher rate than the 48.6 percent calculated for the region (Latin America) and 45.3 percent in OECD countries.[41]

Given the high tax rates, any additional tax related to pollution may help enforce hazardous waste laws as generators would try to avoid an additional tax or fine for not complying with hazardous waste management regulations, which would favor the proposed HWMS.

Tax deductions for environmental protection available in Colombia are not applicable to potential users of the proposed solution just for complying with the norm. These deductions are available to those generators that make an *additional* effort to protect the environment beyond what is mandatory (in the case of hazardous waste generators, it is mandatory to properly manage wastes and prevent environmental damage). Tax cuts or deductions are available for reforestation, investment on scientific and technological research, and for control and improvement of the surrounding environment. But as previously discussed in the tax policy analysis, hazardous waste generators can save on VAT levies for all equipment acquired for environmental monitoring and control or for investments related to more efficient technologies, as long as they reduce the amount of pollution and waste generated. Although this is basically the only tax incentive available to generators that wish to shift towards environmentally sound hazardous waste management, it may be an important incentive for industry sectors most dependent on technological advances to increase efficiency in their

---

[41] The World Bank (2009). Doing Business, Measuring Business Regulations, Colombia. http://www.doingbusiness.org/exploreeconomies/?economyid=46

production processes as long as there is adequate enforcement of environmental protection policies and enough credit to support the investment. These credits are typically available through governmental organizations and governmental agreements with financial institutions (Tamayo 2002)

For example, in the case of the textile sub-sector, acquiring new equipment that minimizes use of tints or chemical compounds for the treatment of fabrics may not be strictly necessary, but if waste management laws are enforced and waste management expenditures become a concern (through enforcement), it may influence some firms to invest in better technologies to improve efficiency, reduce waste management costs, and take advantage of the VAT waiver. Again, their ability to invest may be dependent on whether or not they have access to especial credits for clean production.

Affordability for environmentally sound hazardous waste management will not only depend on prices and revenues, which are very sensitive to changes in market conditions as in the case of exchange rates, but also on a balance of taxation policies and fiscal incentives. Barbosa et. al (2005) argue that a fiscal policy that promotes clean production and waste minimization should achieve a balance of financial incentives, tax incentives and environmental cost taxes. Increasing the amount of credits available for clean production investments is considered a powerful financial incentive (Tamayo 2002). Tax incentives would be those that promote a change of behavior, as in the case of the VAT waiver that is intended to promote investment on cleaner production. Finally, environmental cost taxes would be applied through command and control mechanisms to

increase fiscal revenues and cover costs of environmental services and environmental protection or mitigation strategies. Determining a good combination of these tributary and financial mechanisms is a constant battle for most governments. Strategies developed through the proposed solution may be aimed at supporting the financial and tributary incentives that are already available through an offer of services that may reduce or mitigate some waste management costs.

Promoting Environmentally Sound Hazardous Waste Management Through Economic Incentives

In the absence of regulation and regulation enforcement, environmentally sound hazardous waste management is unlikely to occur. However, under a moderately regulated scenario, that is, a policy environment where significant but flexible fees and penalties are positively enforced, hazardous waste generators will have an incentive to re-use, recycle or properly dispose wastes to avoid fines and penalties. Stringent regulation would not be appropriate in Colombia as it is dependent on expensive technology standards and requirements (monitoring and control technology) to help achieve a determined level of hazardous waste abatement (Sigman 1994). This may lead to a limited governmental enforcement capacity, which may ultimately encourage illegal disposal and result on detrimental environmental effects (Sigman 2003).

A moderately regulated scenario can be based on regulations that give waste managers some flexibility to develop cost-effective disposal alternatives and economic incentives that would encourage hazardous waste generators to eliminate waste dumping.

Because Colombia has not yet built the capacity to use command and control mechanisms to eliminate hazardous waste dumping (i.e it does not have the technological requirements, budgetary requirements or consistent enforcement capabilities), it has opted for a rather moderately regulated scenario where the first step has been to enforce reporting of hazardous wastes inventories and determining deadlines for industrial generators to comply with the new hazardous waste management regulations per industry size, concentration of contaminants, and economic capacity. This has given industrial sectors a considerable amount of time to organize environmental management departments and to consider alternatives to reduce the amount of waste produced and determine cost effective waste management solutions (depending on the company size, from 6 months to one year for hazardous wastes inventories and from one year to three years for complying with hazardous waste management regulations ending in December 2010 (Ministerio de Medio Ambiente 2005).

Flexibility is not only determined by policy adjustments but also by the enforcement approach. The enforcement approach in Colombia is that there would be no provision for an actual hazardous waste pollution tax (a tax for producing too much hazardous wastes), but rather for a *fine* that becomes the equivalent of a tax *only if* hazardous waste disposal is not completed by approved alternative disposal methods which include land disposal, incineration, recycling and other environmentally sound treatments that neutralize hazardous components but are only suitable for certain wastes (Basel Convention 2007). This means that no pollution caps have been established as in

many countries with relatively strong regulations because the government's target is centered on reducing waste dumping and hopefully modifying producers' behavior towards cleaner production practices. This approach has probably been taken to avoid bringing a negative economic impact to the industrial sectors that sustain the economy.

Economic incentives or savings that could be provided through the proposed solution via services would be aimed at moderating the costs for hazardous waste management so they would be inferior to the alternative penalties. The idea would be to use the current state of enforcement flexibility to position hazardous waste management (the service) as a potential saving and not as a net expense.

Regulation alone is not sufficient to make hazardous waste management economically attractive. Sigman argues that market-based incentives may be more efficient to minimize hazardous waste pollution and improve welfare (2003) than traditional command-and-control approaches because generators are more sensitive to supply and demand factors that determine price and thus operational costs (1994). This implies that when environmental goods are priced through emissions fines (such as hazardous waste contamination) or when they are part of a trade mechanism (such as in manufacturers' waste exchange/recycling programs) they tend to be more successful and less expensive for both regulators and generators than typical sanctions. Through the study of economic instruments aimed at reducing hazardous waste contamination in the United States, the author's investigation suggests that a combination of regulation strategies and market-based incentives may be appropriate to reduce the amount of

hazardous waste generated and shift dependence on land disposal towards more environmentally sound incineration techniques.

Taking into consideration Sigman's analysis (1994 and 2003), a hazardous waste management solution should not rely solely on policy regulation and enforcement to succeed, but should also identify market-based mechanisms that would potentially increase the demand for hazardous waste management in tune with current sustainability targets and other social/environmental concerns. Technology requirements for hazardous waste incineration and recycling opportunities should be supportive of the design of economic incentives aimed at minimizing impacts related to hazardous waste management costs, thus reducing the costs for regulation compliance.

The Need for Infrastructure Improvements

Previously it has been argued that investment in green infrastructure improvements will be needed to mitigate sotormwater management problems as part of an urban planning approach that is intended to address issues of risk perception. Additionally, it is necessary to establish whether or not here is a need to invest on regular road infrastructure improvements in the event that local authorities will not be able provide a safe hazardous waste transportation corridor.

According to the National Urban Development Agency (IDU, Instituto de Desarrollo Urbano), only 34% of the road infrastructure in Bogota is in good state. Roads in regular state account for 23% and roads in bad state reach 43% of the whole road system (highways, intermediate and local roads) (IDU 2008). For hazardous waste

transportation, road quality and availability is an important factor because it has an impact on mobility issues, such as time spent on the road, variable speed, etc. All types of mobility issues may increase risks related to hazardous waste transportation. It is important to identify plausible corridors of waste transportation and if necessary, the proposed solution should consider investing in the improvement of corridors for hazardous waste transportation in agreement with competent governmental institutions to minimize risk factors.

About Capital Costs

This report does not evaluate incineration options for treating Bogotá's hazardous wastes nor does it evaluate efficiency of incinerators capable of generating heat-energy. This type of analysis should be performed by a chemical engineer specialized in hazardous waste combustion that fully understands waste streams form Bogota's industrial production. However, a review of some incineration vendor technology indicated that today, efficient waste-to-energy incinerators and other environmentally secure combustion systems are readily available and are relatively inexpensive compared to its economic returns (Fleming and Sanford 1990: 12-28). A cost analysis should follow the identification of adequate technology, but to give a ballpark figure, a limited review of today's offer for environmentally sound hazardous waste incineration systems allowed an estimation of costs for incinerator combustors, filters, and energy recovery mechanisms for as low as five million dollars for a medium incineration capacity, that is, an incinerator capable of processing between 200 and 400 Kilograms of waste per hour

(Basic Energy 2009). Cheaper systems without energy recovery and filters can be found in the market for a few hundred thousand dollars, and of course, expensive ones can cost hundreds of millions of dollars with the capacity to produce large amounts of energy to power a whole town (Santoleri et al 2000:305-379). Further discussion regarding hazardous waste incineration equipment will be the focused on the latest technology available for environmentally sound incineration with energy recovery systems that would require a minimum capital investment. Later, this amount should be adjusted according to an estimation of Bogotá's initial incineration demand (see "Technological Factors" in this chapter).

Social Factors

Understanding Siting effects on Human Wellbeing and Safety

According to Gillespie (2007), social factors that should be considered to support business development include changes in social trends (which modify demand), analysis of the workforce (level of schooling and need for training), population age (aging populations tend to increase costs of pension plans and are also determinants of product demand), and community organization (unions). This type of analysis is basically focused on social factors that affect two types of populations. First there are the consumers of products and services and second, there are the agents that manufacture and deliver those products and services, in other words the workforce.

Here the analysis of social factors will not be centered on either of these populations. Because hazardous waste management is an activity that typically creates

rejection from the local communities where it exposes them to risk factors, the analysis of social factors will be centered on this population segment, which is also expected to become part of the workforce for the proposed solution. Any other analysis of social factors should carefully consider the social impacts related to hazardous waste management operations.

Hazardous waste management may have immediate positive impacts on natural environments and human health. However, location and exposure to a hazardous waste management facility may not be perceived as positive to neighboring communities but rather as an added source of contamination with potentially harmful impacts. Concerns for neighboring hazardous waste management operations may include a wide breadth of issues, such as deterioration of social infrastructure, decrease in property values and deterioration of environmental, and human health. A siting approach for a hazardous waste management facility should directly address communities' perceived health and environmental risks as well as potential environmental quality impacts to assure a project's success and ease of operations.

In Colombia minority and ethnic communities with strong political cohesiveness and representation are more likely to oppose infrastructure projects that may disrupt their way of life or that may pose environmental risks than other heterogeneous communities, such as the typical neighborhood organizations. As explored through previous examples, the Constitutional Court has been paying close attention to the situation of indigenous communities (as the Embera Katios in the case of the URRA hydroelectric project), as

well as vulnerable communities (as in the case of the recyclers against the waste management firm Ecoeficiencia in Cali). These communities have special constitutional rights (Constitucion Politica de Colombia 1991, Semper 2006), and this special treatment has been ratified over the years in decrees, court rulings, and municipal master plans. In the previous example of the municipal landfill for Nemocon, although the community was organized and politically supported, it has not been able to achieve similar results to stop this particular project. Partly because the community of Nemocon has no special rights to appeal to, as opposed to the constitutionally defined "vulnerable communities" of Colombia (e.g indigenous groups, displaced populations, etc.), and partly because their claims may be insufficient to stop such a vital project for the overall region. In order words, they may be organized, but they are not necessarily "right". Another example may illustrate even further this situation.

Considering Vulnerable and Indigenous Populations for a Siting Approach

Two multinational companies, Royal Dutch Shell and Occidental Petroleum Corporation (OXY) have been trying to explore an area near the Venezuela-Colombia border, where, some have speculated, the richest oil reserves of Colombia are located. But the U'was, a highly traditional indigenous group that inhabits the land, has successfully stopped oil explorations since 1992. The U'wa is an indigenous group of about 7,000 integrants that belongs to the Muisca People (Osborn 1995). Highly organized, the U'wa managed to convey sufficient international attention to successfully deter oil companies from drilling in their territory whose environmental licenses have

been conceded by environmental protection agencies and then reversed by the Constitutional Court in several occasions (Uribe 2005). Benito Kuwaru'wa, the designated international representative of the U'wa people was a recipient of the 1998 Goldman Environmental Price for his fight against the drilling. However, the government through the local oil company Ecopetrol, managed to find oil through unauthorized explorations at one site. A statement by the U'wa people in 2003 summarizes their stance regarding this development: "Today March 4, 2003, we are here to remind Ecopetrol, the National Government, Occidental Petroleum, and the world, that we will never change our position. The U'wa will never negotiate or sell our mother earth, nature, the environment, our culture, our history, and our higher laws. For the U'wa, all of this is not to be sold. It represents our right to live, which takes preference over any right, be that economic social or political."[42] Massive suicide threats and lack of clarity about oil reserves and potential costs of explorations have stopped the process. These explorations are in the government's best interest, but the cohesiveness of the U'wa people and their determination to fight for their special constitutional rights have been sufficient for them to succeed. Hunger strikes and invasions of public buildings that last months are just some of the political demonstrations that indigenous groups and vulnerable populations (or just angry communities) have used to attract public attention to ensure that their rights are properly considered.

---

[42] Luis Tegria, Vicepresident Cabildo Mayor U'wa. Communities with principles have no price. Comunique to the International and national community in response to the discovery of petroleum in our ancestral territory Kera chikara. Available in http://colombia.indymedia.org/news/2003/03/1909.php

Vulnerable Communities may be Present on Plausible Locations

From technical, environmental and economic perspectives, the most suitable place to locate a hazardous waste incinerating facility in Bogota would be near the sources of pollution: the industrial production areas. Bogotá's industrial areas are typically located on the city's periphery, where a considerable number of communities are partly comprised of displaced residents coming from different parts of the country due to paramilitary/guerrilla violence. According to the UN Refugee Agency (UNHCR or ACNUR in Spanish), a large portion of the 580,000 violently forced refugees of Bogotá ("desplazados") settle on communities on the outskirts of the city (ACNUR 2008). These communities may have a similar cohesive representation and political power when compared to a whole indigenous group because they have been declared a special interest group by the government (CONPES 1995) and the constitutional court declared that their situation was a "massive, prolonged and reiterated violation of constitutional rights" (Corte Constitucional 2004)

This situation poses a tremendous challenge for this project both in terms of environmental justice and community involvement. According to Ringquist (2003), inequalities of the distribution of environmental risks posed by polluting facilities are based on intentional discrimination, transitional neighborhood effects, scientific/market rationalizations that ignore important social aspects, and on the basis of avoiding political opposition. (2003:247-251). According to the author "the rational political actor will attempt to site polluting facilities where they will face the least amount of political

resistance" (2003:249). Given the frailness of most displaced communities in Colombia, the proposed solution must avoid developing a hazardous waste management facility next to their settlements.

However, this may be difficult to accomplish because displaced communities tend to relocate constantly around working class industrial neighborhoods until the government finds a way to return them to their place of origin, place them in jobs, or place them in especial neighborhoods, in other words, until they are no longer considered displaced by returning to their hometowns or by being relocated.

In the event that displaced communities or other vulnerable populations settle near a hazardous waste management facility, issues of social and environmental justice can be addressed through community involvement and through the provision of socio-economic and environmental benefits for the project's neighboring communities. According to Ballard and Kuhn (1998), failed siting attempts of hazardous waste management facilities in Canada indicate that "residents consistently respond to their risk perceptions in a not-in-my-backyard (NIMBY) fashion (1998:533), and that such perceptions can be minimized if communities perceive that "positive economic benefits outweigh technical or environmental concerns" (1998:534).

A hazardous waste management solution for Bogota should be consistent with broader community and regional development objectives as well as ensure public health safety and environmental quality. Identifying stakeholders and consulting with them

aboutsiting issues would increase the solution's ability to address a wide range of concerns.

Furthermore, a collaborative relationship with affected parties would give a better understanding of the array of issues/impacts derived from hazardous waste operations that may be perceived as damaging to a community's wellbeing, in terms of health, environmental degradation or job security. Community input can be contrasted against typical welfare indicators such as income, school attendance, public services coverage etc., which are typically taken before and after a project of this magnitude is implemented. This sort of comparison would help improve monitoring of potential environmental impacts as well as help identify issues of risk perception because stakeholder input will give some social meaning to welfare data (Rapley 2003).

Identifying Potential sites for the Development of a HWMF

The proposed solution is intended to serve Bogotá's growing industrial sectors. Since the most important industrial hub both in size and waste generation is located between Bogotá and the southern municipality of Soacha, the proposed HWMF is likely to be placed around this area. This siting approach is based on the risk minimization criteria that indicates that hazardous waste facilities should be near major sources of pollution to minimize potential risks related to hazardous waste transportation and handling.

This location, however, is not exempt from sociopolitical distress, a situation that must be carefully measured before engaging stakeholders in a planning process for a

hazardous waste management facility. Soacha, a municipality with an estimated population of 400,000 people according to the latest census (DANE 2003), has been beset in the past by paramilitary and guerrilla groups that camouflage themselves as political organizers among working class suburban neighborhoods, creating political instability. These groups may be interested in interfering with opposition or supportive actions to land use projects and may pose a security threat to future hazardous waste management operations and neighboring communities' safety. These are security considerations that should lead to specific safety measures to protect the integrity of a given facility and the surrounding natural and social environments where it may be located.

Technological Factors

Technical, Constructability and Operability Requirements For Environmentally Sound Hazardous Waste Management

According to Gillespie (2007), technological factors refer to new technologies, processes or products that can improve business operations, reduce costs, increase the quality of goods and services and benefit both consumers and organizations. Here the emphasis will be on the identification of minimum technical, constructability, and operability requirements for environmentally sound hazardous waste management so as to enable the design of an efficient solution that can fulfill stringent environmental quality standards.

Technical requirements refer to the hazardous waste management process, which includes collection, transportation, storage, sampling, recycling/re-use, and final disposal

of wastes. Constructability refers to the ability to build, adapt, and install an incinerating/ recycling facility under the technical requirements established for the project, whereas operability refers to the resource needs that will keep such a facility functioning.

The technical requirements identified here are for managing hazardous wastes in compliance with the criteria of environmentally sound management. The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal defines environmentally sound management as the ability to "take all practicable steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes" (Basel 2008:3). Taking into consideration this principle and following the Basel Convention's "Updated General Technical Guidelines for the Environmentally Sound Management of Wastes Containing or Contaminated with Persistent Organic Pollutants (POP)" (Basel 2007:18-48), this report explores basic principles for handling, transportation, storage, sampling, pre-treatment, incineration and recycling of hazardous wastes. Some aspects of vendor-technology, site development and post-treatment operations will be explored as well.

Technical Requirements

Waste Handling, Collection, Transportation and Storage

Waste handling occurs when there is an indirect manipulation of wastes (through man-work or machinery) in the process of sorting and packing hazardous wastes in appropriate containers for their transportation, transitory storage, or final disposal (Basel

2002). Hazardous wastes must be collected in appropriate containers to prevent spills, leaks, or transfer of materials that may result in combustion, exposure to human beings or releases to the environment. These containers should be labeled specifying the type of waste and their level of reactivity (i.e explosives, corrosives etc.). The Basel Convention has established Standard Operating Procedures (SOP) for waste collection, packaging and labeling. In Colombia, these standards should correspond as well with the norm per waste type and level of compatibility, which should be specific to Colombian waste streams. These norms are specified by ICONTEC (Colombian Institute for Technical Norms and Certification) and by other guidelines and implementation manuals developed through international agreements subscribed by the Colombian government (SAO, COP, and others).

Waste transportation is considered to be the activity that entails the highest risks in the waste management process because of the risk inherent to operating a motor vehicle. To minimize risk of exposure in an event of an accident it is necessary to study alternative routes for the transportation of properly packaged, identified, and restrained hazardous wastes inside a vehicle that complies with the characteristics defined by the Colombian Ministry of Transport (Ministerio de Transporte 2002). The routes designed should avoid circulation restriction sites, especially if they are of social or environmental concern like streams, schools, and hospitals. Likewise, contingency plans should be developed to minimize spills and accidents during transport as well as an emergency plan in case of the arrival of improperly packaged/restrained wastes.

Waste storage refers to the temporary shelter of wastes that are awaiting laboratory analysis, recycling evaluation, pre-treatment operation, or that are just in line to incineration. This requires the design of storage areas that will prevent the release of hazardous wastes to the environment and exposure to human beings following the guidelines established by the Ministry of Environment and those established by international agreements regarding sealing, ventilation, use of suitable materials, alarm systems, etc. The type of storage chosen and handling methodologies will depend on the state of the waste (liquid, solid, mixes) and its hazardous level (the level of hazardous substances that determines the degree of danger to human beings as defined by the Ministry of Environment) This would determine other storage needs such as solution tanks, containers, and pumps.

Sampling and laboratory analysis

The Colombian government requires sampling only for verification purposes and when requested by competent authorities, thus there is no encouragement to sample wastes from a generator's perspective. Furthermore, up to date there are no qualified laboratories to do the testing (Ministerio de Medio Ambiente 2005a:11). Today, local universities and National Regional Corporations are the sources of technical support to perform sampling and analytical testing. Additionally, testing techniques most commonly used are based on US EPA methods, which may pose a problem for successfully identifying and classifying hazardous wastes at a low cost. According to Yakowitz (1988), it is possible to classify hazardous wastes through a qualitative description of the

waste including its origin, type and components. To Benavides, qualitative classification based on wastes' properties, such as composition, physical state and hazardous characteristic (i.e. flammable) is a viable option when testing is not available (Benavides 2006:3). There are several guidelines for developing an empirical hazardous waste classification system for transportation and storage purposes, which can be introduced in the absence of laboratory testing (Basel 2007, Benavides 2006). However, this empirical procedure does not solve the sampling requirements for incineration and/or for verification purposes before environmental authorities. If no specialty laboratory is developed at the time of the implementation of the proposed solution it might be necessary to design a laboratory for basic sampling and to use on site testing kits and empirical classification techniques to verify dubious waste classification and mixes.

Pre-treatment operations and incineration technology

As defined by the Basel Convention, "incineration is a high temperature thermal treatment process in which hazardous wastes are converted into gases and essentially incombustible solid residue. A high level of technical competence is required in designing, operating and monitoring an incineration facility. It is an integrated activity involving a number of process" (Basel 2002:23).

Normally hazardous wastes are treated before they are incinerated to ensure that there is an appropriate combination of wastes that prevent formation of POPs and that wastes will be able to fit the incinerating chamber, a process commonly known as pre-treatment operations. For hazardous waste incineration, pre-treatment operations may

include PH adjustment, blending, solvent washing, mixing, dewatering, mechanical separation, reduction of waste size, and other mechanisms that could be defined according the type of wastes that need to be treated (Basel 2007:27). The nature of these operations are also relative to the type of incinerator and should be considered when choosing a specific vendor-technology, as they may increase or minimize the costs and risks of operations. Considerations should be made to avoid mixing wastes that would create even more hazardous materials and Persistent Organic Pollutants (POPs).

Incinerators can be designed to accept wastes in any concentration or physical form (Basel 2007:36), although it is important to identify alternative technologies for hazardous waste incineration and examine their efficiency to safely dispose of common hazardous compounds like PCBs (polychlorinated biphenyls, a type of persistent organic pollutant typically present in coolants, insulating fluids and adhesives)[43] and other persistent bio-cumulative substances. This information can be found in different reports, such as the Inventory of Worldwide PCB Destruction Capacity (UNEP 2004). Once the technology sought is established, it would be possible to identify vendors in Colombia and abroad and to define alternative options (pros and cons).

Today, hazardous waste incinerators are designed to minimize new formation of POPs. Variance in emissions and pollutants is more closely related to efficiency in the operability of the combustor than on the type of filtering devices applied.

Costs of incineration systems vary depending on the vendor/technology chosen.

---

[43] Stockholm Convention on Persistent Organic Pollutants (2008). PCBs Overview. Available in http://chm.pops.int/Programmes/PCBs/Overview/tabid/273/language/en-US/Default.aspx

Some vendors in the US like BASIC Systems, for example, offer incinerator solutions with energy recovery systems that exceed US EPA environmental emission standards for about five million dollars (costs are estimated from information offered by the vendor about hazardous waste incinerators, filters and energy recovery systems). There are other vendors with much more sophisticated systems, such as the ones offered by Von Roll Inova, a Swiss manufacturer and technology developer for waste management. Although this vendor did not provide information about the costs of its systems, it was possible to find information about estimated costs for previous projects contracted with Inova. The one built in the Netherlands, for example, had an estimated cost of 353 million dollars with the capacity to produce 600,000 Mega Watts of electricity per year (this system included incinerators, wastewater treatment systems, filtering devices and electrical instrumentation and controls) (VonRoll Inova 2009). Both systems are environmentally safe, but of course, the Inova system has more capacity to treat wastes and produce energy than the other. Most importantly, it has more computerization capabilities, which minimizes the risks posed by deficient Standard Operating Procedures (SOP).

Post-treatment operations and emissions control

According to the Basel Convention, complete combustion of hazardous wastes "is only a theoretical concept being contrary to the laws of nature, so the development of a 100 percent efficient incinerator is not possible. The combination of the most efficient combustion and gas cleaning systems can, however, reduce the release of undesirable contaminants virtually to the maximum extent possible" (Basel 2002:14).

Incineration reduces waste volumes in about 90 percent. Remaining substances typically require additional treatment to minimize the release of gasses, dust, and organic compounds. This process is commonly referred to as post-treatment operations, which includes the use of filtering mechanisms to prevent emissions dispersion.

Regardless of the efficiency in the combustion process and the level of standardization, post-treatment of incineration residues such as bottom ash and gas emissions or air particulate matter should be one of the most important components of the hazardous waste management cycle because they can guarantee to a greater extent that there would be virtually no harmful releases to humans and the environment. These may include the use of cyclones, electrostatic filters, scrubbers, static bed filters, carbon absorption, selective catalytic reduction, rapid quenching systems, and disposition of ashes in landfills (Basel 2007:36). As with pre-treatment operations, post-treatment will depend on the type/amount of waste and the type of incinerator used.

Operability Requirements

Incinerators can be customized at a relatively low cost for managing specific combinations of hazardous materials in all states (solids, liquids etc.) with adequate temperature control mechanisms for specific mixtures, which would prevent production of dioxins and Persistent Organic Pollutants (POPs).

There are widely known aspects of operation that should be taken into account, such as preventing mixing hazardous wastes that contain chlorines and hydrocarbons during pre-treatment, incineration and post-treatment operations to avoid POP formation.

Additionally, according to the Basel technical guidelines of incineration on land, "incompatible wastes should be segregated on the basis of their corrosive and or reactive properties" (Basel 2002:16) to prevent accidents such as formation of flammable gases, explosions and emissions of toxic dusts.

In terms of post-combustion residues like bottom ash, they should be carefully managed because the ash needs to be landfilled or recycled, which could mean a transfer of pollutants to soil and water resources. If dioxin formation is prevented, non-toxic ash could be re-used instead of landfilled, which would represent an environmental asset that would reduce waste management costs.

Constructability: Land and Site Development Requirements

These requirements refer to the site selection parameters that should be considered to examine each potential location for a HWMF, which should evaluate aspects related to human health, environmental protection and protection of the private/public property (Basel 2002). Parameters of suitable candidates may include but do not exclusively depend on site hydrology (the dryer the land the less the possibility of contaminating underground water), geology, presence of sensitive habitat, urbanization of surrounding areas, socio-economic aspects, streams in and around the site (rivers, creeks etc.), location of markets for recovered materials and availability and cost of land (Basel 2002:19).

Previously it has been argued that from an environmental protection and technical perspective an industrial hazardous waste incinerating/recycling plant for

Bogotá would be ideally located on the manufacturing industrial corridor Bogotá-Soacha, identified a the source of 15 percent of the total hazardous waste generation in Colombia (Ministerio de Medio Ambiente, 2005a). Besides location, space requirements should be examined as a function of facility type (incinerating/recycling), capacity, and type of wastes managed (physical form).

A HWMF should be located in the proximity of potential service recipients, which would allow for the design of high efficiency routes that will minimize transportation related emergencies, as well as save costs and reduce fossil fuel emissions. It will be necessary to determine buffer zones according to the proximity of the incinerators and storage facilities to human settlements, agricultural land or cattle.

About Recycling

The proposed solution should prioritize recycling opportunities to prevent the risk posed by incineration and to minimize waste accumulation and final disposition costs. Ideally, the plant would incinerate only those wastes that cannot be re-used or recycled. Materials to be produced from recycling, such as metal, should be based on an estimation of market needs.

Environmental Factors

According to Gillespie (2007) an analysis of environmental factors that may affect a business activity should include issues of weather, which may impact certain industries like farming and tourism, and broader environmental protection targets or concerns like climate change. Here the emphasis will be on environmental and health concerns derived

from hazardous waste management activities.

Environmental Protection and Public Health

The main concerns derived from hazardous waste management facilities are related to the health risks associated with exposure to pollutants, either directly to humans or through ecosystem contamination. For hazardous waste incineration, risks of exposure to harmful emissions (i.e. semi-volatile metal, dioxin emissions, acid gasses and particulate matter) are frequently associated with respiratory ailments, carcinogenic effects and interferences of the reproductive cycle (Costner and Thornton 1990). However, many of the latest risk assessment studies indicate that there is no direct correlation between hazardous waste incineration and health detriment when emissions are compared to other "socially acceptable" sources of air pollution (Sedman and Esparza 1991, Shy et al 1995, Kelly 1995). Furthermore, Roberts and Chen (2006) argue that health impacts from incineration facilities are more directly related to public anxieties than an actual increase in airborne contaminants. To the authors, incineration "may have a significant harmful effect on the mental physical and emotional health of local residents, regardless of whether emissions have any direct effect on health" (2006:261).

Health and environmental risks associated with waste incineration can be minimized using modern incineration technology and meeting stringent requirements and standards for design, operation and pollution control (Ontario Ministry of Environment 1999). However, neighboring communities to incineration facilities do face the risk of

exposure. It is the risk factor that drives rejection of these facilities, generally perceived as unwanted land-use projects.

Preventing hazardous waste incineration impacts on human health and the environment

An understanding of technical requirements and technological limitations is crucial to identify environmental and health risks that could be prevented. A Google search of adverse health/environmental effects of hazardous waste incineration results in about 60,000 sites. However, a review of the first 100 articles that oppose hazardous waste incineration showed little or no scientific background. Additionally, further research of peer-reviewed articles that question the environmental and health impacts of hazardous waste incineration showed that properly cared facilities pose no significant risk. Many of the articles found online opposing incineration due to alleged health and environmental effects sited Costner and Thornton's (1990) Greenpeace report about health impacts from release of contaminants from incineration facilities in the US and abroad. The report used an epidemiological study that showed incidence in larynx cancer at one site, a health survey that found cancer and respiratory ailments at another site, a study that found twins incidence and other related health concerns at other sites. However, this report did not measure amount of dioxins and other harmful emissions from the incineration source nor controlled for extraneous variables that may have cause health impacts in neighboring populations to incineration facilities. Kelly (1995) studied the scientific basis of each one of the cases presented on the Greenpeace report and found

that results were neither "scientifically accurate" nor "factually based," lacking important features for epidemiological analysis such as statistical data or calculations, demographic information, correlations between exposure to facility emissions and twining, air and air emissions monitoring to make comparisons, among others. It must be noted that Dr. Kelly is the CEO of Delta Toxicology, an environmental risk assessment organization that serves corporate clients, like Bayer and CEMEX, as well as government agencies like the US EPA and the US department of Energy, and public institutions like the University of Newcastle, Australia. Dr. Kelly is an experienced researcher prevention and assessment of environmental risks, and no ethical concerns about her work were found during this study.

On the other hand, there are several peer-reviewed studies that developed analytical methodologies to measure and assess hazardous waste incineration effects and compare risks. Roberts and Chen (2006) developed a quantitative method to measure risk, resulting in the calculation of a single number to assess the probability of dying from hazardous waste incineration emissions: 1 in 4 million chances. According to the authors, "to facilitate better public understanding of the comparative risk of incinerator emissions, we propose a simple method of deriving a single annual risk figure allowing comparison with the risk of dying from other causes with which the public is more familiar" (2006:261). Other authors analyzed specific health and environmental risks. Shy et al. (1995) evaluated adverse respiratory effects at different communities to determine if they were more likely to suffer respiratory ailments due to their proximity to

hazardous waste incineration facilities. It is one of the first studies that simultaneously measured air quality and respiratory function and symptoms to compare incinerator and non- incinerator communities. The authors found that "even though an incinerator may be a point source of air pollution in a community, its contribution to the total mass air pollution may be relatively small and nearly undetectable by standard air monitoring… we did not find consistent community differences in the prevalence of chronic or acute respiratory symptoms" (1995:21-722). Similar findings regarding emissions and health effects are found in Sedman and Esparza (1991), who measured semi-volatile metal and dioxin emissions. Finally, Roberts et al. (1998) gathered various studies regarding health and environmental impacts of hazardous waste incineration, with evaluations of ecological effects.

The review of these studies provided a better understanding of the health and environmental risks posed by properly executed hazardous waste incineration when compared with other sources of contamination that are more socially acceptable, such as transportation emissions. The results of these studies helped link the relationship between actual health and environmental detriment and risk perception, which has an important impact on other social factors.

Monitoring incineration and hazardous waste treatment emissions is an indispensable component to secure human and environmental health. However, emissions monitoring can be very difficult because it requires monitoring air and resource quality previous to hazardous waste management operations. Environmental impacts assessments

and reports required for constructing and operating a hazardous waste management facility not only require an estimation of potential impacts, but also require evaluation of local air quality and urban ecosystems mitigation measures and implementation plans.

Legal Factors

According to Gillespie, legal factors are "related to the legal environment in which firms operate" (2007), therefore the analysis will be centered in the Colombian hazardous waste legal framework as well as in international legal frameworks applicable in Colombia through ratified treaties and agreements. This review also includes technical guidelines with political and legal implications.

Borrowing from previous thesis work done by Jimenez (2005) for the laboratory management of hazardous wastes at Universidad de Los Andes in Bogotá, it was possible to identify early relevant legislation. Probably the oldest current law related to hazardous wastes in Colombia is the Law 09 of January 24 of 1979 (Congreso de la República de Colombia 1979), which establishes a code of sanitary measures for the protection of environmental resources, especially water (for the sanitary control of permitted water uses). The main relevance of this law is that it confers responsibility to hazardous waste generators for damaging public health and the natural environment, which is the basis for subsequent laws that will finally seek to reduce and control hazardous waste generation in Colombia. Decree 1594 of June 26 of 1984 (Ministerio de Agricultura 1984) further regulates water usages and liquid residues, forbidding discharges of hazardous wastes and characterizing hazardous components, properties and concentrations for their

management and transportation. Most importantly, this regulation contains the first sanction scheme for non-complying generators and users. The resolution 2309 of February 24 of 1986 (Ministerio de Salud 1986) is a detailed legislation for hazardous waste management, defining waste characteristics and compatibility for storage and treatment. The next most important law is the later resolution 189 of July15 of 1994 (Ministerio de Medio Ambiente 1994) that defines parameters for hazardous waste classification and forbids the introduction of hazardous wastes from other countries. This resolution was an antecedent for subsequent laws regarding the attachment of Colombia to the Basel Convention for the control of transboundary movements of hazardous wastes (formalized later by the Law 253 of January 9 of 1996).

From the previous review of national legislation it is evident that it took over 15 years, from 1979 until 1996, to start building a coherent hazardous waste regulation framework under internationally standardized technical guidelines. It would take almost another 10 years to generate a policy document for environmentally sound hazardous waste management (Ministerio de Medio Ambiente 2005a). However, the pace of policy achievements has accelerated for the past five years. Most notably, Resolution 058 of 2002 (Ministerio de Medio Ambiente 2002), established maximum limits of emissions from waste incineration; Decree 4741 of 2005 (Ministerio de Medio Ambiente 2005b) enforced a policy shift from hazardous waste disposal to hazardous waste management; and Decree 1299 of April 22 of 2008 (Ministerio de Medio Ambiente 2008), requires from all industrial companies to create an internal department for environmental

management with dedicated staff in charge of complying with current legislation regarding environmental protection. This is one of the most important pieces of legislation because it mandates an incorporation of the environmental dimension within an organization's decision-making process. Additionally, environmental management departments are required to report prevention, mitigation, correction and compensation actions from the environmental impacts generated by industrial activities. This project would be required to have such a department.

The three last legislations discussed here are coherent with international environmental protection agreements acquired by Colombia. Overall, national policy regarding hazardous wastes makes direct reference to The Montreal Protocol for the elimination of substances that deplete the ozone layer (UNEP 2006a), the Basel Convention for the control of transboundary movements of hazardous wastes and their disposal (UNEP 2008a), the Stockholm Convention on Persistent Organic Pollutants (UNEP 2008b), the Rotterdam Convention on shared responsibility to control trade and use of hazardous chemicals (UNEP and FAO 2004), and the working group for the SICM, Strategic Approach to International Chemicals Management (UNEP 2006b).

The relevance of international agreements and their impact on recent local legislation denotes a special interest for protecting environmental resources that are of national security concern, such as water resources. Water is a resource of national security concern since previous draughts in Colombia triggered by unsustainable management practices and climate change forced the central government to impose

national energy cuts for over a year. During this time (1991-1992) hydroelectric projects, which are the main energy sources in a country typically flooded with water, could not produce enough energy to satisfy the demand. The Ministry of Environment was created in 1993, almost as a reaction to the need to protect and sustain the natural resources that support the country's existence, especially in terms of energy and other major commodities, like coffee and other agricultural products.

The revision of the hazardous waste policy framework should enable the identification of opportunities for the consolidation of a business solution, and of possible threats derived from rather recently established political goals that may yet need to be enforced.

The hazardous waste policy framework has important repercussions on other macro environmental factors identified in this report. This is particularly relevant for technology as well as health and environmental factors.

SWOT Analysis

Evaluating the conditions established for the proposed solution and indentifying future challenges

Taking as a basis the previous macro-environmental analysis the SWOT exercise will help understand two main issues. In first place, from an evaluative perspective, SWOT would help identify the strengths and weaknesses that characterize the proposed solution. In second place, from a strategic planning perspective, it would help identify

opportunities and threats that may emerge for an organization that would manage Bogota's industrial hazardous wastes.

In general business planning, SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) is a powerful tool that enables the design of strategies to achieve specific objectives. Strengths and weaknesses are usually identified as the *internal* organizational attributes that may help achieve or delay specific goals and objectives whereas Opportunities and Threats are typically defined as the *external* conditions that may help achieve specific goals or may harm business performance (Bradford et al 2000). According to Gillespie (2007) SWOT is an instrument to develop strategies because it helps understand what are the present conditions of a particular business and what can be done to improve those conditions in the future so as to increase efficiency and profitability.

Since no organization has yet been established, the focus of this analysis will not be to evaluate organizational performance but to identify the conditions needed for the development of an environmentally sound waste management solution. Strengths and weaknesses identified here will be related to some of these conditions and requirements, whereas opportunities and threats will be related to the external conditions that may facilitate or interfere with the consolidation of a hazardous waste management private initiative.

The SWOT exercise is intended to identify the range of strategic services that could be implemented to help establish an organization around this business solution. The

analysis is centered on two methodological questions: First, how to use strengths to take advantage of business opportunities around hazardous waste management and minimize external threats for a future business proposition? And second, how to overcome weaknesses that would prevent taking advantage of opportunities while minimizing threats to develop such a business proposition?

Understanding Strengths: Conditions and requirements that may help develop a business opportunity around hazardous waste management

The issues explored so far indicate that a hazardous waste management solution for Bogotá based on environmentally sound practices minimally requires recycling technology, efficient and advanced incineration technology, filtering mechanisms, pre-treatment and post-treatment capabilities and if economically feasible, waste-to-energy components. Such a technological platform would be supported by a service-based solution approach that could perhaps offer economic incentives to help mitigate waste management costs while supporting current legislation for hazardous waste management and the expansion of recycling and reusing opportunities that lead to cleaner production.

But an offer of efficient and environmentally sound hazardous waste disposal and recycling must be able to meet adequate demand, so it would be able to offer savings to reduce waste management costs for hazardous waste generators and increase reuse and recycling opportunities. The proposed solution should quickly identify what are the particular industries that may be most attracted by such an offer. One may speculate that these industries are probably the ones that have sustainability or social responsibility

goals that are defined as organizational targets. This is a relatively easy to find sort of information because these industries tend to be part of larger organizations or are clients of big corporations, based locally or abroad, that make sufficient efforts to communicate their adherence to environmental protection and their social responsibility approach. For example, most of the European Union's businesses today require from their suppliers, product representatives or importers, to meet certain environmental quality criteria so the products thy consume, trade or represent would comply with their local regulations. According to Kirchenstein and Jump (2006), businesses outside the European Union "will soon discover that pressure is mounting for their products to meet minimum environmental standards now been drafted by the European Community (EC). Companies will be pressed to demonstrate that their products and production facilities and operations (1) help preserve, protect and improve the environment, (2) contribute toward protecting human health, and (3) ensure a prudent and rational use of natural resources" (2009:53).

Further strategic planning should address this aspect by identifying organizations with such sustainability targets to design services specifically tailored to help them certify that they have reached their goals. One approach would be to provide them assistance in the process of acquiring international environmental management standards such as ecolabels, environmental audits or ISO (International Organization for Standardization) certifications of environmental management. The idea would be to help these

organizations achieve sustainability goals through the use of the proposed hazardous waste management solution and help them certify they have done so.

It is plausible to say that today most organizations are likely to make efforts to protect the environment and support broader sustainability targets like climate change abatement and waste minimization. But it is also plausible to say that there are some firms that are not preoccupied about environmental protection and may not be interested in mitigating potentially damaging impacts of their industrial activities. The reasons behind managerial decisions that neglect the environment may be economic or ideological. Some managers do not have a clear understanding about life cycles and climate stability. Others may be aware of this, but may not be willing to internalize the costs of using natural resources in a sustainable manner.

Establishing a direct relationship between hazardous waste generators, environmental authorities, environmental agencies and waste management providers may help understand the reasons behind this managerial misbehavior towards the environment. The purpose of this relationship would be to engage firms in the proposed solution so managers can strengthen or develop an understanding about the impact of hazardous waste accumulation on environmental quality and human health. Such relationships may be supported by the provision of services based on market mechanisms that could help these firms reduce waste management costs so they can start perceiving the benefits of shifting towards cleaner and more responsible forms of production.

Engaging a wide range of industrial hazardous waste generators, in other words, increasing demand for the proposed solution, will largely depend on governmental and institutional enforcement capabilities. Strategic planning should be focused on the development of partnerships with policy enforcement agencies so as to gain institutional support for the proposed solution while strengthening governmental enforcement capacities for hazardous waste management.

Since environmental authorities are in the process of building a national hazardous waste inventory, the proposed solution could support this effort by helping potential users of the solution to prepare their individual inventories and submit them to environmental authorities. This process could be developed as a service and would require establishing partnerships with the national environmental information system SINA (Sistema Nacional Ambiental).

Flexibility given by current regulation standards should allow waste management providers to develop a range of services that would help generators to comply with the law, avoid fines and transitionally move towards environmentally sound hazardous waste management practices.

Waste-to-energy technologies that may generate energy excesses are one of the mechanisms that may enable market-based solutions by allowing a generator get energy credits in exchange of paying for hazardous waste final treatment and disposal. Under this transaction, the generator becomes a *customer* for environmentally sound hazardous waste disposal because of the motivation created by receiving a tangible benefit.

Moreover, here it will be argued that under this type of transaction the generator becomes a *service recipient* of the proposed hazardous waste management solution.

Similar incentives can be identified from recycling activities and will be further analyzed through the strategic service solutions explored in the next chapter.

Overcoming Weaknesses: Conditions that may threat a hazardous waste management business opportunity

In terms of technological requirements, although latest waste-to energy technology can be more expensive than a regular incinerator, return on the investment is expected at the very least by fulfilling future operability energy needs. If sufficient demand for incineration is achieved, then energy production is expected to support energy credits to be negotiated with future service recipients (hazardous waste generators).

Other conditions for consolidating a hazardous waste management solution are related in first place, to the development of low cost environmental and health monitoring systems to minimize incineration emission levels and in the second place, to the development of alternative technical procedures for hazardous waste sampling and hazardous waste management training.

These two requirements may be addressed by engaging other agents in the proposed solution. Communities directly affected by hazardous waste treatment may be service recipients of the solution as well in the sense that may become beneficiaries of the solution by receiving new skills that would allow them to participate in activities such as

air quality monitoring, green infrastructure design efforts and other labor related activities. This entails engaging neighborhood and non-governmental organizations as well as individuals concerned with hazardous waste pollution and mismanagement.

The purpose of engaging communities is to first, create an awareness of the social value provided by hazardous waste management. Second, to increase knowledge about hazardous waste management benefits and risks. Third, to build future constructability support. The engagement component relies on the ability to transfer to these community members some monitoring power regarding their own health and safety and to facilitate training that would allow them to participate on future hazardous waste management activities.

About some risks

Other aspects that were not recognized as conditions or requirements necessary to build the business-solution were rather identified as potential risks. Therefore the following risk factors should be the focus of further analysis throughout the development of a hazardous waste management solution.

Security

Insurgent groups could target hazardous waste management operations and facilities. In Colombia both guerrilla groups (FARC and ELN) as well as paramilitary groups are known for attacking public and private infrastructure to achieve political ambitions. This is part of the political environment in Colombia and any enterprise

intending to do business in this country should take security measures according to the location of a future organization and its area of influence.

Specific aspects that should be considered include the social and political activism mix of neighboring communities, which may facilitate identification of insurgent activities in a given area that may pose a specific threat to facilities and operations. Since imported technology would need to be adapted to the country, foreign technicians would probably travel to Colombia. The nationalities of workers should be considered here because international workers are more likely to be kidnapped for political reasons. Finally, it is important to identify political interests that may be affected by the new enterprise, even if those interests are, or appear to be legitimate. Some of these interests may include landfill managers that illegally dispose of hazardous wastes and charge a fee for it, uncontrolled on-site incineration enterprises, or large generators that simply discharge their waste on streams or any other natural environment.

Additionally, international terrorism should be considered as well. Under current world's state of affairs, any major infrastructure project needs to secure its area of operations and the people that work and live around it, especially if it handles hazardous materials.

Transportation

Hazardous waste management's highest risks are not posed by incineration or its related treatment, but by transportation hazards that may lead to spills threatening the life of both humans and the natural environment. As previously argued, using appropriate

vehicles and restrains are imperative. However, transit related accidents might still occur and cause damages. Therefore special attention should be made to security measures regarding hazardous waste transportation. Alternative routing and hours of operations should be carefully studied to minimize exposure risks in case of a spill. The type of wastes transported and the mix of wastes in a single vehicle (even if stored on separate containers) should also be considered. Finally, the transportation factor should be carefully evaluated when choosing the site for a hazardous waste treatment facility to avoid crossing streams, residential neighborhoods and social infrastructure, such as schools and hospitals.

Changes in Commodity prices

The lower the price of commodities that could be obtained from recycling hazardous materials the less attractive it would be for industrial manufacturing corporations to adhere to re-use and recycling solutions. Therefore, future economic feasibility studies should take into account tendencies in commodity prices and study alternative solutions.

Energy is another commodity that may fluctuate; thus it should be considered as a risk factor for the proposed solution. Energy prices have recently dropped due to lower oil prices. If this trend continues it would threaten the ability of the solution to exchange energy credits with hazardous waste generators. For this strategy to work, energy provided by the solution should be cheaper than the one the generator typically purchases.

The charged sociopolitical environment in Colombia and the limited enforcement capability of environmental authorities may adversely interfere with a future business initiative around hazardous waste management.

However, technical and financial constrains in enforcement, training, laboratory testing and monitoring capabilities can be addressed through a combination of service solutions that involves multiple stakeholders. A service approach based on economic incentives capable of engaging stakeholders would help create the conditions needed to position environmentally sound hazardous waste management as an important component of local industrial activities. To support the sustainability of the proposed solution, one of the main goals of strategic planning approaches should be to shift the notion of hazardous waste management as a disposal service with no other value towards a service-solution that can provide environmental, social, and economic gains.

CHAPTER 3

Defining a Business Planning Approach that Supports the Design of Strategic Hazardous Waste Management Services

The previous PESTEL analysis helped identify the minimum technological requirements and the sociopolitical and economic conditions that would determine the development of an environmentally sound hazardous waste management solution for Bogota. Later, these issues were examined using SWOT analysis to sort out the requirements and conditions that would be supportive of a hazardous waste management business in Colombia and the conditions that would represent a threat for such an enterprise. Advantageous conditions established for the proposed solution were defined as strengths that could be further developed as business opportunities. Disadvantageous conditions were defined as weaknesses that could threat business sustainability. Once plausible threats and opportunities are identified it is possible to define the business strategy that would help strengthen the conditions for establishing a sustainable,[44] service-oriented, hazardous waste management business in Colombia.

Taking into consideration all the information examined here, such a strategic approach would be defined as follows: A hazardous waste management solution for Bogota that would be based on a service business platform should be supported by a flexible business architecture that enables key stakeholder engagement and therefore,

[44] The term "sustainable business" is being used here to refer to the ability to maintain and support a hazardous waste management business over time without generating a significant impact to the natural environment (Smukowski, 2006).

increases the likelihood of developing high value services so as to increase the demand for the proposed solution.

To define a business planning methodology based on service delivery, one may think about the business forms of organization that would support the development of hazardous waste management services so as to increase the number of users of the proposed solution. In this chapter the analysis will be centered on identifying the business organizational forms that are most likely to support the delivery of hazardous waste management services given the environmental, technical, political, legal and socio-economic factors that are typical of the waste management business in Colombia.

The business forms explored here are based on network associations and market-based mechanisms. The main argument here is that these business forms of organization should be mapped into a service-oriented business architecture that supports a wide spectrum of stakeholder engagement strategies and enables the design and delivery of adequate waste management services.

Understanding the Concept of Business Architecture

The term *business architecture* refers to an organization's structural design. Two main streams of theoretical development include the domain of the Enterprise Business Architecture (EBA) and the domain of the Service Oriented Architecture (SOA). For EBA proponents (Myrick et al 2005, Whittle 2005), a business architecture is a representation of the integrated structural design of the enterprise that provides common ground to guide people's actions and enable the development of technology platforms

that make possible the delivery of products and services. An Enterprise Business Architecture is a "shared domain from which all strategic initiatives are linked (…) it is a definition for what the enterprise must produce to satisfy its customers, compete in a market, deal with its suppliers, sustain operations, and care for its employees" (Whittle 2005). Defining an EBA is a formal exercise of conceiving and defining what the enterprise is (its values and objectives), what it does and what it can do (its strategies), what are the relationships that support its operations (with the internal and external environments), and what are the resources it needs to develop products and services.

In the SOA domain the main emphasis is on Information Technology (IT) and service integration; here business architecture is understood in terms of the relationship between a business strategy and its information and communication technology. According to Erl (2007), the SOA would represent a service-oriented model of the enterprise that supports business agility and cost-effectiveness by reducing difficulties related to software complexity and lack of software integration, which would limit the range of services (web-based or not) that such an enterprise may be able to provide. These difficulties could be diminished or eliminated through the introduction of new technology and IT platforms that would support the implementation of service oriented solutions. According to this author, the actual face of a service-oriented architecture is unique to each enterprise. The common denominator would be the service orientation, which would enhance the ability of an enterprise to fulfill specific strategic goals aimed at building a growing range of services.

According to an IBM executive brief,[45] "businesses are only as flexible as the IT systems that support them" (IBM 2006). This implies that a business strategy can be limited by its IT capabilities, shifting the SOA focus towards the construction of IT architectures that can allow as much flexibility as the business requires to be able to maintain or improve its competitive position within a determined market.

The term *service orientation* has been developed in the computing domain to describe a design paradigm that refers to the ability to build or assemble flexible computing resources that would enable functionalities that could become services (Erl 2007). Previously it has been argued that services should not be confused with "intangible" IT products but should be rather understood as transactions imbedded in human interactions that concomitantly occur in the process of service production and delivery. In the realm of SOA, these services may include business and IT functionalities that would be available to customers through system integration or technology improvements, or simply through IT business transactions (Channabasavaiah et al 2003). Tangible or intangible computing resources, including the service-oriented platform, would be part of the infrastructure that supports service development and deployment.

In the SOA domain, computing resources should be flexible enough to change on demand yet independent from one another to be able to serve specific customer needs and

---

[45] A substantial stream of theoretical development about the SOA domain has been developed under the umbrella of IBM through their service-oriented designs and SOA technology platforms (2009). However, there are a wide variety of SOA services and technology platforms developed through different companies with different emphases (see Microsoft 2007, and Cisco 2009).

increase their capacity for change (the more dependent computing resources or applications are from one another the more difficult it would be for them to adapt to change and help enhance functionality) (Channabasavaiah et al 2003). This concept of building flexible (easily integrated) yet independent services (capable of change) is particularly relevant to the proposed strategic approach because it serves as a metaphor for understanding how a flexible business architecture could support a wide range of waste management services so as to increase the likelihood of establishing a sustainable hazardous waste management solution.

Building a Flexible Business Architecture Model

The purpose of this analysis is not to map the proposed solution's business architecture, but to develop an understanding of the qualities and characteristics that such architecture should have in order to support the development of a hazardous waste management solution that is based on a service-oriented business model.

The idea developed here of a service-oriented business architecture for waste management combines the general guidelines of the EBA approach with the service notion typical of the SOA domain (the idea of *service orientation* previously explored), which relies on a flexibility principle. The purpose of combining these two approaches is to formulate general guidelines for a structural design of an organization that would be flexible enough to support the development of hazardous waste management services aimed at covering a wide range of waste generator's needs as well as hazardous waste minimization objectives.

A service orientation would require a high range of flexibility not only in the way services are produced and delivered, but also in the way the organizational structure is conceived. For instance, in terms of business governance, a flexible architecture for the proposed solution would allow variability within governance forms of transaction and association. From a business planning perspective, defining such variability would allow the development of both formal agreements (e.g. contractual or based on legal entities) and informal agreements (e.g. made through other organizations or cooperatives and largely based on trust). Simply put, if the proposed solution's architecture supports different governance forms, it increases its ability to support various types of engagement strategies that would be aimed at increasing the demand for environmentally sound hazardous waste management services. If building such a demand depends on engagement strategies, and engagement strategies are somewhat dependent on the ability to establish a flexible business, one may argue that paying attention to the design of a flexible business model is crucial to secure the proposed solution's long-term sustainability.

Defining a Business Architecture that Supports the Design and Delivery of Hazardous Waste Management Services

The definition of business architecture taken here specifically refers to the "blueprint of the enterprise that provides a common understanding of the organization and is used to align strategic objectives and tactical demands" (OMG 2008). Such a blueprint should coordinate an integrated view of the organization, including its

strategies, which should be based on the tactical goals of increasing demand while reducing waste management costs; its capabilities, which would rely on the services the solution would be capable to deliver; its knowledge base, in terms of information and the shared semantics that facilitate communication among stakeholders; and its organizational structure, which defines the roles and relationships between business units (OMG 2008). Most importantly, defining flexibility within the business architecture for the proposed solution would help identify a variety of roles and relationships among working departments and stakeholders that could limit or enhance the possibilities for increasing the demand for the proposed solution's services.

The importance of defining a flexible business architecture for the proposed HWMS

The more flexible the business model that supports the proposed HWMS, the higher the solution's ability to adapt strategies, information channels and technology to the changing circumstances of the waste management market. The main argument here is that to achieve this level of adaptation or flexibility it is necessary to identify the business forms of organization that are most likely to support the engagement of hazardous waste generators into environmentally sound waste management practices. As previously argued, these engagement strategies would be largely based on the provision of cost-effective hazardous waste management services. The business forms of organization that would be identified here would be analyzed from a business planning perspective so as to recognize the business association forms that are most likely to support the development

of flexible (easily integrated) yet independent services (capable of rapid adaptation or change). The purpose of doing this type of analysis is to avoid developing strategies without understanding first the organizational forms that could support those strategies without affecting other business capabilities (which could become services) or other tactical goals. For example, engagement strategies that would be based on market or financial incentives should not interfere or conflict, in principle, with the ability to build engagement strategies based on network-trust associations related to waste minimization objectives. To avoid interference or conflicting goals established for those services, the proposed business architecture should elaborate on the nature of such network and market-based forms of association and define under which conditions those association forms would be supportive of the proposed solution's goals. These aspects will be discussed in detail later in this chapter.

Establishing a flexible business infrastructure or architecture enables an efficient alignment among business components (strategies, IT, management, etc.) that may increase business performance. Such a level of flexibility would determine what the organization is actually capable of doing with its strategies, information and technology. In other words, flexibility within the business architecture may actually define the range of services that the proposed solution will be able to support.

Developing a flexible business architecture for waste management may be as important in terms of business performance as it is in terms of business sustainability (i.e. the ability of the business to adapt to changes and endure or increase its growth without

generating impacts to the natural environment). Because the proposed solution is in many ways a public infrastructure service provided by private parties, one may argue that it is important for business sustainability that potential users (i.e. industrial hazardous waste generators), the governmental institutions involved in waste management issues, and the general public, can perceive the proposed organization as a public service. A business architecture that is flexible enough to support a wide range of hazardous waste management services would be able to benefit a wider range of stakeholders, including non-waste generators. Communities that are affected by hazardous waste dumping may benefit from hazardous waste management activities through waste minimization, proper disposal and developer's impact mitigation strategies (such as in green infrastructure developments). Equally, hazardous waste generators that may be able to increase their recycling capabilities and see improved environmental services that may be available to them (or the general public) may perceive the proposed solution as a public service. This would be the case if, for instance, people can perceive improved water quality or the ability to maximize investments in water treatment costs as a result of less hazardous waste dumping. For governmental institutions and environmental protection agencies and organizations, the wider the services the proposed solution can provide the higher the support to their environmental protection efforts.

Developing strategies from a service oriented business architecture may help identify business capabilities that otherwise would be difficult to perceive at the business action level (as opposed to a planning stage). Increasing enabling business capabilities

may enhance the value of the services that the HWMS would be able to provide and thus increase the potential number of users (i.e. industrial hazardous waste generators) of the proposed solution. The argument developed here is that strategies need to be sorted out at the business architecture level and not at the action (ad-hoc) level because at the architecture level (i.e. at the planning level) they would be easier to develop and perhaps more flexible to adapt and implement.

Why a service based business architecture requires so much flexibility?

The rapid evolution of information technology has completely transformed the way businesses operate. According to Versteeg and Bouwman (2006), "the internet makes a number of new business models possible [but it requires a great amount of flexibility] in order to respond quickly to the changing circumstances and to adapt the business model if necessary" (2006:91).

Palmisano (2006) identified three main changes that in the past three decades have revolutionized the way business operate: First, the liberation of trade and investment barriers across the world. Second, the use of information technology (IT). Third, the standardization of business rules and technology platforms. To Palmisano, the combination and expansion of these three developments have shaped a new business paradigm referred to as the *globally integrated enterprise:* "the globally integrated enterprise is a company that fashions its strategy, its management and its operations in pursuit of a new goal: the integration of production and value delivery worldwide" (2006:129).

This idea of value delivery is closely linked to the idea of services used here in the sense that the value of a business and its competitive edge may be measured by the reach and quality of the services it is capable to provide. Developers of products and services can make decisions about their suppliers and partners based on the idea of value delivery, which may be defined by the quality or the amount of services that they may be able to get, or the ability to improve and increase the number of services they may provide by partnering with an enabling businesses.

The Importance of Stakeholder Engagement for the Design of a Service Oriented Architecture

Schekkerman (2006) argues that defining and mapping a business architecture should be a holistic exercise in the sense that all aspects associated with business performance should be addressed, including aspects of business planning (such as goals, visions and strategies), aspects of business operations (organizational structures and processes) and aspects of enabling technological and IT infrastructure. To this author, it is important to have a holistic business architecture approach, supported by collaborative efforts between all key stakeholders and value net members of an organization. A collaborative planning effort would help uphold a common vision of the organization's future, increase it's ability to build relationships with external partners, help develop a proactive organization capable of meeting costumer demands, and increase the organization's ability to prepare for rapid and unexpected changes (2006:25-26). Taking into consideration previous analysis about recurrent issues of community engagement

related to the development of sanitation infrastructure projects in Colombia, one may argue that engagement strategies should be at the core of the proposed business strategic approach, especially because this approach is actually focused on aspects of stakeholder engagement to increase or help build a demand for environmentally sound hazardous waste management services.

How to Develop Strategic Services for a HWMS for Bogota from a Service-Oriented Architecture

The analysis developed in this report has been based on the thesis that to consolidate an efficient and cost-effective solution for a wide range of hazardous waste emitting industries it is necessary to find a balance between waste management costs, disposal methodology, regulation and compliance. It has been argued that part of the methodology that would help achieve such a balance should be based on the development of customized services that may be able to reduce some waste management costs and engage a large number of hazardous waste generators. As economic incentives help increase the number of generators that participate of environmentally sound disposal methodologies, support to hazardous waste regulation and compliance will increase as well. However, it has been argued as well that economic benefits alone may not be sufficient to increase the service-value of the proposed solution and that other strategic approaches that involve a wider range of stakeholders are needed in order to develop the idea that the proposed solution is a public service and not just a business. Building a public value perspective may increase the overall value perception of the solution and the

likelihood of building a sustainable hazardous waste management business. Now the case has been made that the proposed solution should be capable of change, not just to adapt to the changing needs of stakeholders, but also to be able to adapt to the changing circumstances of the hazardous waste management business (these changing circumstances may be related to incineration technology, to new waste disposal methodologies or to changes in other waste management areas, just to mention a few). To be able to fulfill stakeholder's expectations through the provision of services that may be diametrically different as they respond to different interests, the proposed solution will need a flexible service-oriented business architecture that supports various levels of stakeholder engagement and collaboration, from where flexible yet independent services could be built based on goal setting.

It has been argued that to achieve this level of flexibility within a business' architecture it is necessary to identify the business forms of organization that would support different modes of engagement to help achieve a wide spectrum of collaboration levels. Taking into consideration the previous PESTEL and SWOT analyses, here it will be argued that some stakeholders may be better engaged through the establishment of network forms of business organization, whereas others may better respond to market based business organization approaches. From a business architecture perspective, these two organizational methodologies could help develop effective business association forms from where different strategies could be defined to help fulfill a wider range of business sustainability goals through service planning and delivery.

Defining a Business Architecture that Supports the Delivery of Hazardous Waste Management Services Based on Network and Market Forms of Organizations.

The previous analysis indicates that a hazardous waste management solution that is based on the provision of services should be flexible, far-reaching and involve a variety of stakeholders. The methodology proposed here to facilitate stakeholder engagement is based on a collaborative level of participation. To support the development of this level of engagement, part of the strategic planning effort developed here will be focused on a service oriented business platform where the organizational governance structure, the business information (e.g. hazardous waste incineration/recycling benefits and risks) and the services related to hazardous waste management are largely based on network forms of organization.

A second strategic planning approach will be focused on market based business forms of organization, which in contrast to network forms, are less dependent on relationships and reciprocity and more dependent on prices and contractual transactions. Market forms of organization may be more efficient to support the design of services aimed at engaging some stakeholders, perhaps hazardous waste generators that have not yet started to internalize the costs of hazardous waste management. This group of stakeholders may be more attracted by market-based incentives than on reciprocal collaboration.

It must be noted that the level of collaboration proposed for this project is not necessarily reciprocal in nature, but some form of reciprocity may be developed through

market-based services and market transactions. As Powell notes, “economic exchange is embedded in a particular social context,”(2006:300) and one may argue, this particular form of exchange, (i.e. hazardous waste management and disposal in exchange for payments for waste management services), will develop in a social context that is more dependent in relationships and mutual interests than in other markets unrelated to environmental or public infrastructure services.

The purpose of drafting these two business models as strategic approaches to a hazardous waste management business is to allow more flexibility, not only within the business architecture but also in the process of service production and delivery, or in terms of Teboul (2007), to allow sufficient flexibility for backstage production and front stage performance.

According to Powell “Markets offer choice, flexibility and opportunity. They are a remarkable device for fast, simple communication. In network forms relationships take considerable efforts to establish and sustain, thus they constrain both partners ability to adapt to changing circumstances” (2006:303-304).

The previous PESTEL analysis has provided sufficient information to understand the circumstances in which network forms would be easier to construct to support the development of services and when market-based business approaches may be more appropriate. The following analysis is centered on understanding these two forms of organization so as to support the development of a flexible service-based business architecture that would give space to changing governance forms, information sharing

and service delivery according to the needs of both generators and hazardous waste managers. Examples of strategic solutions that could become services will be explored, not to be fully elaborated but to identify the conditions in which such a business may develop.

The Need for Network Forms of Organization

According to Powell (2006), network forms of business organization are characterized by "reciprocal patterns of communication and exchange" that lead to collaborative action (2006:295). However, not all business scenarios would benefit from this form of economic organization. To Powell, there are enabling conditions that would foster the proliferation of network forms as opposed to market or hierarchical governance structures. First, network forms are facilitated when the business relies on a highly skilled workforce, whose performance depends on the exchange of distinctive competences, requiring long-term collaboration. Second, when potential business partners have the common need of reducing the risks and sharing the expenses of producing costly products and services, which could be the case for some hazardous waste generators. Third, network forms can easily develop when there is an environment where people are more likely to collaborate either because they see a high probability of a future association, because participants in the work setting have some common background or because there is a "combination of legal, political and economic factors [that] are especially conducive to network agreements as well as interorganizational

collaborations" (2006:326). Powell respectively identifies these three enabling factors as *know-how*, the *demand for speed* and *trust*.

In many cases, the environment in which the proposed solution would develop generally fits the characteristics in which networks will be more likely to succeed. In terms of "know how", a HWMS for Bogota would be dependent on formal and informal sources of knowledge and skills that would benefit from a high level of collaboration to achieve a variety of common goals. For environmental monitoring activities, for example, local communities worldwide have proven to be very efficient to help manage environmental monitoring systems in a variety of scenarios. A remarkable example is the project PMAC Alto Urubamba in the state of Cusco in Peru, where native indigenous and rural communities have successfully participated in environmental monitoring activities for potential impacts of an extractive natural gas infrastructure project. Monitoring activities carried out by the communities under this program included measurements, observations and evaluations of environmental impacts of gas viaducts (PMAC 2009). For a hazardous waste management solution, this type of collaboration would support fungible knowledge; it allows the exchange of similar competences shared by experts and communities alike through the development of learning channels that enable stakeholders to participate in the solution through quality and environmental impact monitoring programs. Additionally, this type of collaboration may help facilitate dissemination of information regarding hazardous waste management benefits and potential risks to other stakeholders.

In terms of "demand for speed", collaboration among stakeholders would be greatly based on the need to reduce waste management costs and the risks posed by hazardous waste accumulation, which may give space for the development of network agreements to favor an affordable and environmentally sound hazardous waste disposal methodology, involving hazardous waste generators, hazardous waste managers and enforcement environmental authorities.

In terms of "trust", however, networks may not be so easily conformed. The legal, institutional and political factors that make hazardous waste management enforcement and hazardous waste management activities difficult in Colombia would require increasing levels of trust in which hazardous waste generators can perceive government enforcement (and the proposed solution) as a relative benefit, not just to the natural environment, but perhaps also to overall business performance (in terms of practices and methods of production and in some cases, in terms of profitability). This will only be possible if hazardous waste management services can dramatically minimize some generators' levels of hazardous waste production through increased recycling capabilities or through the implementation of cleaner production mechanisms that may help reduce waste volumes and waste management costs. Other generators may not perceive an overall increased performance and may need more flexibility from enforcement authorities as well as benefits from waste managers in order to be encouraged to comply with hazardous waste regulations.

In an environment of trust, waste managers (i.e. the proposed solution) may become facilitators between hazardous waste generators, governmental enforcement authorities and clean production agencies. In an environment of mistrust, hazardous waste mangers can be viewed as a disabling enterprise to business performance and profitability because they may generate a disruption in the normal form of production (through the encouragement of clean production processes) and may increase production costs (because generator's may be "forced" to pay for hazardous waste disposal).

Trust may be also difficult to develop among stakeholders that perceive hazardous waste management activities as a threat to their health, for both neighboring and non-neighboring communities (e.g. environmental protection organizations or communities that are against hazardous waste incineration).

Even if conditions are given, it must be noted that nothing can guarantee that "trust" will develop in an environment where so many interests are involved, that a "know how" prevalent environment will trigger collaboration, and that the "need for speed" will be shared by hazardous waste generators, waste mangers and enforcement authorities. Some generators may try to actually delay payments for hazardous waste management services if it makes no sense to them to pay for using environmental services that they have been getting for free through waste dumping.

In business scenarios that are not conducive to network forms of organization it would be possible, by establishing another strategic orientation within the business architecture, to appeal to market based mechanisms.

The Need for a Market-Based Business Strategic Approach

Market forms of business organization are typical of firms that participate in market economies, which one may argue, are preponderant forms of association in countries with economic systems ruled by capitalist principles, including Colombia. Market forms of organization have a distinctive way of coordinating economic activity: they mainly rely in the process of trading goods and services through various types of transactions (determined by prices and contracts) that involve different forms of labor and economic agents (buyers, sellers, product developers, marketing managers, etc.). According to Powell "in market transactions, the benefits to be exchanged are clearly specified, no trust is required and agreements are bolstered by the power of legal sanctions" (1999:301).

However, some authors have made the argument that there is a new state of affairs in market economies. The revolution of information technology has been feeding a more democratic, globalized economic system that relies in interconnections and innovation, where market exchanges and market-based business forms are dependent on different levels of collaboration (Benkler 2006, Spence 2002, Boisot 1998, Webster 1995). Because innovation plays a central role, some authors have identified this new state of affairs as the era of the *knowledge-based economy,* where knowledge-based technologies, information and management are becoming the sources of wealth creation, a wealth that is not necessarily proprietary, even though it feeds from market transactions (e.g. free software platforms, search engines etc.) (Felin et al. 2009, Foss 2006, Nahapiet et al

2005). These new forms, especially in areas of IT development and education, are giving space to the idea that networks can create wealth (Benkler 2006), an argument that is central to the concept that the proposed solution may increase its value by involving a wide range of stakeholders via services so stakeholders could perceive broader benefits from the proposed solution. Here it will be argued that market-based organizational forms and transactions should be framed in this context of interconnection, where some level of collaboration will be needed.

When implementing market-based forms of association or market-based mechanisms, self-interest, which is typically the main motto of market transactions, should not be the only guiding principle for the proposed hazardous waste management business. This form of transaction should respond to self-interests, but should also be ruled by principles of social responsibility and environmental justice. If one thinks about the fragility of human health and the natural ecosystems that sustain life, these guiding principles for an enterprise that will make of hazardous waste management a lucrative business could be considered just as a minimal requirement for business development.

The purpose of the following analysis is not just to understand the circumstances in which market forms of association or market-based mechanisms will be more appropriate than network like forms, but also to identify the nature of market-based transactions that would be likely to support the proposed solution as it intends to be strongly grounded in social responsibility and environmental justice principles. This discussion is neither implying that network forms of association are more desirable for

the proposed solution, nor does it imply that networks are not motivated by self-interests; it rather recognizes that in many instances, network forms of governance, information sharing, service delivery and association may not be desirable precisely because they are motivated by particular interests where it would be rather difficult to build an environment of trust or reciprocity. What is central to this discussion is that, because of the nature of the proposed solution (it deals with dangerous wastes), it is important to debate the market forms of association and the market mechanisms that would help engage hazardous waste generators in responsible hazardous waste management practices so as to avoid ethical concerns related to the encouragement of hazardous waste production (specially once incineration is available, as it dramatically reduces waste volumes) and to prevent the commodification of hazardous wastes (i.e. a demand for hazardous waste "goods" once various waste managers are competing for the same market). Such market mechanisms should be rather aimed at the commodification of *environmentally sound hazardous waste management services*, where the only perceived commodities should be certain recycled or reused hazardous wastes, clean production mechanisms that minimize waste production, and energy credits produced through *clean* incineration.

About The Market Economy

As summarized by Johnson (2005) the market economy is based on the "interplay of supply and demand in free markets, largely unhampered by government rationing, price fixing or other coercive interference" (2005:1). The main theoretical developments

about "the market"[46] are supported on the works of the classic political economists Adam Smith and David Ricardo. Smith developed the idea of the free market in his 1776's work *The Wealth of Nations* and Ricardo developed important trade theories related to labor value and market efficiency by analyzing issues of wages, profits and rent (*The Principles of Political Economy and Taxation* 1817). Later, neo-classical economists focused on studies of human economic behavior based on the theoretical constructions of supply and demand. Edward Chamberlin, who is considered to be one of the most prominent neo-classic theorists of recent times, identified the impacts of common market forms on overall economic performance in the U.S, which led him to the development of models for solving common market problems such as *imperfect competition* (when ideal market conditions are not given, making space to monopolies, unemployment etc.) (*Theory of Monopolistic Competition* 1993). Some of the most prominent market economy theorists have been fostered under the tutelage of the Chicago School of Economics[47], which is considered to be a neoclassical school of thought focused on issues of the free market and monetary theory (Miller 1990, Stigler 1990 and Bronfenbrenner 1990). Important representatives of this school, like Milton Friedman (*Capitalism and Freedom*, 1962) developed the notion of *economic freedom* as an

---

[46] The broad definition of market taken here refers to the economic term. A market is "an actual or conceptual place […] where forces of demand and supply operate and where buyers and sellers interact (directly or through intermediaries) to trade services, goods, contracts, or instruments, for money or barter. Markets include mechanisms or means for (1) determining price […] (2) communicating the price information, (3) facilitating deals and transactions and (4) affecting distributions" (Business Dictionary 2009).

[47] The name refers to the approach of some professors and graduates from the economics department at the University of Chicago, but it broadly comprehends other economists aligned with the neo-classical thought

indispensible mean to realize political freedom, referring to the desire of a limited role of the government for the proper functioning of the economic system (i.e. of the free market).

Theoretical development gave space to sound criticisms that supported alternative economic systems, most notably from Karl Marx. In 1847 Marx published *Wage-Labor and Capital*, where he first criticized the model of supply and demand as an exploitative form of pricing the market that determined costs of production without equating the labor-costs of production. However, it was not Marxist theory (at least not directly) the main motor of criticism about the role of the market economy on socio-political, humanistic and ethical issues, not to mention issues of economic stability. Some of the latest critics of the market economy, mostly academics and intellectuals, argue that a change in the way businesses are conducted is needed in order to mitigate some of the unwanted effects that appear to be intrinsic of market transactions, such as poor communication and learning-transfer, mistrust, environmental sustainability problems and unethical behavior (Chomsky 1999 and 1994, Inoki 2000, Yonay 1998).

According to Powell "markets, as described by economic theory, are a spontaneous coordination mechanism that imparts rationality and consistency to the self interested actions of individuals and firms" (1999:302). However, the almost exclusive focus on the creation of wealth and the fulfillment of self-interest has given space to ethically questionable market transactions that have proven to threaten the very same economic system (capitalism) that sustains the market economy. In reference to several

cases of corporate scandal linked to episodes of economic crisis in the U.S., Adler (2002) criticized the focus of the academia on theories of self-motivation and economic gain as the *only* driving forces of business association. He also criticized the emphasis on limiting government vigilance to keep markets dynamic and prevent inference with the "invisible hand" of the market. According to Adler, the over emphasis on issues of self-interest and non-regulation can lead to "lapses of persona and professional integrity… undermining confidence in capital markets, eroding trust in professional institutions, and casting a shadow over the probity of corporate life and those institutions affiliated with it, including business schools" (2002:148).

The Emergence of Alternative Forms of Coordinating Economic Activity Within Market Economies

Theorists and critics enabled an environment where other forms of coordinating economic activity evolved as alternative to market forms of association. These new forms would be network like, collaborative forms of business association that are becoming attractive to organizations as IT development transforms business relationships (Bankler 2006). However, some authors have noted that many of these network-collaborative associations occur in market like transactions, through market-based mechanisms and within the oversight of the market economy (Gulati et al 2000). One may argue that in practice, there no are "pure" network or market associations in this era of information technology, and that market forms evolve in network forms of organization and network forms prosper within market transactions. The point here is not to draw a definite line

between these two forms of business association, but to identify the best fitting market-based strategic approach (as well as network based strategic approach) that would be supportive of the proposed solution from a business architecture perspective.

Powell's parameters have been used here to define the conditions in which network forms would be more likely to prosper (i.e. an environment of know how, trust and demand for speed in business associations). One may argue that market-based forms of association should take place when these enabling conditions are not given or would be difficult to develop. However, since the aim of the proposed solution is to establish a sustainable business, such market-forms of association would only make sense if they were to be guided by two additional principles (beyond those of self-interest): environmental protection and social responsibility. The market-based transaction forms and mechanisms applied here should be framed in this environment.

Under a flexible business plan, both market and network forms of association should be capable of supporting flexible, yet independent services, capable of change without interfering with other services performance. By defining a flexible, service-based business architecture, the proposed solution should be able to develop services from market-based mechanisms while allowing (if the environment is conducive) the emergence of collaboration. In addition, the proposed solution should be capable of designing services through network forms of association, and if the environment requires, allowing market-based forms to develop. The following strategic solutions, based on both network and market forms of business association, will exemplify better the range of

services that could be developed through this sort of business planning, and the role of a flexible business architecture in the development of a sustainable hazardous waste management business. It would be difficult to define from a planning perspective the actual forms that these services would take in practice, nor to anticipate the relationship forms that could develop between stakeholders, government agencies and waste mangers. The idea here is to identify market-based and network-based approaches that have been successfully used in similar scenarios to the ones depicted here for an environmentally sound hazardous waste management solution based on recycling and incineration. These approaches will be adapted so as to roughly describe the sort of solutions that could be successfully developed and that of course, in their actual design, would become the focus point of a different project that could be supported by the analysis presented here. The purpose of this type of analysis is not just to identify these common places and develop them around the particularities of the proposed solution, but also to study, from a business planning perspective, the variety of forms of association that may support the proposed business so as to try to increase its ability for rapid change and adaptation.

How Market Based Transaction and Association Forms can support the delivery of hazardous waste management services.

Typically, market-based forms of association occur successfully when products and services have an easily quantifiable value that communicates well to all costumers: i.e. a price. One may argue that hazardous waste disposal services could be easily priced; the equation could be based on costs per amount of wastes incinerated or treated like in

any other waste disposal scheme. However, hazardous waste management services, especially those value services that are intended to reduce costs of waste management or that are intended to reduce the amount of wastes generated, are harder to measure. This is a similar situation to the one posed by other solutions intended to abate the accumulation of industrial emissions by putting a price on emissions levels, especially those concerning fossil fuel emissions. In their massive production to meet "the needs" of an ever-growing population, fossil fueled industries are causing a level of greenhouse gas accumulation that is threatening the earth's climate regime and the life forms that it sustains.

The Kyoto Protocol, which is to date the main instrument of global alliance to fight climate change, has pioneered the ideas that market-based mechanisms are the most viable economic instrument to help reduce the costs related to greenhouse gas abatement and give space to cleaner forms of production. The signatories of this treaty have put a price to the fossil fuel emissions that exceed a certain amount of allowed emissions levels. Because the idea would be to reduce the concentration of atmospheric greenhouse gasses, it would not make a difference for a manufacturing company in Taiwan to make emission reductions by introducing cleaner production mechanisms in another manufacturing company in Thailand, for example, as long as the overall GHG accumulation is brought down. The idea of these market-based mechanisms would be to give more flexibility to parties to comply by making emission reductions where it would be more efficient and cheaper to do so, as long as these parties are complying with emissions targets and their emissions at home don't increase in exchange.

The differences between the proposed solution and the Kyoto Protocol are evident. This treaty is an intergovernmental agreement to fight perhaps one of the most pressing environmental problems ever experienced by modern human societies, and the proposed solution is just a private business that offers a hazardous waste management solution and disposal infrastructure to local industries. Nonetheless, problems related to the implementation of these market-based mechanisms in the Kyoto Protocol may be similar to the ones that the proposed solution may face. These problems, in the Kyoto Protocol, are related to non-compliance of greenhouse gas regulations because of a rather rooted concept (proper of capitalist systems and market economies) that non-compliance of environmental regulations is an acceptable choice as long as it appears to be too expensive to comply. In other words, why to pay for environmental services that used to be free? This is the same question that some hazardous waste generators will face when presented with the proposed solution.

In the case of the Kyoto Protocol it has become evident that market-based mechanisms truly work *only* when they are based on collaboration, on the coordinated action of the treaty's parties to share the common but differentiated responsibility of their emissions levels.

The truth is that no one has been able to measure the economic value of environmental services that are main supporters of human life and industrial production (ecosystems, biodiversity etc.). Such value is simply priceless. The hazardous waste management solution proposed here would be based on environmentally sound waste

disposal methodologies in an effort to protect environmental resources and the services they provide. Because such a solution would be partly aimed at protecting the environment by helping reduce waste accumulation and dumping, the form of pricing within market-based mechanisms or forms of association that would be supportive of the proposed waste management business should be based on what could be called here *a shared but differentiated responsibility towards the abatement of hazardous waste dumping and accumulation*. A shared responsibility means that all hazardous waste generators (including the solution itself) should make efforts towards sustainability targets and environmental protection goals related to the elimination of hazardous waste dumping and introduction of clean production mechanisms. A differentiated responsibility means that, although all stakeholders should participate on the effort for cleaner production and waste minimization, the greatest industrial hazardous waste emitters should take all the necessary measures to comply with hazardous waste regulation, and that includes paying for environmentally sound disposal methodologies. Although hazardous waste generators in Colombia are not legally bound to comply with an international agreement related to the world's hazardous waste problematic, the Colombian government *is* (through Basel, Stockholm, and other agreements as explored earlier). In this international cooperation context, the Colombian government is trying to enforce local regulations regarding hazardous waste treatment and management. Once such regulations enter in full effect, hazardous waste generators will have to comply. What a HWMS for Bogota would intend to do is to facilitate compliance by offering

market-based benefits for participating in the proposed solution (and prefer it over other waste management offers). The crucial point here is that without a minimum level of collaboration from hazardous waste generators, market-based mechanisms would be difficult to succeed.

The following market-based business strategies could support the delivery of services that could balance issues of disposal methodology, waste management costs, regulation and compliance so as to help engage generators in the proposed solution. These strategies have been chosen because they have worked in the past in similar scenarios where market-based incentives actually triggered collaboration. The argument here is that collaboration may be an essential quality of market-based mechanisms and market-based association forms that are intended to successfully help minimize hazardous waste related problems (and increase the likelihood of establishing a sustainable business). Further strategies should be defined once the proposed flexible business architecture is fully developed and environmental and economic impact assessments are performed.

Balancing Waste Management Costs Through Technology Innovations.

Trading Wastes for Energy

To generate energy from hazardous waste incineration the proposed solution must be built on a waste to energy technology platform. This technology, although very innovative, is not precisely new. As explored in previous chapters, waste to energy incineration technologies are actually implemented every day in some parts of Europe

and Japan as important mechanisms for generating alternative energy sources that would help minimize reliance on fossil fuels. However, no evidence was found here about a waste manager that would trade this form of energy production with its customers (i.e. hazardous waste generators), perhaps because most of these waste-to-energy facilities are government owned facilities. The idea of offering energy credits from hazardous waste incineration to waste generators themselves (in exchange for participating in the proposed solution), has been influenced by the concepts that rule one of the Kyoto Protocol's market-based mechanisms known as emissions trading (ET).

ET enables some parties to acquire greenhouse gas reduction units from other parties and use them in order to meet their emissions targets. Through ET countries can make use of lower cost opportunities to reduce emissions by implementing clean technology mechanisms in other countries. This mechanism "enables parties to pursue cheaper opportunities to curb emissions or increase removals wherever those opportunities exist, in order to reduce the overall cost of mitigating climate change."[48]

If the proposed solution is developed on a waste-to-energy technology platform, part of the energy produced through clean incineration could be distributed among participating hazardous waste generators in the form of tradable energy credits. This form of trade would not only be between the proposed solution and waste generators, but also between generators and whomever wants to buy those credits. Hazardous waste generators would be entitled to energy credits as long as they use the proposed solution's

---

[48] UNFCCC (2005). "Caring for Climate. A guide to the Climate Change Convention and the Kyoto Protocol". Climate Change Secretariat. Bonn, Germany. Pp.33

services (based on incineration and recycling), allowing them to use, buy or sell those energy credits to others, a concept closely linked to the idea of the carbon market.

In the carbon market (Point Carbon 2009), certificates of emissions reductions are traded every day and sold to highest bidder. Usually the highest bidder is the one that is in most need to comply with carbon emissions regulations, or a speculator that want to save those certificates for a better sale in the future. In the trading scheme proposed for the HWMS, energy credits would be given in exchange for payments for waste management services. Those credits would be probably used or bought by the generators that have greater energy needs or sold by the generators that have a grater need to reduce overall costs of hazardous waste management and disposal. Of course, who buys those credits is not necessarily a hazardous waste generator, as these credits could be easily distributed through the general electricity grid.

The conditions in which such trading would occur are not clear at this point. The ideas consigned here are only speculative. The most direct way in which participating generators could receive benefits from this incentive would be to use those energy credits themselves. The following discussion further illustrates how such trading may occur.

Energy credits could be traded in the form of low cost energy units (measured in kilowatts). In this case, generators would receive those credits, but will still have to pay a nominal fee for them. In other words, participating hazardous waste generators would be receiving some electricity at a much lower price, which would become an economic incentive for using the proposed solution as it may help them lower their overall energy

bill. Another form of trading energy credits would be to allow generators to "sell" the credits that they would be entitled to, to the proposed solution itself, in which case generators would receive a discount for the waste management services they use. This would become an advantage for generators because they could use the gain of their credits to lower their overall waste management costs. And finally, these credits could be sold to others (as Certificates of Emissions Reductions measured by greenhouse gas removal units are sold in the carbon market) to any other generator or any other party that would benefit from cheaper and cleaner electricity.

The form or variety of forms that this mechanism may take would depend on two main factors. First, the amount of clean energy that the proposed solution would be able to produce, that is, as long as wastes incinerated are not generating an environmental or health impact according to the emission technical guidelines proposed by the IPEN Dioxin, PCB, and Waste Working Group for incineration on land, which are arguably one of the strictest emissions standards established, exceeding the targets established by both Stockholm and Basel Conventions emission standards (IPEN). Second, the shape of these forms of trade would depend on how easy it would be to distribute energy through the general grid. It may not be possible for the proposed solution to negotiate energy units directly with hazardous waste generators in the form of electricity if the local electricity company does not allow it. In this case the proposed solution would be selling directly the energy produced form incineration to the highest bidder and would distribute those credits in the form of savings or discounts.

The idea behind this discussion here is to explore the potential of clean technologies to help support market-based incentives that would make the proposed solution more attractive to generators because of cost reductions or value exchanges that may facilitate generator's compliance of environmental regulations. If waste to energy technology is not appropriate because of exceeding investments costs or because of specific waste streams,[49] the same idea of trading energy through clean waste to energy incineration technology can be applied to recycling (e.g. participating generators may be entitled to recycled materials). What must be noted here is that this sort of market-based trading mechanism has successfully worked in the past and has helped build collaboration among stakeholders because they see the need of a long-term association (that is, in the presence of minimum enforcement and shared responsibility agreements).

In summary, collaboration would not only facilitate the development of these mechanisms, but may also help build an understanding among generators that the underlying problem is to reduce the amount of wastes generated as the ultimate resource for reducing waste management costs and to maximize possibilities for recycling and reusing to consolidate cleaner production alternatives.

[49] The combination of some types of wastes would not be supportive of "clean" energy production, requiring most expensive filtering mechanisms and devices. In this case, energy produced would be most likely sold to cover the costs of those filters to help sustain affordable hazardous waste management costs.

Using Financial Incentives to Increase Compliance. The Feedback Mechanism

Besides trading, market-based forms of association could be based on the offer of financial incentives. This is not a new idea to the area of waste management. As McNeil and Foshee point out (2008), governments are in fact the main developers of financial mechanisms that support fiscal policies that help fund waste management solutions, help mitigate the costs for cleaning up hazardous contaminated sites, and help develop clean management alternatives for all industries. Through an analysis of U.S tax and subside policies, these authors provide good examples about the financial mechanisms that are typically used to help reduce waste management costs and enforce hazardous waste regulations. However, the proposed solution may not offer the same type of incentives (tax exemptions and subsidies) as the cases illustrated by Neil and Foshee, mainly because it is not managed or owned by a government agency that strongly relies on enforcement capabilities. The proposed solution would be owned and managed by a private operator that has no authority to tax or to directly enforce hazardous waste regulations. Financial incentives do need to be coupled by enforcement efforts, but here the main emphasis will be on those financial incentives that support industries to achieve social responsibility goals. Borrowing Smith and Alcorn's (1991) idea of "cause marketing", marketing strategies that "simultaneously demonstrate a sense of social responsibility and satisfies shareholders demands for increased profits" (1991:19) could

be implemented here to develop stakeholder engagement strategies that may increase hazardous waste regulation compliance.

The idea of the feedback mechanism proposed here is based on this tactical goal of increasing compliance of hazardous waste regulations by relying on the idea of advertising financial incentives that are linked to aspects of social responsibility. The word "feedback" is used here because it describes how the strategy would work, like a system "where the output becomes the input in the next iteration."[50] The proposed concept is similar to the one used by credit card companies that offer a percentage of money back or points for using the cards. Under this strategy, the proposed solution would save a percentage of hazardous waste recycling and energy production revenues under a tax-free fund that would be distributed among service recipients as long as it is destined to clean technology improvements (as explained in chapter two, tax-free funds are available in Colombia to enterprises that make efforts to adhere to clean mechanisms standards and help minimize waste. Establishing a clean disposal methodology supported by recycling would help the proposed solution to qualify and apply for such a fund). This means service recipients (i.e. hazardous waste generators) would be able to take an advantage of a percentage of net revenues obtained from the hazardous waste management services sold by the proposed solution (defining such a percentage would require further analysis and evaluation). The purpose of this fund is to provide generators with a yearly budget (or every two, or three years) that they could spend on energy or

---

[50] Campbell Harvey (2009). "Feedback System". Dictionary of Money and Investment. Available in http://www.duke.edu/~charvey/Classes/wpg/glossary.htm

waste saving technology. This could be for improving operational efficiency by training employees, buying solar panels, building their own hazardous material testing laboratories, etc. The idea would be that generators would *gain* money by using the proposed solution but they could only spend it on waste reduction or energy saving activities.

This particular solution is expected to trigger a decline in the amount of hazardous wastes generated by providing an opportunity to improve industrial manufacturing efficiency, which may as well help diminish some of the technical impairments identified here about the local environment. Once processes become more efficient and there are potentially fewer wastes to be treated, waste management costs would also be reduced, providing a double benefit to hazardous waste generators.

Funds would be equally divided among service recipients. To entitle great generators with larger funds on the bases that they would be the ones feeding the fund would deliver the wrong incentive. The service goal is to promote waste reduction, not increases. The larger the number of industries that manage their wastes through the proposed solution, the greater the fund would be (and the sooner it could be exercised). This generates an incentive to participate in the solution, which is expected to prompt voluntary compliance of hazardous waste management policy.

How Network Based Transaction Forms and Associations Can Support the Delivery of Hazardous Waste Management Services

According to Powell, networks "are especially useful for the exchange of commodities whose value is not easily measured" (2006:320). As previously explored, hazardous waste management services could be difficult to price. Some service forms could be "priced" (or measured in costs or savings) through market-based mechanisms and transactions. But there are other services that may not be easily quantifiable and yet have enormous value. Here it will be argued that network forms of association would be more helpful to enable the introduction of those hard-to-price services as valid forms of exchange.

As previously mentioned, network forms of association also require considerable amounts of collaboration and reciprocity. Here it will be argued that services related to alternative disposal methodologies (i.e. recycling) would require higher levels of collaboration and reciprocity. Because waste recycling (hazardous, household or municipal) largely depends on complex collection systems that only work when manufacturers, users and distributors are motivated to participate in recycling programs (because of different motivations, such as regulation compliance, concerns about the environment etc.), one may argue that waste management schemes that are based on recycling would be most likely to succeed under network forms of association (Salhofer and Isaac 2002).

Support to governmental enforcement capabilities of hazardous waste regulations is a prerequisite for the existence of the proposed solution (in the absence of regulation and compliance it would make no sense to establish such a hazardous waste management business). The proposed HWMS should be able to provide services that would help strengthen the current regulatory framework and encourage compliance from generators so as to increase the demand for environmentally sound hazardous waste disposal methodologies. However, complying with hazardous waste regulation is typically viewed as expensive. Services that would directly or indirectly help strengthen hazardous waste management policies and regulations may benefit as well from network forms of association. Network forms may facilitate interorganizational partnerships that may facilitate flexible regulation compliance so industrial sectors could still make profits while protecting human health and environmental services, which is the main reason why these regulations are put in place.

In the case of disposal methodologies, most industries that today "comply" with hazardous waste regulations in Bogota may not see any advantage for participating in the proposed solution, as they are doing so mostly through land disposal. As explored in the second chapter, land disposal of hazardous wastes in Bogota would be cheaper than incineration because most of the landfills available do not have and do not invest on minimum technical requirements for this purpose. To make the proposed solution more appealing, the HWMS may introduce value-added services that generators could take advantage of so as to engage them in long-term network forms of association that would

support current hazardous waste regulation and environmentally sound disposal methodologies, especially recycling.

These value added services would be available to generators that become customers of the proposed solution, and in some cases, they may give generators the ability to increase the number or the quality of services and products they provide to their own customers. Some of these value-added services may be difficult to price or may be rather based on non-monetary exchanges, therefore network forms of association may be most appropriate. It is important to keep in mind that market-based forms may develop here through service use, which arguably requires increasing levels of communication between stakeholders so as to be able to adapt to the changing circumstances of the business and to be able to identify the most valuable services for different types of customers (i.e. generators) at different times.

In terms of hazardous waste policies, because adherence to environmentally sound disposal methodologies relies so much on technical investments and training, here it will be argued that the proposed solution should offer services that would facilitate the transfer of technology and technical training to generators. This sort of solution would require increasing levels of collaboration and reciprocity where network forms of association may help develop communication and negotiation channels between generators, clean technology vendors, and regulating agencies, so as to facilitate their commitment to sustainable hazardous waste management and the fulfillment of

environmental protection policies. The following examples would illustrate better the types of services that network forms of association could support.

Balancing Issues of Disposal Methodologies Through Value-Added Services

Establishing a Recycling Bank

Hazardous waste management requires a balance of disposal methodologies. According to the technical guidelines studied here from Basel and the European Union's Directive, most industrial waste streams could be easily destroyed by thermal process (incineration). However, it is important to identify among those hazardous waste streams the materials that could be easily recycled or re-used because recycling is to date the most desirable disposal alternative. In absence of an environmentally sound disposal methodology that would be capable of destroying hazardous wastes at the rate needed to meet industrial production, most environmentalists and critics rightly argue that the main policy focus should be on recycling (Greenpeace 2009). However, identifying recyclable industrial waste streams is not that simple, not to mention that the collection and treatment of such wastes may be quite expensive (adding costs such as transportation and treatments), making it harder for some industrial sectors to get access to affordable recycled hazardous materials.

The proposed solution could address this issue of balancing disposal methodologies by offering a value-added service that facilitates the identification of such recyclable waste streams so generators could build and have access to their own industrial recyclable wastes. Before such value-added service is explained in some detail

(the reader must remember this is just an exploration of how value-added services would work under network forms of association), an exploration of the case of electronic waste recycling will facilitate the argument.

Electronic hazardous waste is one of those waste streams that could easily accumulate at a high rate in a very short period of time and become the largest hazardous waste stream in the world. This is not just because single individuals have the capacity to acquire one or many electronic gadgets for personal use in their lives, but also because those same individuals are likely to replace those gadgets many times, as soon as the old ones become obsolete and new models arrive to the market. Most regulation measures taken around electronic hazardous waste streams have been focused on recycling and re-use of hazardous materials and components of end-of-cycle products. Recycling targets have been accompanied by the encouragement of changes in production processes to release "cleaner" products. However the collection of end-of-cycle-products has been difficult. Some regulators, like the European Union's Hazardous waste Directive, has set up return systems so individuals could return electronic wastes to the source manufacturer so the manufacturer could recycle these products or take care of their final disposal (the Directive requires producers to set up end-of life return systems at their cost before these products become wastes in landfills) (Europa 2009). This "return" mechanism has transformed the way electronic manufactures build their products, not just to save costs, but also, as the demand for green products and services is on the rise, to ensure their customers their products are somewhat greener than the "older" generation.

The case of electronic waste recycling is of particular interest here because it shows how different interests and sectors (governments, consumers, manufacturers, vendors etc.) have agreed, in compliance with regulations and in tune with environmental protection goals, to try to reach recycling targets for electronic end-of-cycle products. In this effort, manufacturers are trying to recycle their own products and some are even implementing cleaner technologies, whereas consumers collaborate by preferring greener products and making an effort to return these end-of-cycle products. However, because of the difficulties related to waste collection (even for cell phones and other end of cycle electronics that are easily identifiable) the problem of electronic hazardous waste is not nearly resolved. Some authors argue that higher levels of collaboration are needed to implement alternative collection mechanisms. To Mulder et al. (1999) "the use of local community collection schemes would be more effective [than current return to manufacturer of end of cycle mechanisms to] ensure higher return rates" (Mulder et al. 1999). There are important lessons that could be drawn from the electronic hazardous waste example that could be applied to the proposed value-added solution.

To solve the problem of identifying recyclable hazardous waste streams, the proposed solution may introduce an IT functionality to enable participating generators to build a "bank" of their own recyclable hazardous wastes. The idea here would be to give generators electronic access to such a bank (mostly built by their own waste inventories) so they could easily obtain the recyclable materials they may need in their production processes. This may solve part of the problem of designing adequate collection

mechanisms of recyclable hazardous wastes because generators may exchange those materials directly. Wastes not exchanged would be treated or sold by the proposed solution through regular recycling mechanisms.

It must be noted that the proposed solution should sort out the waste streams that would qualify for such an exchange (existing guidelines drafted by the Basel Convention should be used as explore throughout Chapter two). Qualifying wastes would be mainly those that do not require extensive treatment to be recycled and only when such treatment poses no major occupational threat (others do, and as such need to be managed with care by qualified personnel and equipment), which would allow generators to recycle some of their wastes. Some wastes could be actually immediately reused (as in the case of many metallurgic hazardous wastes). Generators could easily trade these materials among themselves based on reciprocity a long as they have access to such a local bank.

Because of the sensitive situation of the recycling business in Colombia (see chapter two), one may argue that such a bank should work in the absence of monetary transactions. If such a bank works through monetary transactions, then the proposed solution should analyze how to consult, engage and include in the business equation the marginalized communities that make a living from the recycling business, as it would be necessary for any other recycling approach taken through the proposed solution. The idea here is to give access to generators to their own recyclable materials to help them reduce costs by allowing other generators to take care of the disposal of such wastes through recycling. Costs would be reduced for both transactional ends because some generators

may obtain recycled hazardous materials from others, which would otherwise be incinerated at a cost.

The proposed value-added service is intended to maximize recycling and reusing opportunities so as to help balance aspects of disposal methodology while perhaps increasing the demand for the proposed solution, especially among those generators that can identify recyclable waste streams that may help them reduce some production costs.

To be able to offer such a service the proposed solution would have to make investments on an IT service platform for recycling or re-direct use of materials for industrial or manufacturing purposes. This type of service would be supportive of hazardous waste reduction goals, as it would be based on recycling. Additionally, it would also be supportive of policy compliance because it would encourage generators to report hazardous waste inventories to competent authorities to gain access to such a bank.

Labeling the Service as "Green"

Corporations and businesses are not usually rewarded for generating hazardous wastes, but they can be rewarded for shifting from hazardous waste production and pollution to hazardous waste management, which includes proper disposal and adoption of waste minimization techniques.

One way to do this would be to design a label for clean management practices. This label would be provided to service recipients to certify their manufacturing products as environmentally friendly products. The idea is similar to the "green seal" concept

developed to advertise eco-products, and could be achieved through ICONTEC, the Colombian Institute for Technical Norms and Certification.

The hazardous waste management solution proposed here would be built under ISO 14,001 standards, which are Environmental Management Systems (EMS) standards that could be applied to organizations that want to "operate in an environmentally sustainable manner" (ISO 2004). Such certification process is managed through ICONTEC. Since this institute also manages environmental labels through ISO 14,000 series, it would be possible to acquire a label of best management practices to be transferred to the service recipients that would use this waste management solution and that can prove that their manufacturing processes do not pose other major environmental impacts.

To be entitled to this label service recipients may have to engage in additional clean management practices beyond waste treatment and disposal. Some of the tools to achieve this would be available through mechanisms that are already supported by the Ministry of Environment (through training, assessments, loans etc., as explored in chapter two). The proposed solution would facilitate the process by helping service recipients develop a Clean Management Plan with the support of the environmental institutions designated for this purpose.

Additionally, this process could be precursory to service recipients' own ISO certification process, which would guarantee that further actions and commitments are being taken by the manufacturing industrial sector towards broader regional sustainability

goals. Service recipients that are in the process of improving their management practices to protect the environment and human health can obtain a certification of Best Management Practices (not a label for their products) that would become a statement of their efforts towards mitigating impacts from their industrial activities.

Issues To Consider When Planning Strategies and Services

The solutions proposed here are merely illustrating the range of services that could be developed from a HWMS supported by market and network business association forms. The strategic services explored were considered here because they may address the problem of balancing waste management costs, disposal methodology, regulation and compliance in a way that they may also encourage a demand for the proposed solution. Taking into consideration the problems related to balancing waste management costs, disposal methodology, regulation and compliance of hazardous waste policies in other countries, one might argue that targeting such a balance is crucial to achieve a long-term sustainable and profitable solution. Further analysis of strategic solutions to these balancing problems and the range of services that could be drafted should also consider aspects of technical training and partnership building so as to overcome problems related to training in hazardous waste management, monitoring emissions, and sampling/laboratory testing of waste streams. One may argue that the possibilities for designing such flexible waste management services are endless. The main concern here has been to connect a macro-environmental analysis about the hazardous waste management business in Colombia to help identify gaps and problems

that may interfere with the proposed business and that could be solved through a service-based collaborative approach. This approach may facilitate the adoption of environmentally sound waste management practices while supporting the development of the proposed solution.

CHAPTER 4

Building a Hazardous Waste Management Facility in Bogotá
Issues of Site Development and Urban Planning

To plan and build a hazardous waste management facility it is important to address technical, legal, environmental and socioeconomic issues that have the potential of causing health, environmental and economic detriment to neighboring communities. Issues of concern commonly include aspects of risk perception, air quality, environmental degradation, and developmental impacts (e.g. increased traffic from waste collection trucks, loss of home price values, etc.).

Lessons learned from other waste management projects in Colombia indicate that these issues will start to arise the minute plausible development sites are identified and evaluated (see chapter 2). If these issues are not addressed timely and appropriately, they may delay or impede the development of the proposed hazardous waste management solution. Urban planning tools related to Green Development[51] concepts and green infrastructure building standards coupled with stakeholder engagement strategies could help address problems related to environmental monitoring, stakeholder anxieties, risk perception, and urban decay. In addition to health concerns and environmental impacts, previous analysis about common problems related to NIMBY attitudes towards waste management facilities indicates that risk perception and urban decay are some of the most

[51]From Wikipedia: "Green Development is a land use planning concept that includes consideration of community-wide or regional environmental implications of development as well as site-specific green building concepts." Available in http://en.wikipedia.org/wiki/Green_development

pressing concerns for stakeholders that oppose to neighboring these facilities (Lima 2000, Ballard and Kuhn 1998, Environmental Justice Case Studies 1997).

The following analysis is based on a project implementation scenario from where a plausible location to develop the proposed solution will be analyzed so as to illustrate the wide breath of issues that should be taken into consideration for establishing a Hazardous Waste Management Facility (HWMF) in Bogotá. The purpose of this analysis is not just to identify issues of concern, but also to explore tools that may help overcome common site development problems.

Site Evaluation

Evaluating plausible sites to develop a hazardous waste management facility based on recycling and incineration is a matter of balancing technical, economic and social aspects. Evidently technical aspects are crucial. They would determine development requirements such as minimum distance to human settlements, the project's technological needs, and the building standards needed for establishing an efficient and environmentally safe hazardous waste management plant. Economic aspects are important as well, especially because high waste management costs are at the core of the global problems related to hazardous waste mismanagement. If cost aspects are not addressed appropriately and as a result, waste management fees increase, generators will be less likely to comply or worse, may try to "export" the problem somewhere else. Social issues should not be neglected either. However, judging from the examples examined throughout this report, social issues in Colombia have been largely overlooked

in the past, especially those issues related to risk perception and community engagement. Inattention to communities of interest has resulted in many cases in tremendous economic and legal impacts to some development and waste management enterprises. To avoid the stream of problems related to lack or poor engagement strategies, the proposed site evaluation approach should take especial consideration to these communities of interest.

The Proposed Location: The Bogotá-Soacha Industrial Corridor.

The proposed development site is located at the end of the Bogotá-Soacha industrial corridor, outside of Soacha's southern urban perimeter. This is one of the most important industrial corridors in Colombia (Alcaldía Municipal de Soacha 2001), mainly comprised by an agglomeration of manufacturing industries along Highway 40 from Bogotá's Southeastern outskirts throughout the neighboring municipality of Soacha, situated approximately 11 miles away from Bogotá.

Site Evaluation Criteria

In an attempt to balance technical, economic and social aspects, three main criteria were considered to evaluate whether or not this would be a plausible site for development: proximity to local communities, risk minimization and identification of most benefited communities from the proposed development (additionally, enough geological and climate assumptions were taken).[52]

---

[52] These assumptions include ideal soil type and impermeability (the more permeable the soil the higher the risk of contamination of underground water), low precipitation rate (the more it rains the more difficult it may be to prevent accumulation of pollutants in stormwater runoff) and predictable wind patterns (too much wind or too little wind may be a problem. Winds should be considered to appropriately place incineration exhausts) (Caroll 2003, Cooper 1998).

The first criterion considered was proximity to humans, cattle, crops and sensitive ecosystems, determined not just by distance but also including crucial aspects such as wind patterns and precipitation, as wind and rain could become important conduits of hazardous components. To avoid and minimize risk exposure from hazardous wastes and related treatments, the proposed facility should not be close to human settlements, natural resources and agricultural land.

In terms of rain being a concern, the southern eastern corner of Bogotá adjacent to the Soacha municipality is one of the areas around the city that has comparatively the lowest precipitation rates (GELT 2009) (the reader should note this is still in the Andean region at the highly elevated Cordillera Oriental, so regardless of microclimate conditions, it does rain in Soacha, but it rains less than in most other neighboring areas).

In terms of sensitive ecosystems and neighboring natural resources, this area would be relatively non-problematic as there are neither identified corridors of endangered species present at the site, nor creeks or rivers at risk, nor agricultural land where hazardous compounds could be transferred from soil to crops, and from them to cattle or humans. There are some sensitive soil conditions (erosion) due to previous quarry activities that included the removal of soil and rock. However, this would not be a problem for the proposed HWMF because no landfill would be constructed at this site and because in spite of erosion, there seems to be no risk of landslides. According to an environmental report prepared by the municipality (GELT 2009), erosion problems in this area are rather mild and quarry activities left no unstable hills, slopes or valleys that

would make difficult the construction of a recycling plant or a hazardous waste incinerator.[53]

It must be noted that the environmental conditions described here are only representative of this particular area and are not necessarily characteristic of the whole municipality. Soacha does have strategic ecosystems such as wetlands, rivers and natural preservation areas[54]. Environmental impact assessments and environmental mitigation strategies would be of outmost importance to ensure that there would be no important environmental damage from the proposed development. Additionally, the precise environmental and geological conditions for this exact site may not be the same as the ones described in the literature for the area as a whole. To define such precise conditions it would be necessary to perform further geological and environmental studies on this specific location.

Most of the proposed site is surrounded by urban settlements and an area called the 'Mining District', which has been designated as a preservation area in the current general plan (known as the POT, Plan de Ordenamiento Territorial) as part of a municipality effort to recover soil vegetation and stop illegal settlements outside of the urban perimeter (CAR 2005). Relative proximity to urban settlements is perhaps one of

---

[53] These statements about biodiversity and soil characteristics are mostly informed assumptions based on reports available about the area's environmental conditions and map observations (CAR 2005 and GELT 2009).

[54] Most important ecosystems identified in Soacha include the Paramo and Paramo Wetlands (at over 3,800 meters of altitude, it is considered to be one of the most important ecosystems in terms of climate and water sustainability, therefore all paramos are protected areas), High Andean Humid Forests, Savannah Wetlands and High Andean Dry Forests (GELT 2009). The closest most important ecosystem to the site of the proposed facility would be a Dry Forest, at quite a prudent distance (CAR 2005).

the main problems of this site. However, the site is still considered appropriate here because the development of a HWMF at this location still poses less risk to the fewer number of individuals, as opposed to building the proposed facility outside of the city, closer to agricultural land and preservation areas from where contaminants could be transferred to water resources or to the food chain. This risk factor is directly related to the second rationale considered here for site evaluation.

The second criterion studied was risk minimization. Because most compelling evidence related to accidents of hazardous waste management facilities is related to waste transportation (the second most common is related to negligence in waste handling and equipment operations (Asante-Duah 1993), the proposed facility should be located as near as possible to the sources of pollution as a measure to minimize related risks from land transportation.[55] This rationale also has important economic implications, because placing waste management facilities near sources of pollution also helps minimize costs of waste transportation, insurances, and in a given event, from transportation related accidents.

The proposed location roughly complies with these proximity and risk minimization criteria.[56] The most compelling arguments derived from these criteria are perhaps that the facility would be located at a prudent distance to urban settlements on a

---

[55] Accidents of trucks carrying hazardous wastes can have severe consequences. In the most recent case found in the media, a truck carrying toxic wastes crashed in Clarines, Venezuela this month. So far 12 people have died, most of them from toxic gas inhalation (Ojeda 2009).

[56] Plausible sites were considered at the Southwestern corner of Bogota in Usme (the fifth locality of the capital district), which also has ideal soil and climate conditions for this type of development. However, urban density was a problem. Plausible sites were just too close to urban settlements and agricultural land.

rather impermeable soil (this is an old quarry site for extraction of construction materials) but still close to the source of pollution since most manufacturing industries in Bogotá (chemical, textile etc.) are located along this corridor. Because this is mainly an industrial area, there are no major sites of interest such as natural preservation areas, schools, hospitals or places with the capacity for large assembly (churches, convention centers, etc.). Illegal settlements abound in the surrounding area, still arguably at a prudent distance. At the point of current settlements, the proposed facility should be able to dedicate space for a buffer area of about 0,5 square miles (banned for community use) and a green infrastructure open space area of 0.32 miles, which adds up to a relatively large open space from the development site to these settlements (especially considering Bogotá's density and the land available for this type of use).

One of the most important considerations that should be taken for site evaluation is whether or not the community can benefit from the proposed development. The third criteria evaluated here, 'identifying benefited communities', could be crucial to avoid neighboring opposition. In many cases, NIMBY attitudes towards waste management facilitates are largely based on the fact that such facilities will not service the town's residents, but mostly distant communities. In the previously discussed case of a municipal landfill in Nemocón (see chapter 2), a town located at about 60 miles away from Bogotá, the main reason for community opposition seems to be that such a landfill will not solve Nemocón's waste problems, but mostly Bogotá's. In the case of Nemocón, its residents do not to want to be affected by a land use project that may not benefit them in any way

that they can actually perceive. In Soacha, the situation may be different. Although residents are not the source of pollution and this is not a municipal waste treatment plant, hazardous waste dumping is affecting these neighboring communities. In many ways, the proposed solution may directly address those environmental concerns that the community can perceive on a daily basis.

History and Characteristics of the Proposed Development Site: Urban and Industrial Growth Problems in the Bogotá-Soacha Industrial Corridor.

Soacha was "founded" in 1600 by Spanish colonizers, though indigenous groups were already established in the area and kept its original name. Human remains found in the region dated approximately 12,400 years ago suggest that the site has a longer settlement history. The earliest area map available was developed in 1875, a date that demarcates subsequent industrialization and urban development.[57] By 1898 the southern train from Bogotá arrived to the region (no longer in service) and almost ten years later the first hydroelectric project was built at the municipality's outskirts. Highway 40, which now connects Soacha with Bogotá, was built in 1924, bringing important industrial development to the area.[58]

Regardless of the rapid industrialization process that took place since the early 1900s, Soacha kept most of its suburban "town" character. Urban density was not an issue until the early 1970s and 1980s, mainly due to forced displacement of farmers from

---

[57] Oficina Departamental, "Historia de Soacha," Cundinamarca.

[58] Oficina Departamental, Historia de Soacha.

other parts of the country imposed by guerrilla or paramilitary violence.[59] Today, one of the area's major development problems is related to this pattern of population growth that has continued over the years. This tendency led to a disorganized land development scheme in which newcomers would establish themselves in any clear area where a temporary house could be erected. This exacerbated housing-infrastructure imbalances and helped establish illegal urbanizations and settlements.[60] Soacha's POT of the year 2000 (Plan de Ordenamiento Territorial, the equivalent of a General Plan of the area) estimated that by 1998 there was deficit of about 34,000 housing units and that 80 percent of the population was living under the poverty line. In addition, Soacha does not have enough health, recreational and open space to service the growing community. Sadly, the situation is not close to resolution. The National Department of Statistics has estimated an arrival to Soacha of about 10,605 new displaced immigrants per year from 2004.

Another major problem that affects Soacha's residents living in both normal and subnormal areas is related to the industrial corridor that thrives throughout its urban center. The National Planning Department estimates that 18.6% of Soacha's urban soil is used for heavy industrial manufacturing activities.[61] However, Soacha does not have a specially engineered landfill or any other sort of specialized hazardous waste disposal or management facility. Most of the hazardous wastes generated by industrial processes

---

[59] Camara de Comercio de Bogota. "Estudio de Competitividad Soacha." http://camara.ccb.org.co

[60] Alcaldia Municipal de Soacha. "Plan de Desarrollo Municipal 2004-2007: Hacia un Desarrollo Comunitatio."

[61] Cámara de Comercio de Bogotá. "Estudio de Competitividad Soacha." http://camara.ccb.org.co

ends up being discharged into the Bogotá or the Soacha Rivers. Some businesses just bury their wastes in clear portions of land right next to densely populated neighborhoods. In April 2000 the police found 18 containers of chemical waste buried in an unfenced neighborhood backyard in the urbanization Rincon Santa Fé in Soacha. The search for wastes was initiated after a growing number of residents reported inexplicable symptoms like extreme eye irritation, vomit, headaches and dizziness (Lesmes 2000). Businesses that do invest in waste management may do it on their on premises, some through their own hazardous waste incinerators. But in general, most industrial businesses are dependent on the waste management offer available, which has been qualified as technically inappropriate and inefficient by governmental environmental authorities (basically, non-engineered landfills are accumulating hazardous wastes, causing leakages to underground water reservoirs that feed both the Bogotá and Soacha River streams).[62] This situation is exacerbated by the lack of enforcement capability for hazardous waste management for the Bogotá-Soacha industrial corridor. As a result, the Bogotá River and the Soacha River are experiencing high levels of contamination with human health impacts not yet sufficiently quantified (some communities living on illegal settlements in the outskirts of Soacha use contaminated stream water for human consumption).

About the Site and Stakeholder Engagement

Regardless of the arguably prudent distance to urban settlements from the proposed site, people living in those settlements (whether they are normal or subnormal

[62] Ministry of Environment, Decree 4741 of December 30 of 2005.

settlements) would be the closest neighboring communities, and as such, they should be acknowledged and their concerns should be addressed. This process would require a variety of stakeholder engagement strategies to achieve different levels of community participation throughout all stages of development. This engagement process is of particular importance because some members of these communities may be especially vulnerable, not just because they may have been violently displaced from other parts of the country, but also because most of them are probably illegally settled in areas that do not have the necessary infrastructure to accommodate them (i.e. public services). Any substantial negative impact exerted over these communities could be considered not just an issue of environmental justice, but also an inhumane act. The proposed solution should take all the precautionary and mitigation measures necessary to prevent negative health, social and environmental impacts from hazardous waste management activities. Furthermore, the proposed solution could take a site development approach based on the implementation of "green" urban planning tools that could benefit these neighboring communities by improving their surrounding environment. With the use of Green Development building standards and "state of the art" stakeholder engagement strategies the proposed solution could extrapolate its service business-orientation to the process of site planning and development in order to directly improve some of the environmental conditions that are already affecting these neighboring communities.

Site Development Strategy: Connecting the HWMF With the Proposed Business Service-Orientation

The proposed site development strategy would be based on the design of an Area Development Plan that would be based on Green Development building and infrastructure standards and that would be sustained by stakeholder engagement. The ultimate goal for such a plan would be first, to minimize site development and operational impacts related to waste management activities (waste storage, transportation etc.), second, to seize opportunities to improve the surrounding environment for local neighboring communities, and third, to support regional environmental sustainability. If these goals are accomplished or are reinforced from an urban planning perspective, it may be possible to successfully minimize development impacts, increase environmental monitoring capabilities through community engagement, and create social and public value around the HWMF and the proposed waste management solution.

Scope and Description of the Proposed Area Development Plan

About the Site

The specific site chosen can be seen in the following map, which is just outside Soacha's southern urban perimeter. The white line demarcates the site's boundaries, which covers approximately 1.32 square miles. No address was available for this site. The local Territorial Organization Plan (POT in Spanish) shows that the area is located at Soacha's Mining District, which extends to the southern rural area of the municipality. The site was originally an old quarry exploited for the extraction of building materials.

Today major quarry extractions are no longer allowed, though a manufacturing factory is still producing bricks from extraction stocks. Unpaved roads surround the perimeter of the site (green lines). Quarry owners made most of them to access important extraction sites. Today, the roads provide access to the nearest southern rural town ("El Molino") and to other normal and subnormal settlements.

Source: Google Maps.

Access to the quarry would be from Highway 40-South to a paved portion of the road that surrounds the San Mateo residential Neighborhood. Access to the site from the highway neither intersects residential hotspots (only scattered residential units), nor does it cross hospitals, schools, fire stations, agricultural fields, major creeks or streams, nor any other major social service area. However, Soacha's River, which in this area is now a

small-canalized creek, crosses underground through the inner road that separates the proposed HWMF from the site's buffer area planned for public recreational use and environmental recovery. The proposed HWMF would not interfere nor pollute or damage the stream (there is no engineered landfill at the site. Residual ashes from hazardous waste incineration would be deposited in a landfill with such a capacity and incineration exhausts could be positioned on a higher gradient in the opposite side from the recreational area and the closest neighborhood). On the contrary, the buffer area planned may be part of a stream recovery effort, which would be mostly outside of the planning area and which may be part of other neighborhood revitalization activities.

The Plan's Purpose

The proposed Area Development Plan is expected to allow the establishment of a hazardous waste management facility with incineration and recycling capabilities in order to capture future waste generation and alleviate environmental and health concerns related to hazardous waste accumulation and mismanagement. Additionally, the HWMF would include an important vegetated buffer area that could be used for recreational and environmental recovery purposes.

The expected outcome from the planning effort would be to encourage environmentally sound hazardous waste management practices to achieve specific socioeconomic and environmental goals. These goals would be, first, to reduce the environmental/health hazards generated by local industrial processes and second, to

increase the current social infrastructure offer by including recreational elements to a large portion of the site's buffer area (parks, sports fields, community garden etc.)

The HWMF in this area would help implement important POT zoning and socio-economic elements that would otherwise take longer to realize. From a zoning perspective, allowing a hazardous waste management facility in this particular site with such a buffer area would prevent further subnormal residential development that is not contemplated in the current POT. Additionally, it would help recover some of the environmental preservation buffer area between Soacha's urban perimeter and the current Mining District, which has been lost due to illegal development. From a socioeconomic perspective, Soacha's POT recognizes the need for hazardous waste management to control urban stream contamination and ecosystem deterioration. Further implementation of a recreational component would be consistent with the POT's envisioned social infrastructure needs.

Plan Description

As shown on the map, the plan would cover an area of approximately 1.32 square miles.[63]The space that would be occupied by the Hazardous Waste Management Facility would cover 0.5 square miles, leaving 0.82 square miles of buffer area (and actually more, since incinerators and exhausts don't need half a mile of space to operate. There would be an additional buffer area within the facility itself). A portion of this buffer area would be dedicated to recreational open space (0.32 square miles). The rest of the buffer

[63] Distance and space was calculated from coordinates provided for the site by google maps.

area to the southern border of the site would be open space dedicated to environmental restoration and would be closed to the public to provide security to both residents and the HWMF.

Access to the recreational facilities would be provided through the northern unpaved road (green line) that comes from the San Mateo Neighborhood bordering the northeastern side of the site. Access to the HWMF would be provided through the current unpaved road that borders the San Mateo Neighborhood. Both roads have direct access to Highway 40.

Besides containing specific information regarding location and distribution of planned development and preservation areas within the site and allowed uses (recreation, environmental protection and hazardous waste management through incineration and recycling), the plan should specifically consider three components to minimize risk exposure (these would be subsidiary from major project components): waste transportation, emissions filtering/control of visible volatile emissions, and noise.

In terms of transportation, the proposed plan should carefully study the routes and times in which wastes would be transported to avoid traffic congestion or school bus routes. The plan should also include contingency plans to protect the population in cases of accidents or spills, as well as remediation plans to prevent damages to local roads (e.g. roads that would be used for waste transportation may need to be reinforced to prevent deterioration due to low carrying capacity).

For emissions filtering and control of visible volatile emissions, the proposed plan

should consider coupling technological aspects related to emissions filtering with community environmental monitoring activities. Because the proposed development is expected to raise issues of risk perception, having neighboring community members participating in environmental monitoring may help dissipate doubts and concerns about actual emission levels and their possible correlation to health problems. For instance, community members could be doing their own readings of emission levels from environmental monitoring systems distributed in the area to measure changes in air pollution. They could also perform health surveys or collect soil or vegetation samples to be tested, a work that they would be payed for. These are just examples of the environmental monitoring mechanisms that may help community members address issues of risk perception, and of course, help them identify environmental impacts that should be promptly remediated.

Community members could be better "sensors" of acceptable visible volatile emissions that are not necessarily hazardous, which may help identify possible problems related to incineration filtering mechanisms, or help identify additional sources of pollution from other adjacent activities. The purpose of these environmental monitoring activities is to engage community members so as to allow them to identify themselves the environmental problems that may affect them, which may not be even related to the proposed development (e.g. they may be originated from waste dumping and other exhausts from neighboring manufacturing industrial activities). Simply put, the proposed solution could *service* neighboring communities by facilitating training for reading

emissions monitoring equipment and by introducing comparative methodologies, such as on site testing of collected samples (through readily available testing kits for this purpose) and the gathering of empirical data, so its members have the opportunity to make their own environmental observations and assessments.

Through this engagement strategy stakeholders would have the ability to promptly identify and understand the point sources of pollution that affect their surrounding air quality. To do this at the development planning stage is of particular importance for the proposed solution because it would help build comparative data to understand the actual environmental performance of the proposed incineration devices and filtering mechanisms. In other cases in which incineration performance has been measured, environmental monitoring studies that intended to calculate emission levels from hazardous waste incinerators have found no hazardous emission changes (especially from organic persistent pollutants), from before or after the operation of the incinerator, which indicates that other sources of pollution (car smog, other industrial emissions, etc), could be the cause of common correlated health problems, such as respiratory ailments (bronchitis, asthma etc.) (Roberts et.al. 2006 and Roberts 1998). Identifying these alternative sources of pollution before the proposed plant is built and before an incinerator operates would be important for understanding the actual impact of the proposed hazardous waste incineration component, and to help identify solutions to address common air quality issues (perhaps by helping communities to implement mitigation strategies to address other sources of pollution).

Finally, in terms of noise, the proposed plan should consider mitigation strategies to minimize noise problems. Although neighboring communities would be almost at a mile of distance, having a hazardous waste generator working at night (especially the energy recovery generator), or trucks coming in and out of the facilities at certain hours may be problematic in terms of noise. Issues of noise should be addressed and mitigated for by building appropriate "green noise barriers," which is a green infrastructure mechanism that consists of a vegetated barrier supported by a sound absorbing or insulating wall made of organic or recycled materials, including steel and hardwood. Seeds would be planted at both sides of this wall. Once grown, the foliage of the vegetation would help control noise while providing environmental and aesthetic benefits. Some of these barriers have been extensively used in places like the Netherlands (IEES 2007) and Hong Kong (Hong Kong Information Service Department 2006), where they have proved to be effective for controlling road and highway noise, helping improve habitat fragmentation for small animals and control water and air pollution.

After risk minimization and mitigation measures, the proposed plan should consider as well mechanisms specifically aimed at improving the surrounding environment of neighboring communities. These should include aspects of public green infrastructure, public transportation, and financial mechanisms to support continued neighborhood revitalization activities.

Improving the Environment in Neighboring Communities

Activities and projects aimed at recovering and improving environmental and

recreational qualities of closest urban settlements are the focal point of he proposed mitigation strategies. These strategies could be designed to prevent neighborhood decay, to compensate neighboring communities for the establishment of a rather unwanted land use project, and to help neighboring and non-neighboring communities recognize that the proposed hazardous waste management activities could be actually beneficial for the local and regional environments. The proposed solution is expected to control the negative impacts of waste dumping, and evidence reviewed here indicates that waste dumping is mostly affecting these communities in Soacha, and not other neighborhoods or regions around rest of the city.

Public Green Infrastructure

The closest urban settlement next to the proposed recreational open space area has no connectivity to most public services. The proposed plan could implement low cost green infrastructure mechanisms such as bioswales and rain gardens to provide the proposed recreational facilities with the needed sewage, water reservoirs and stormwater drainage for the proper functioning of areas proposed for community use (The proposed solution could not take responsibility for extending these green infrastructure coverage to serve residential dwellings in these neighborhoods. The proposed solution could limitedly support such a project in various ways (through community organizing, funding, negotiations, etc.), but such responsibility relies in competent authorities and planning departments).

Bioswales are “gently sloped, vegetated ditches that slow the flow of rainwater

runoff into the sewer system" (City of Portland 2009), that naturally filter water pollutants accumulated on stormwater runoff. These could be placed in parking lots to absorb automotive pollutants and along impervious surfaces (like asphalt or concrete roads) to slow rainwater and prevent flooding, a common problem in the area due to lack of a stormwater drainage system (and the common blockage of the nearest one). Rain gardens work similarly. They are planted depressions (generally of native perennial plants) that absorb rainwater runoff from impervious surfaces, soaking the soil and allowing slow infiltration of water, which increases natural filtration mechanisms and prevents underground water and soil contamination (University of Rhode Island 2009). These are just two examples that could be implemented. A specialist on this type of development may be able to identify or design the most effective measures for the particularities of this area.

Another aspect that should be considered here is related to energy generation from hazardous waste incineration. If this technology is in effect implemented, it would be most appropriate for the proposed solution to provide public street lighting not just for the recreational facilities, but also for the closest neighborhood to the proposed HWMF, not just to provide this service to the community, but mostly to provide security to both residents and the hazardous waste management plant.

Public Transportation

Because part of the proposed open space area in the plan would be dedicated to recreational community use and there is not much of that in the surrounding

neighborhoods, the proposed solution should consider a transportation component that would study public transportation options (e.g. bus routes, walking and biking paths) from the nearest neighborhoods to the public recreational facilities. Such a component should address issues of public parking to avoid disturbing the nearest residents and most importantly, to help the community plan evacuation emergency plans and emergency evacuation routes due to the vicinity to the HWMF in case of involuntary spills or other related accidents. It must be noted that these accidents are not expected to cause immediate major health issues, unless the incineration plant actually explodes and debris and toxic gasses are immediately spread up to a mile of distance, similar to a volcano´s explosion. One may say this is highly improbable. No records were found throughout this research about this type of accident for a hazardous waste incineration plant, unlike the records for chemical and nuclear facilities, like the Seveso disaster in Italy in 1976 (Corliss 1999) and Chernobyl in Ukraine in 1986 (World Nuclear Association 2009).

Financial Mechanisms

The proposed Area Plan should design a financial component that explores financing mechanisms for further civil/social infrastructure needs (the proposed solution is not government owned, it will not have the funds nor the authority needed to solely support the community in their future enterprises, but it may help them plan for it). Various implementation agencies should be identified to perhaps engage them later in a potential specific area planning effort in which competent authorities take responsibility for the protection and improvement of the life conditions of these residents.

Because of the social responsibility principle that rules the proposed solution, some of the financial mechanisms that would be explored to help these communities plan for further funding could be *service-based* as well. For example, the proposed solution may help these communities apply for grants or help them raise money for specific projects. Generators that participate in the proposed solution may help as well. They may choose to donate their energy credits, or the feedback funds they would be entitled to for investing in clean production, to invest in these communities and in a way, take responsibility for the damages that industrial production has exerted over these communities. These are just examples of what could be done. The main point for a financial component in this plan would be to try to connect as much as possible the service-orientation proposed for the business-solution to the proposed site development strategy in order to maximize the opportunities to extend indirect or direct services that would benefit these communities of interest.

Supporting Community Engagement Strategies to Address Site Development Issues Through The Proposed Solution's Service Orientation

The urban planning green tools and approaches explored here could become strategic project components that may help address site development issues while improving local environmental quality and perhaps help build positive community perceptions about the public value of the proposed solution. The main goal for this kind of site planning approach would be to show communities of interest that an environmentally sound hazardous waste management establishment could be of great

value to the city. This idea should be directly linked with the service-orientation approach proposed for the hazardous waste management business.

The service design and delivery approach proposed for the HWMS should be connected with this broader sustainability goal in which neighboring communities and communities of interest are being engaged directly or indirectly as service recipients. Making this connection between the business and business sustainability from a service perspective requires important community participation components and stakeholder engagement. At the planning stage, this approach may help avoid or minimize impacts related to NIMBY attitudes that could interfere with the development of the proposed hazardous waste management solution. But in the long run, one may argue that such a participatory engagement approach may be the key for business success.

To be able to implement the proposed Area Development Plan the most important aspect would be to identify and engage communities of interest to increase environmental monitoring capabilities and create social value. Although a specific site has been already identified here, it must be acknowledged that community engagement starts with participation on the decision process for the location of the incinerating facility. Community here refers to governmental organizations, private businesses, the industrial sector that generates hazardous wastes, neighboring communities to hazardous waste facilities, and any other community of interest. Identifying stakeholders will be crucial to plan engagement strategies.

Community engagement is a cumulative process. It begins before the project is conceived and it continues throughout project monitoring operations. Mechanisms for obtaining community input start with stakeholder identification and analysis techniques to identify high, medium and low power interested community members that may affect or may be affected by a hazardous waste management facility, as previously explored through Chapter 1 (Bryson 2004). Once stakeholders are visible, it would be necessary to introduce mechanisms for involving stakeholders in the planning process.

In terms of monitoring, participatory monitoring strategies are perhaps one of the most important mechanisms to engage stakeholders and evaluate development site problems. One may say that environmental monitoring has better results when it takes part in an interdisciplinary and collaborative effort, where not just actual risks but issues of risk perception could be addressed, which as seen in some of the literature reviewed here, can help relieve stress related to high impact land-use developments.

CHAPTER 5

Using Anthropological Tools and Approaches for Designing a Hazardous Waste Management Solution for Bogotá

The sort of strategic planning proposed for this project illustrates the applicability of anthropology as a discipline capable of conjugating related field's tools and techniques such as stakeholder analysis, urban planning, and environmental economics in order to adapt them to local sociopolitical realities to favor both community and private interests. Through anthropology's holistic perspective, these tools and techniques can be applied to develop research questions, business planning tools or design instruments in order to help formulate a business proposal from the private sector that concomitantly addresses profitability targets and pressing environmental sustainability concerns related to hazardous waste management.

In terms of specific anthropological theories and practices that were brought into the present research, anthropological forms of inquiry that cover subfields such as evaluation anthropology (Butler and Copeland-Carson 2005) and anthropology of development (Escobar 1988, Mosse 2005) enabled the researcher to correlate the global hazardous waste management situation with the local socioeconomic and political environment in Colombia so as to understand the sort of hazardous waste management approach that would be applicable to the proposed urban setting. A comparative approach between the global/local environments related to hazardous waste management helped identify common problems abroad and in Colombia that could be addressed through the

proposed strategic planning, taking into account the technical and legal conditions given for Bogotá for developing this type of projects.

This comparative approach also helped identify main differences between hazardous waste management methodologies that have been applied in other countries (e.g. based on enforcement, waste minimization targets, or a combination of both) so as to try to understand which hazardous waste management practices have been more or less successful, in which area, and why. Once differences and patterns between these waste management methodologies are found, some of these correlations and comparisons could be framed as generalities that could be studied to try to understand what would be their impact if implemented in a particular context such as the one explored for Bogotá. For example, throughout this research it was found that most successful hazardous waste management approaches typically rely on stringent regulatory frameworks as a mechanism to minimize hazardous waste production and prevent waste dumping (see chapter 1). However, critics like Sigman (2003) have found that this particular approach does not necessarily translate into the proliferation of environmentally sound disposal methodologies (as explored earlier for the case of the U.S. approach), and in some cases it does not prevent waste dumping (as in the example explored for Japan). Given this analysis, a stringent regulatory approach of hazardous waste management laws in Bogotá would neither necessarily benefit the proposed solution nor prevent waste dumping. In fact, such an approach may actually become counter productive to the proposed solution because in general, hazardous waste generators in Colombia are not used to pay for

hazardous waste management or for environmental externalities,[64] therefore they would be less likely to support hazardous waste management services that could be offered through the proposed solution. A flexible regulatory approach could be more beneficial in the proposed setting as long as it is accompanied by comprehensive enforcement capabilities to help implement the new hazardous waste regulation. In order for this flexible approach to be successful, the proposed solution could support enforcement through a collaborative effort in which all parties (hazardous waste generators, government entities, and the public) would perceive benefits from environmentally sound hazardous waste management practices and waste minimization efforts.

The analytical perspective taken here is similar to the one explored by project appraisal expert David Potts (2001). According to this author, "projects are feasible if they can work, but they are not necessarily desirable…a good project must be both feasible and desirable from the points of view of all those who are affected significantly" (2001:16). This principle developed by Potts was explored here not just to try to think about ways to benefit both generators and communities of interest, but was also extrapolated to the business model proposed for the solution itself.

The proposed business model is based on the building of a flexible business architecture based on market and network association forms that could be malleable to fit the needs of the people involved or affected by the proposed solution. One of the purposes of thinking about such flexibility within the business model would be to avoid a

---

[64] i.e. costs incurred to protect the environment form industrial activities or for using environmental services.

"mapped" or pre-established business structure to determine the forms of association (business like or not) that could take place throughout the development of the proposed solution. In other words, the business structure should be able to adapt to the realities of the proposed project, allowing the people involved with the project to accommodate a variety of business forms and objectives. This type of approach may be of particular importance to the proposed solution because it is after all a service-based solution.

An anthropological perspective of business and strategic project planning helped translate technical, economic, environmental, legal, political, and social factors related to hazardous waste management into patterns (e.g. waste management imbalances, high waste management costs etc.) or differential phenomena (e.g. the interactions between infrastructure development projects and vulnerable communities in Colombia) that could be studied to solve problems. These factors were analyzed throughout this research in order to be understood and to try to anticipate and solve potential difficulties from a project planning perspective. The purpose of doing this sort of analysis at the planning or design stage would be to minimize difficulties that could arise later through project implementation, which could easily turn into high economic, environmental or social costs that may affect some or all parties involved and ultimately may lead to project failure.

Research Implications and Next Steps

Following Research Questions

The comparative and holistic forms of inquiry adopted here helped identify and develop two important research questions that constituted the core of the present analysis. The first one, related to hazardous waste management in general, was focused on how to solve the problem of successfully implementing a hazardous waste management approach that would be affordable, that would rely on environmentally sound disposal methodologies, and that would be accompanied by an adequate mix of regulation and enforcement. The second question, related to the particular problem of implementing a development/infrastructure project in Bogota from the private sector, was focused on how to introduce the idea of environmentally sound hazardous waste management from the project's design so as to gain public acceptance for the proposed solution and try to prevent project failure. Here these two questions are briefly re-examined.

With respect to the first research question, by observing and studying current global waste management phenomena, it was possible to identify throughout this research that there is, with very few exceptions, a world wide pattern in waste management approaches that lacks balance between hazardous waste management costs, policy regulation, disposal methodologies, and regulation compliance. The problem with such an imbalance is that it interferes with a much needed standardization of environmentally sound hazardous waste management practices regardless of borders so as to prevent the current deterioration rate of valuable natural resources and irreplaceable environmental

services (not to mention to prevent human health effects that are not yet fully understood but have been successfully correlated to hazardous waste production and mismanagement (Rogers et al. 1992, Roberts et al. 1998, Lima 2004)). This situation is exacerbated in countries where hazardous waste management costs (and regulation) are rather scarce or new, like in Colombia. The issue of approaching to a balance between these aspects so as to benefit all parties involved or affected by hazardous waste production and mismanagement (the public, hazardous waste generators, and hazardous waste managers) is arguably of outmost importance for the proposed strategic planning effort.

With respect to the second research question, by observing the local hazardous waste management phenomena and reviewing related projects, it was possible to identify throughout this research that project failure in waste, sanitation, and infrastructure developments in Colombia (funded or owned by private or public parties) is closely linked to problems of lack of community engagement and participation. In many cases (see chapter 2), failure to engage communities of interest from project planning through completion has led to project disruption and failure.

The comparative yet holistic anthropological perspective adopted here helped recognize plausible effects from hazardous waste management imbalance situations when different waste management approaches are taken (e.g. when there are variations in disposal emphases, command and control mechanisms, and coordinated action to prevent waste production). The main purpose of this type of analysis is to be able to connect a general or global hazardous waste management situation with the local environment so as

to identify the most suitable hazardous waste management approach applicable to Bogotá's realities but yet in tune with current institutional and intergovernmental agreements related to environmentally sound hazardous waste management practices.

Getting a Problem-Solving Plan for Community Engagement

What makes an anthropological perspective of particular interest for this project is that it facilitates an understanding of the larger context of this hazardous waste management phenomenon in a way that it helps recognize some of its political, social, economic, and environmental implications locally and abroad. Understanding these implications would be the first step to find ways to identify and solve potential problems when trying to establish a hazardous waste management business in tune with sustainability targets. Much of the issues of policy context and considerations of technical and technological needs for environmentally sound hazardous waste management explored throughout this report were focused on critical questions about development, market based, network, and collaboration mechanisms for business planning, with the idea in mind of developing a problem-solving knowledge base from where to start a project.

In Colombia, project failure due to lack of involvement or participation of communities of interest in large infrastructure projects is rather common. This alone indicates that the consolidation of the proposed solution into a fully funded project needs to be accompanied by the design of a state of the art community engagement plan that includes stakeholder analysis and community development components. Further research

is needed to fully understand and plan for engagement strategies, especially to engage communities in the evaluation of environmental issues, pre and post project operations. Because the proposed solution relies on principles of environmental sustainability and social responsibility, it is also important to plan for engagement strategies that could facilitate spaces for collaboration with both highly and low influential stakeholders. In the last case, such spaces could be consolidated through further implementation of urban planning benefits around a future hazardous waste management facility.

Anthropological expertise could be helpful in this process, especially in areas that would require careful attention, such as in research assessments to help make strategic decisions, or by serving as translators of tacit knowledge (from neighboring communities and experts alike), which could be crucial to identify and engage a wider spectrum of stakeholders.

Following the Proposed Business Planning Tools

An anthropological form of inquiry based on what is typically understood as a combination of bottom-up and top-down perspectives (Nader 1972) helped tailor existing business planning tools such as PESTLE and SWOT analysis to facilitate an understanding of the conditions that would determine the success of the proposed solution, while trying to keep into perspective three main sociopolitical dimensions: a business, an institutional, and a community-of-interest point of view. Although no fieldwork was performed and most of the analysis was based on critical case studies and plausible assumptions derived from legal and technical documents, the bottom-up/top-

down approach taken here was not so much a question of dichotomy (of planning from the top or from the bottom) but it was rather taken as a bi-dimensional planning tool to help understand the dynamic relationships (emerging from the bottom or from the top) that could shape and transform the given sociopolitical conditions for Colombia when a project like the one proposed here is implemented. For example, it was considered here that low powered communities of interest (it could be neighboring communities, some generators, or governmental/non governmental expert groups) would not react to the proposed solution in a political vacuum from the bottom, but their reactions or actions would rather be shaped by historic processes related to similar projects that have already transfigured the way development or infrastructure projects are implemented in Colombia from the top-down. In some cases, such historic processes have given to some communities enough "power" to act from the top-down under special circumstances. This was the case for some of the examples previously explored here in which "specially vulnerable communities" were able to use strenuous and unfortunate life circumstances to achieve political cohesiveness and act from the top-down as highly powered constitutional figures, not just to defend their rights, but also to achieve their political interests.

This top-down/bottom-up approach may be of particular interest in the process of planning a hazardous waste management solution for Bogotá because it keeps into perspective the "needs" of politicians, generators, and expert/lay communities alike (needs particularly but not necessarily in terms of hazardous waste management) so as to

help waste managers (which would own the proposed business) to define strategic planning tools that will meet all of these groups needs through the delivery of hazardous waste management services. The question of how to plan a business solution based on the design of strategic services to reach such a wide and differential group of stakeholders could be easier to answer when stakeholder needs and their plausible interactions from the top-down and bottom-up are somewhat understood or identified.

The flexible business infrastructure proposed here was developed through this bi-dimensional planning tool of looking up and down. Both market and network association forms were analyzed keeping into perspective the need to engage both highly and low powered stakeholders. Highly powered stakeholders may only be interested in the services the proposed solution could provide if a monetary or price benefit is obtained. Low powered stakeholders may be more interested in obtaining potential benefits (monetary or not) through network association forms.

One may argue that a bottom-up/top down perspective like the one introduced in this analysis should consider more detailed interconnections to better explain further sociopolitical intricacies that need to be understood to implement the proposed solution. For example, highly powered stakeholders are not necessarily looking for market-based solutions. Likewise, low powered stakeholders may not necessarily be looking for a long-term relationship or to become part of a network association. The question is then, how to understand the interconnections that may incline low-powered and high-powered stakeholders to prefer network or market association forms (the extent of power discussed

here directly relates to the stakeholder ability to affect positively or negatively the development of the proposed solution). Understanding these preferences or a wide range of preferences may be crucial to be able to design tailored services.

In many ways, the business architecture proposed for this project would be a blueprint to the proposed solution. Some authors have criticized the idea of a "blueprint" project in the sense that such a blueprint may not give enough flexibility to act (Potts 2001). The reason why the proposed business architecture is drafted here is because it may help to plan for decision-making. If there is no blueprint at this point, it would be harder to build a cohesive approach, not just in terms of guiding principles such as the ones adopted here of social responsibility and environmental protection, but to build the necessary body of information that would lead to business decisions, such as whether or not to offer market-based benefits through service use and how to do it without harming profitability. What has been done here to avoid problems of inflexibility is to think about a flexible business platform that may be as inclusive and malleable as possible to engage the largest number of stakeholders while increasing the demand for the proposed solution.

Most importantly, the proposed flexible business infrastructure, which is based on social responsibility and environmental protection principles, should be understood as the proposed project´s blueprint because it allows to systematically study and understand common questions related to hazardous waste management projects locally and abroad. Such a blueprint constitutes a systematic guidance tool that enables the implementation of

international hazardous waste management standards locally, and therefore is an essential methodological tool to develop the proposed solution.

The use of SWOT and PESTEL as structures for macro-environmental analysis helped gain an understanding of how business or project managers typically plan and think ahead about issues. To understand general methods and stages of policy making for projects, it is important to have analytical clues that would help understand how and why things are done when business planners plan for businesses and how projects may be created with a business in mind. Although this process is not typically the focus of anthropological questions, the anthropological eye was of particular assistance to get a critical view of how the business planning process works. Once the process is understood, it may be reinforced by, for instance, anthropological theory of development or stakeholder analysis theory, so the proposed planning effort would evolve from a simple hazardous waste management business into a service based hazardous waste management solution aimed at achieving both business and environmental sustainability targets. The macro-environmental analysis presented in this report was performed through a business format, but it was an anthropological perspective what helped define how such an analysis could support the development of hazardous waste management services. Two main ideas should be carefully considered within further stages of business planning (e.g. economic feasibility of market/network based incentives): the impact of knowledge and network economies on market and network association forms. These two

issues were previously considered in this report, but have not been directly or carefully explained.

Planning For Flexible Services. Further Analysis is Needed to Understand The Impact of The Knowledge and Network Information Economies on The Proposed Service-Based Waste Management Solution

The market-based forms of business association that could take place through the proposed solution could be characterized by the influences of what is known as the network information economy (Shapiro et al. 1999) and the knowledge economy (Ronney et al. 2005). In general, these two new economic forms are the result of recent transformations in economic and business association forms that have evolved since the beginning of the IT revolution, which in its expansion has altered typical economic factors of production such as labor and capital into new factors such as 'technology' or 'knowledge,' and have created new commodities like 'information' or 'networks'.

According to Powell and Snellman (2004), the known market economy is evolving into a knowledge economy as production and services based on knowledge intensive activities are contributing to an accelerated pace of technical and scientific advance. However, these rapid advances fueled by knowledge (knowledge as a product or as commodity) are also leading to a rapid obsolescence of products and procedures. It is important that future business planning for the proposed solution considers the impact of knowledge as a commodity within plausible business association forms. The point here is that the market mechanisms that could be drafted through this solution, which could be

based on what Felin, Zegner, and Tomsik (2009) call the "microfoundations" of knowledge production (referring to the individual interests, proprietary rights and market like incentives that fuel the knowledge economy), can actually enable rather than impede network and communal forms of organization that are associated with knowledge creation through service delivery (2009:559). In other words, the self-interested behaviors of individual agents, which may be the general case for hazardous waste generators, could be re-directed to help build network association forms through the offering of highly valued services gathered under a shared knowledge base for a group of stakeholders. This could happen when it is identified that knowledge is a highly valued factor of production or commodity among a group of generators, and it could be offered or facilitated through services that help generators implement more efficient processes to reduce waste production and overall waste management costs. The implications of this analysis for the future planning of services is that a better understanding of the impact of the knowledge economy within market transactions may help devise opportunities to increase the demand for the proposed solution through knowledge as a tool to achieve increasing levels of collaboration among generators.

It has been argued along this report that alternative forms of business association to the typical market-like transactions are booming because of the fundamental changes brought by IT, technology, and globalization, a new environment in which businesses sometimes require long-term relationships and a high level of knowledge transfer that may be difficult to foster under market-like transactions (once the transaction is over in

market-like associations, typically there is no need for extended engagement, knowledge transfer, or collaboration). Additionally, as Baumol (2002) has noted, the main concern of business organizations may be no longer pricing (in terms of balancing offer and demand), but innovation. According to Baumol, one of the most critical attributes of the free market economy is "its ability to produce a stream of applied innovations and a rate growth in living standards far beyond anything that any other type of economy has been able to achieve for any protracted period…it seems indisputable that innovation accounts for much of this enviable growth record" (2002:8). Market mechanisms are dependent on proprietary forms of knowledge (knowledge in the form of innovation needs to be owned to be traded). However, other authors, like Benkler (2006), rightly point out that collaboration in the form of networks could become a commodity through market association forms, and as such, networks could be highly valued and easier to maintain than in many non-market collaborative environments.

Yochai Benkler (2006) carefully studies the concept and impact of the network information economy. In his essay "The Wealth of Networks" (2006), the author argues that the revolution of information technology should not be considered a passé subject, and emphasizes how access to information has transformed markets and "freedom" through new and even "free" IT platforms that are available to whomever is "connected." The proposed services drafted in this report would operate within a network information economy in the sense that generators would rely on information about others to gain access to some of these services (to participate in recycling and reusing exchange

programs, through the trade of energy credits etc.). The more the solution is being used through this sort of services the more its users would require of network collaborative spaces for this tools to work and benefit them. In this sense usual commodities would not be the essence of market-based exchanges, but rather networks. The real value of the proposed solution will not be determined solely by an exchange of waste management services, but also by the established networks that could potentially reduce the costs of those services, making them more affordable to generators.

These issues need to be carefully studied when designing actual services because these services may also rely on IT capabilities that some generators may not have access to, as there is such a thing as the technology and the internet divide among small or large businesses in Colombia. Whether or not there is access to IT platforms, further business planning must consider how to use service design and delivery as a tool for creating networks and collaboration through market-based transactions as they may help increase the demand for the proposed solution.

Following Design instruments

Using Urban Planning Green Infrastructure Design to Build a Hazardous Waste Management Facility and Improve Some Pressing Conditions in the Surrounding Area

The proposed planning effort for a hazardous waste management solution that could be established in Bogotá appealed to some urban planning tools and techniques based on green infrastructure developments to try to address issues of project design. The idea here

was to put together aspects of environmental protection, sustainability, and sociopolitical concerns related to NIMBY attitudes into an urban planning design that could help address all of these issues. Urban planning tools may be more suitable to address these issues than any other social marketing campaign about the benefits that could be provided to neighboring communities through the safe control of pollutants in near water or agricultural land resources through controlled hazardous waste incineration. The interesting point of this approach is that it uses a design perspective of project implementation to address issues of concern from project planning through completion, which may facilitate acceptance to proposed facility as well as facilitate community and expert assessments of related impacts. This type of urban planning approach should be connected to the idea of service delivery to support the concept that the proposed solution is offering a public service, all of which may support the proposed business and the proliferation of environmentally sound hazardous waste management practices.

BIBLIOGRAPHY

Adler, Paul
2002 Corporate Scandals: It's Time For Reflection in Business Schools. Academy of Management Executive 16(3):148-149.

Academies, N. R.
2006 Health Risks form Dioxin and Related Compounds. Evaluation of the EPA Reassessment. Washington D.C.: The National academies Press.

ACNUR
2008 Más de Medio Millón de Desplazados en Bogotá Por el Conflicto Interno. Electronic Document, http://www.acnur.org/index.php?id_pag=3149, accessed March 15, 2009.

Agenda Río Bogotá
2008 Descontaminación del Río Bogotá, Control Ciudadano. Electronic Document, http://agendariobogota.blogspot.com/2008/06/descontaminacin-del-ro-bogot-control.html, accessed September 18, 2009.

Aguilar, Francis J.
1967 Scanning The Business Environment. New York: Macmillan Co.

Alcaldía Mayor de Bogotá
2009 Empresa de Renovación Urbana (ERU). Electronic Document, http://www.eru.gov.co/index.php?id_c=4&tpl=articulo, accessed June 12, 2009.

Alcaldía Municipal de Soacha
2004 Plan de Desarrollo Municipal 2004-2007: Hacia un Desarrollo Comunitario. Electronic document, Available in http://www.car.gov.co/documentos/, accessed November 20, 2008

Alcaldía Municipal de Soacha
2001 Plan de Ordenamiento Territorial (POT). Documento Técnico de Soporte. Electronic document, www.planeacion.cundinamarca.gov.co, accessed November 22, 2008.

Alcaldía Municipal de Soacha
2000 Plan de Ordenamiento Territorial (POT). Electronic document, http://www.car.gov.co/paginas.aspx?cat_id=132&pub_id=203&pag=11, accessed November 22, 2008

Allison, Michael, and Jude Kaye
2005 Strategic Planning For Non-Profit Organizations. Wiley, second edition.

Andean Information Network
2008 Bolivian Coca Growers Cut Ties with USAID. Electronic document, http://ain-bolivia.org/index.php?option=com_content&task=view&id=128&Itemid=28, accessed April 10, 2009.

Anderson, David, with K.W. Brown and Jan Green

1982 Effect of Organic Fluids on the Permeability of Clay Soil Liners. Land Disposal of Hazardous Waste. Cincinnati: U.S. Environmental Protection Agency (EPA-600/9-82-002).

ANR (Asociación Nacional de Recicladores)
Electronic document, http://www.anr.org.co/nentidad.php., accessed July 22, 2009.

Armstrong, J. Scott
2004 N.d. Don´t Do SWOT: A Note on Marketing Planning. Electronic document, http://marketing.wharton.upenn.edu, accessed February 18, 2009.

Armstrong, J. Scott
1982 The Value of Formal Planning for Strategic Decisions: Review of Empirical Research. Strategic Management Journal 3(3):197-211.

Arsian, Ozcan, and Ismail Deha Er
2007 SWOT Analysis For Safer Carriage of Bulk Liquid Chemicals in Tankers. Journal of Hazardous Materials 154(1-3):901-913.

Asante-Duah, Kofi
1993 Hazardous Waste Risk Assessment. CRC Press.

Autret, Erwan, with Francine Berthier, Audrey Luszenzanec and Florence Nicolas
2006 Incineration of Municipal and Assimilated Wastes in France: Assessment of Latest Energy and Material Recovery Performances. Journal of Hazardous Materials 139(3): 569-574.

Ballard, Kevin, and Richard Kuhn
1998 Canadian Innovations in Siting Hazardous Waste Management Facilities. Environmental Management 22(4): 533-545.

Banco de la República
2009a Política Cambiaria. Electronic document, http://www.banrep.gov.co/politica_cambiaria/index.html, accessed June 6, 2009.
2009b Balanza de Pagos. Electronic document, http://www.banrep.gov.co/estad/Balanza-pagos/I-Trim-2009.pdf, accessed June 6, 2009.

Barbosa, Juan David, with Gerardo Viña, Diana Ruíz and Álvaro Prada
2005 Evaluación de la Aplicación de los Beneficios Tributarios Para la Gestión e Inversión Ambiental en Colombia. Santiago de Chile: Cepal. Electronic document, http://www.cepal.org/publicaciones/xml/1/21871/lcl2306e.pdf, accessed July 13, 2009.

Basel Action Network
2007 Basel Non-Compliance Notification Report. Country Violation: Japan. March 12, 2007. Electronic document, http://www.ban.org/Library Japan_JPEPA_BNN2007_1.Final.pdf, accessed January 25, 2009.

Basel Convention
2010 Description of the Convention. Electronic Document, http://www.basel.int/convention/basics.html, accessed January 2010.

Basel Convention
2007 Updated General Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Persistent Organic Pollutants (POPs). Electronic document, http://www.basel.int/meetings/, accessed January 2010

Basel Convention
2002 Basel Convention Technical Guidelines On Incineration on Land. Basel Convention Series. Electronic document, http://www.basel.int/meetings/sbc/ accessed January 2010.

Basel Publications
2010 Environmentally Sound Management. Electronic document, http:/ www.basel.int/, accessed January 2010.

Basic Energy
2009 Basic System. Electronic document, www.basic-energy.com/about.html, accessed June 10, 2009.

Baumol, William
2002 The Free Market Innovation Machine: Analyzing the Growth Miracle of Capitalism. Princeton University Press.

Benavides, Livia
2006 Guía para la Definición y Clasificación de Residuos Peligoros. CEPIS, GTZ. Electronic document, http://www.cepis.ops-oms.org, accessed October 8, 2008.

Benkler, Yochai
2006 The Wealth of Networks. How Social Production Transforms Markets and Freedom. Yale University Press.

Bergquist, Ann, and William Marsh
1998 Environmental Monitoring for Effects of Hazardous Waste Incineration. *In* Hazardous Waste Incineration. Stephen, Teaf and Bean Eds.

Biblioteca Banco de la República
2005 Tasa de Cambio, Tasa Representativa del Mercado. Electronic document, http://www.lablaa.org/blaavirtual/ayudadetareas/economia/econo112.htm, accessed August 18, 2009

Boisot, Max H.
1998 Knowledge Assets: Securing Competitive Advantage in the Information Economy. Oxford University Press.

Bowman, Ann, and James Lester
1985 Hazardous Waste Management: State Government Activity or Passivity? State and Local Government Review 17(1):155-161.

Bradford, Robert, and Peter Duncan
2000 Simplified Strategic Planning. Chandler House Press.

Branc, Kristi and Helen Ross

2000 Scoping For Social Impact Assessment. *In* Social Impact Analysis: An Applied Anthropology Manual. Laurence Goldman Ed. New York: Berg.

Bronfenbrenner, M.

1990 Observations on the Chicago School(s). *In* Milton Friedman: Critical Assessments, Volume 4. John Cunningham Wood and Ronald Woods Eds.:Routledge.

Bryson, John M.

2004 What To Do When Stakeholders Matter. Stakeholder Identification and Analysis Techniques. Public Management Review 6(1):21-53.

Business Dictionary

2009a Competitive Position. Electronic document, http://www.businessdictionary.com, accessed September 22, 2009.

2009b Fair Competition. Electronic document, http://www.businessdictionary.com/, accessed August 13, 2009.

2009c Market. Electronic document, http://www.businessdictionary.com, accessed, August 13, 2009.

Bustamante, Agustín

2009 Hallaron Más Desechos Tóxicos en El Copey. El Tiempo, August 24, 2009.

Cabral, Luis M.B.

2000 Introduction to Industrial Organization. MIT Press.

Cámara de Comercio de Bogotá

2007 Estudio de Competitividad: Soacha. Electronic document, http://camara.ccb.org.co/documentos, accessed November 15, 2009.

Cámara de Comercio de Bogotá

2005 Plan Económico Para la Competitividad de Soacha. Electronic document, http://camara.ccb.org.co/documentos, accessed February 26, 2009.

Caplan, Bryan

2008 Externalities. The Concise Encyclopedia of Economics. Library of Economics and Liberty. Electronic document, http://www.econlib.org/library/Enc/Externalities.html, accessed March 12, 2009.

CAR

2008 Confirmada Licencia Ambiental a Relleno Sanitario de Nemocón. Corporación Autónoma Regional de Cundinamarca (CAR). Electronic document, http://www.car.gov.co/paginas.aspx?cat_id=104&pub_id=1177, accessed June 18, 2009.

CAR

2005a Equipamientos Sociales. Plan de Ordenamiento Territorial, Soacha. Electronic document, http://www.car.gov.co/documentos, accessed November 4, 2009.

2005b Zonificación Usos del Suelo. Plan de Ordenamiento Territorial, Soacha. Electronic document, http://www.car.gov.co/documentos, accessed November 4, 2009.

Carroll, W. F.

2003 Incinerator Design and Operation: The Robust Approach to PCDD/F minimization. Electronic document, http://www.dioxinfacts.org/sources_trends/incinerator.html, accessed April 24, 2009.

Carvajal, Alfredo
2007 Efectos de la Revaluación. Revista Dinero, June 8, 2007.

Chambers, Robert
1994 Participatory Rural Appraisal. Challenges, Potential and Paradigm. World Development 22(10):1437-1454.

Channabasavaiah, Kishore, with Holley Kerrie and Edward Tuggle
2003 Migrating to A Service Oriented Architecture, Part One. Electronic document, http://www.ibm.com/developerworks/library/ws-migratesoa/, accessed May 27, 2009

Channon, Derek (Ed.)
2005 Encyclopedic Dictionary of Strategic Management. Blackwell.

Cheney, George, with Steve Kent May and Juliet Roper
2007 The Debate Over Corporate Social Responsibility. Oxford University Press.

Chomsky, Noam
1999 Profit Over People: Neoliberalism and Global Order. Seven Stories Press.

Chomsky, Noam
1994 World Orders, Old and New. New York: Columbia University Press.

Cisco
2009 Cisco Service-Oriented Network Architecture: Support and Optimize SOA and Web 2.0. Electronic document, http://www.cisco.com/en/US/solutions, accessed July 22, 2009

City of Portland
2009 Bioswales. Electronic document, http://www.portlandonline.com/bps, accessed March 17, 2009.

Civisol
2009 Trash is Life: The Navarro Case. Foundation for the Civic and Solidarity Building of Systemic Change. Electronic document, http://www.civisol.org/trashislife3, accessed April 14, 2009.

Colebatch, H.K.
2002 Policy. Open University Press.

Congreso de La República de Colombia
2008 Ley 1259 de 2008. Electronic document, http://www.secretariasenado.gov.co, accessed August 3, 2008.

Congreso de La República de Colombia
2002 Ley 788 de 2002. Electronic document, http://www.alcaldiabogota.gov.co, accessed August 3, 2008.

Congreso de La República de Colombia

2000 Law 563 of 2000. Electronic document, http://www.cra.gov.co/portal, accessed August 3, 2008.

Congreso de La República de Colombia

1996 Ley 256 de 1996. Electronic document,http:www.secretariasenado.gov.co/, accessed August 3, 2008.

Congreso de La República de Colombia.

1997 Law 388 of 1997. Electronic document, http://www.cdmb.gov.co/normas, accessed August 3, 2008.

Congreso de La República de Colombia

1994a Constitución Política de Colombia. Electronic document, http://pdba.georgetown.edu/Constitutions/Colombia/colombia91.pdf, accessed March 19, 2009.

1994b Law 134 of 1994. Electronic document, http://pdba.georgetown.edu/, accessed August 3, 2008.

1994c Ley 142 de 1994. Electronic document, http://www.acnur.org/biblioteca, accessed March 19, 2009.

Congreso de La República de Colombia

1993 Law 99 of December 22, 1993. Electronic document, http://www.elaw.org/node, accessed August 3, 2008.

CONPES

2008 Documento 3519. Departamento Nacional de Planeación. Electronic document, http://docs.google.com/gview?a=v&q=cache:bzKciQ_JBWIJ:www.dnp.gov.co/, accessed March 20, 2009.

CONPES

1995 Documento CONPES 2924: Sistema Nacional de Atención Integral a la Población Desplazada por la Violencia. Concejo Nacional de Política Económica y Social, CONPES. Electronic document, http://www.acnur.org/biblioteca/pdf/, accessed March 19, 2009

Cooper, David

1998 Fundamentals of Hazardous Waste Incineration. *In* Hazadous Waste Incineration: Evaluating the Human Health and Environmental Risks. Roberts, Teaf and Bean Eds. Pp. 1-22. CRC Press.

Corliss, Mick

1999 Seveso Disaster, Testament to Effects of Dioxin. Electronic document, http://www.getipm.com/articles/seveso-italy.htm, accessed February 12, 2009.

Coronell, Daniel

2009 Los Negocios Millonarios de los Hijos del Presidente Uribe Vélez. Revista Semana, April 2009.

Correa, Ivan

1999 Urra Dam Project. World Commission on Dams. Electronic document,

http://www.dams.org, accessed February 12, 2009.

Corte Constitucional

2009a Sentencia T-291 de 2009, a Favor de Recicladores de Cali. Electronic document, http://www.corteconstitucional.gov.co/, accessed March 4, 2009.

2009b Sentencia T-123 de 2009, a Favor de la CAR. Electronic document, http://www.corteconstitucional.gov.co/, accessed March 4, 2009.

Corte Constitucional

2004 Sentencia T-025 de 2004. Electronic document, http://www.acnur.org/biblioteca, accessed March 4, 2009

Corte Constitucional

2003 Sentencia T-724 de 2003, a Favor de Recicladores de Bogotá. Electronic document, http://www.alcaldiabogota.gov.co/sisjur/normas/Norma1.jsp?i=11617, accessed March 4, 2009.

Costner Pat, and John Thorton

1990 Playing With Fire: Hazardous Waste Incineration. Washington D.C.: Greenpeace.

Cowley, Michael, and Ellen Domb

1997 Beyond Strategic Vision. Effective Corporate Action with Hoshin Planning. Butterworth-Heinemann.

DAMA

2004 Proyecto de Descontaminación y Recuperacion de la Cuenca del Río Bogotá. Electronic Document Series, http://www.secretariadeambiente.gov.co/sda/libreria/, accessed Septemeber 18, 2009.

DANE

2009a Exportaciones y Balanza Comercial. Electronic document, http://www.dane.gov.co/files/comunicados/cp_exp_abr09.pdf, accessed July 17, 2009.

2009a Indicadores Económicos. Departamento Nacional de Estadística. Electronic document, http://www.dane.gov.co/, accessed July 17, 2009.

2009b Producto Interno Bruto. Electronic document, http://www.dane.gov.co/, accessed July 17, 2009.

DANE

2007 Bogotá Tiene 6´776,009 Habitantes. Electronic document, http://www.presidencia.gov.co, accessed January 29, 2009.

DANE

2004 Soacha: Perfil Municipal 2004. Electronic document, http:www.dane.gov.co, accessed November 14, 2008.

DANE

2003 Censo Experimental de Soacha. Departamento Nacional de Estadística. Electronic document, http://www.dane.gov.co/files/prensa/comunicados/cp_censo_experim_soacha4.pdf, Accessed November 14, 2008.

Daniel, David E.

1981 Problems in Predicting the Permeability of Compacted Clay Liners. Symposium on Uranium Mill Tailings Management, Fort Collins, Colorado, October 26-27, 1981. Geographical Engineering Program, Civil Engineering Department, Colorado State University.

DeMott, Robert

1998 Ecological Risk Assessment Issues for Hazardous Waste Incineration. *In* Hazardous waste Incineration. Stephen, Teaf and Bean Eds.

Departamento de Planeación de Cundinamarca

2006 Plan de Ordenamiento Territorial: Conceptos Básicos de Elaboración y Aspectos Relevantes Para Su Revisión y Ajuste. Electronic document, http://www.planeacion.cundinamarca.gov.co/BancoMedios/Documentos, accessed July 13, 2009.

Donaldson, Thomas, and Lee Preston

1995 The Stakeholder Theory of The Corporation: Concepts, Evidence and Implications. Academy of Management Review 20(1): 65-91.

Eden, Colin, and Fran Ackermann

1998 Making Strategy: The Journey of Strategic Management. Thousand oaks, CA: Sage Publications.

Environmental Justice Case Studies

1997 Waste Technologies Industries Inc. and the Fight Against a Hazardous Waste Incinerator in East Liverpool, Ohio. Electronic document, http://www.umich.edu/ %7Esnre492/mcormick.html, accessed january 12, 2009.

EPA Taiwan

2005 Small and Medium-Sized Waste Incinerator Dioxin Control and Emissions Standards. Air Pollution Control Act. Electronic document, http://law.epa.gov.tw/, accessed February 2, 2009.

Escobar, Arturo

1988 Power and Visibility: Development and The Invention and Management of The Third World. Cultural Anthropology 3(4):428-433

EPD Hong Kong

2006 Getting to Know Dioxins. Electronic document, http://www.epd.gov.hk/epd/, accessed October 26, 2009.

Erl, Thomas

2007 SOA, Principles of Service Design. Prentice Hall.

Estatuto Tributario

2003 Decreto 3172 de 2003. Electronic document, http://www.paramo.org/portal/files/, accessed August 7, 2009.

Europa

2009 Waste Electrical and Electronic Equipment. Electronic document, http://ec.europa.eu/environment/waste/weee/index_en.htm, accessed February 2, 2009.

Europa
2007 Controlled Management of Hazardous Waste. Council Directive 91/689 ECC of 1991. Electronic document, http://europa.eu/scadplus/leg/en/lvb/l21199.htm english/incineration_faq.htm#3, accessed February 2, 2009.
Fahey, Liam, and V.K. Narayanan
1986 Microenvironmental Analysis for Strategic Management. SOS Free Stock Eds.
Fals Borda, Orlando
1986 La Investigación-Acción Participativa: Política y Epistemología. *In* La Colombia de Hoy. Álvaro Camacho G. ed., Pp. 21-38. Bogotá: Cerec.
Federal Ministry For The Environment, Germany
2005 Waste Incineration. A Potential Danger? Bidding Farewell to Dioxin Spouting. Electronic document, http://www.seas.columbia.edu/earth/wtert/sofos/ Waste_Incineration_A_Potential_Danger.pdf, accessed January 13, 2009.
Felin Teppo, with Joshua Tomsik and Todd Zenger
2009 The Knowledge Economy: Emerging Organizational Forms, Missing Microfoundations and Key Considerations For Managing Human Capital. Human Resource Management 48(4): 555-570.
Foss, N.J.
2006 Strategy, Economic Organization, and the Knowledge Economy. Oxford University Press.
Fraser, Heather
2005 Four Different Approaches To Community Participation. Community Development Journal, Oxford University Press.
Fundación Verde Vivo
2009 Diagnóstico del Río Bogotá. Electronic document, http://www.alverdevivo.org/, accessed September 18, 2009
GELT
2009 Soacha, Medio Ambiente. Gobierno En Linea del Orden Territorial. Electronic document, http://soacha-cundinamarca.gov.co/nuestromunicipio, accessed October 26, 2009.
Gillespie, Andrew
2007 Foundations of Economics. Oxford University Press.
Gluschko, Bob
2006 Service Oriented and Global Service Delivery Models. Lecture Notes, UC Berkeley School of Information. Electronic document, http:// people.ischool.berkeley.edu/~glushko/ISE-Notes-Fall2006/210-20061010.pdf, accessed June 17, 2009.
Goodstain, Leonard David, with Timothy M. Nolan and William Pfeiffer
1993 Applied Strategic Planning: A comprehensive Guide. McGraw-Hill Professional.
Google Earth

2009 Map of Soacha. www.googleearth.com.
Gotaverken Miljo
2009 Energy Efficient Solutions For Minimized Environmental Impacts. Facts about Dioxins and Dioxin Emissions. Electronic document, http://www.adiox.se/eng_faktaomdioxiner.htm, accessed June 13, 2009.
Green, William J., with G. Fred Lee and R. Anne Jones
1979 Final Report on Impact of Organic Solvents on the Integrity of Clay Liners for Industrial Waste Disposal Pits: Implications for Ground water Contamination. U.S. Environmental Protection Agency, Ada, Oklahoma, June, 1979.
Greenpeace
2009 Eliminate Toxic Chemicals, The Problem. Electronic document, http://www.greenpeace.org/international/campaigns/toxics/incineration/the-problem, accessed February 1, 2009.
Greenpeace
2007 Japan "Twisting Arms" of Asian Neighbors to Take Toxic Waste. Electronic document, http://www.greenpeace.org/seasia/en/press/releases/japan-, accessed January 17, 2009.
Gulati, R., with N. Nohria and A. Zaheer
2000 Strategic Networks. Strategic Management Journal 21:203-215.
Habitat II
2004 Asociación de Recicladores de Bogotá. Second United Nations Conference on Human Settlements. Best Practices Database. Electronic document, http://habitat.aq.upm.es/bpal/onu04/bp1555.html, accessed April 24, 2009.
Halla, Francos
2006 A SWOT Analysis of Strategic Urban Development Planning: The Case of Dar Es Salaam City in Tanzania. Habitat International 31(1):130-142.
Hampson, Rick
2005 Gentrification: A Boost For Everyone. US Today. April 19, 2005.
Harrison, Jeffrey S., and Edward Freeman
1999 Stakeholders, Social Responsibility and Performance: Empirical Evidence and Theoretical Perspectives. Academy of Management Journal 42(5): 479-485.
Harvey, Campbell and Gretchen Morgenson
2002 Feedback System. Dictionary of Money and Investment. Times Books. Electronic document, http://www.duke.edu/~charvey/Classes/wpg/glossary.htm, accessed March 12, 2009.
Hill, Peter
1999 Tangibles, Intangibles and Services: A Taxonomy for the Classification of Output. Canadian Journal of Economics 32(2):426-446.
Hill, T., and R. Westbrook
1997 Swot Analysis: It´s Time For a Product Recall. Long Range Planning 31(1):46-52

Hoag, Arleen, and John Hoag
2002 Introductory Economics. World Scientific Publishing Company, 3rd Edition.
Hong Kong Information Service Department
2006 Green Noise Barriers to Go on Trial. Electronic document, http://www.news.gov.hk/en/category/infrastructureandlogistics/061221/features/html/, accessed October 12, 2009.
Hornberger, Jacob
2003 But Foreign Aid is Bribery. Electronic document, http://www.fff.org/comment/, accessed November 5, 2009.
Houben, G., with K. Lenie and K. Vanhoof
1999 A Knowledge-Based SWOT-Analysis System as an Instrument for Strategic Planning in Small and Medium Sized Enterprises. Decision Support Systems 26(2): 125-135
Howe, Charles
2009 The Effects of Privatization of Public Services: The Case of Urban Water. University of Colorado at Boulder. Electronic document, http://www.ucowr.siu.edu/updates/pdf/V117_A9.pdf, accessed February 10, 2010.
IAP2
2008 Case Studies. State of The Practice Report. Electronic document, http://www.iap2.org/associations/4748/files/, accessed November 27, 2009.
IAP2
2004 IAP2 Public Participation Spectrum. Electronic document, http://www.iap2.org.au/sitebuilder/resources/knowledge/asset/files/36/iap2spectrum.pdf, accessed November 27, 2009.
IBM
2009 Service Oriented Architecture. Electronic document, http://www-01.ibm.com, accessed March 12, 2009.
IBM
2006 Service Oriented Architecture: Flexibility for Business. Electronic document, http://www-304.ibm.com/tools/cpeportal/fileserve/, accessed March 12, 2009.
IDEAM
2009 Servicio Meteorologico Mundial. Electronic document, http://wwis.inm.es, accessed November 27, 2009.
IDU
2008 Inventario Malla Vial, Bogotá. Instituto de Desarrollo Urbano. Electronic document, http://www.idu.gov.co/web/guest/malla_inventario, Accessed November 27, 2009.
IEES

2007 Green Noise Barriers in Hoogeind, Breda, Netherlands. International Ecological Engineering Society. Electronic document, http://www.iees.ch/cms/index, accessed October 3, 2009.

Inoki, Takenori

2000 Common Problems of All Models in Blending Democracy and a Market Economy. The Trilateral Commission, Tokyo. Electronic document, http://www.trilateral.org/annmtgs/trialog/trlgtxts/t54/ino.htm, accessed June 12, 2009.

IPEN

2009 Proposals For Limits on 'Low POP Content Wastes' in The Stockholm and Basel Conventions. International POPs Elimination Network. Electronic document, http://www.ipen.org, accessed February 7, 2009.

IRC- International Water and Sanitation Centre

2004 Community Participation in Water and Sanitation Within the Latin American Context. Electronic document, http://www.irc.nl/page/8241, accessed February 10, 2009.

JISC InfoNet

2009 PESTLE and SWOT Analyses. Electronic document, http://www.jiscinfonet.ac.uk/tools/pestle-swot, accessed November 4, 2009.

Johnson, Paul

2005 Market Economy. A Glossary of Political Economy Terms. Department of Political Science, Auburn University. Electronic document, http://www.auburn.edu/, accessed April 2, 2009.

Kalmanovitz, Salomón

2010 El Legado Macroeconómico de Uribe. El Tiempo, March 7 2010.

Kalmanovitz, Salomón

2009 Los Negocios de La Familia Presidencial. El Espectador, April 2009.

Kalmanovitz, Salomón

1994 Economía y Nación: Una Breve Historia de Colombia. Tercer Mundo Editores.

Kelly, Kathryn

1995 Health Effects of Hazardous Waste Incineration. An Updated Review of The Scientific Basis of Alleged Adverse Effects of Hazardous Waste Incineration. Presented at the International Incineration Conference, Seattle, Washington. Electronic document, http://deltatoxicology.com/pdf/5cases.pdf, accessed September 19, 2008.

Kessler, Tim, and Nancy Alexander

2006 The Roles of the US Government and The World Bank in The Drive to Privatize Basic Services in Developing Countries. Bank Information Center, IFI Brief # 4 July 2006:1-9

Kirchenstein**,** Roger and Roger Jump

2006 The European Eco-labels and Audit Scheme: New Environmental Standards for

Competing Abroad. Environmental Quality Management 3(1): 53-62.
Kotler, Philip and Nancy Lee
2005 Corporate Social Responsibility: Doing the Most Good For Your Company and Your Cause. John Wiley and sons.
Kulshreshtha, C.S
2004 Stakeholder-Based SWOT Analysis for Successful Municipal Solid Waste Management in Lucknow, India. Waste Management 25(5):531-537.
Langerman, Paul
1983 For Hazardous Waste Policy, Washington is The Real Hazard. The Heritage Foundation. Electronic document, http://www.heritage.org/research/energyandenvironment/bg273.cfm, accessed January 26, 2009.
Leon, Juanita
2009 Recicladores Encuentran Competidor Inesperado en el Negocio de la Basura: Los Hijos de Uribe. La Silla Vacia. Electronic document, http://www.lasillavacia.com, accessed March 15, 2009.
Lesmes, Patricia
2000 Emergencia Por Químicos en Soacha El Tiempo, April 19, 2000.
Lima, Maria Luisa
2004 On the Influence of Risk Perception on Mental Health: Living Near An Incinerator. Journal of Environmental Psychology 24(1):71-84.
Little, Peter
2005 Anthropology and Development. *In* Applied Anthropology. Satish Kedia and John Van Willigen Eds. Pp. 33-59.
Lusch, Robert, and Stephen L. Vargo Eds.
2006 The Service-Dominant Logic of Marketing. Dialogue, Debate and Directions. New York: M.E Sharpe.
Megginson, William, and Jeffry Netter
2001 From State to Market: A Survey of Empirical Studies on Privatization. Journal of Economic Literature 39(2):1-90.
Mansuri, Ghazala, and Vijayendra Rao
2004 Community Based and Driven Development: A Critical Review. The World Bank Research Observer 19(1):1-39.
McKenzie-Mohr, Dog, and William Smith
1999 Fostering Sustainable Behavior: An Introduction to Community Based Social Marketing. New Society Publishers.
McNeil, Douglas, and Andrew Foshee
2008 Hazardous Waste Disposal: A Comparative Analysis of Regulation, Taxes and Subsidies. Journal of Economics and Finance 16(2): 91-101.
Microsoft
2007 SOA and Business Process. Electronic document, http://www.microsoft.com/soa/,

accessed April 29, 2009.
Miller, H.L.
1990 On The Chicago School of Economics. *In* Milton Friedman:Critical Assessments. Volume 4. John Cunningham Wood and Ronald Woods Eds. Routledge.
Ministerio de Medio Ambiente
2008 II Congreso Internacional de Residuos Peligrosos. Electronic document, http://docs.google.com/gview?, accessed October 1, 2008.
Ministerio de Medio Ambiente
2007a Decreto 3600 de 2007. Electronic document, http://www.avancejuridico.com/, accessed September 3, 2008.
2007b Resolución 1362 de 2007. Electronic document, www.alcaldiabogota.gov.co/, accessed September 17, 2008.
Ministerio de Medio Ambiente
2005a Política Ambiental para la Gestión Integral de Residuos o Desechos Peligrosos. Electronic document, http://www.secretariadeambiente.gov.co/sda/, accessed August 13, 2008.
2005b Decreto 4741 de Diciembre 30 de 2005. Electronic document, http://www.andi.com.co/camaras/cuero/sena/RESPEL/NORMATIVA/DECRETO, accessed August 13, 2008.
Ministerio de Medio Ambiente
2004 Resolución 1512 de 2004. Electronic document, http://74.125.155.132/ search?q=cache:KcMvXZ43hgEJ:www.cortolima.gov.co, accessed August 13, 2008
Ministerio de Medio Ambiente
2003 Decreto 1505 de 2003. Electronic document, http://www.superservicios.gov.co, accessed August 3, 2008.
Ministerio de Medio Ambiente
2002 Colombia en el Protocolo de Montreal. Electronic document, http://www1.miniambiente.gov.co, accessed January 18, 2009.
Ministerio de Transporte
2008 Decreto Por el Cual se Reglamenta el Manejo y Transporte Terrestre Automotor de Mercancías Peligrosas. Electronic document, http://www.agremgas.com/files/, accessed April 17, 2009.
Ministerio de Transporte
2002 Decreto 1609 de Julio 31 de 2002. Electronic document, http://www.acercar.org.co/industria/legislacion/residuos/peligrosos/dec1609_2002.pdf, accessed August 3, 2008.
Ministry of Social Development, New Zealand.
2009 Good Practice Participate. Office for the Community and Voluntary Sector. Electronic document, http://www.goodpracticeparticipate.govt.nz/, accessed February 8, 2009.

Mockus, Antanas
2009 Antanas Mockus se Pregunta si La Etica es Para Los de Ruana. Revista Cambio, July 2009.
Molano, Alfredo
2008a Rompecabezas. El Espectador. December 20, 2008, Editorial.
2008b Los Reparos a un Megaproyecto Hidroeléctrico: Viaje al Corazón del Alto Sinú. El Espectador. December 20, 2008.
Montague, Peter.
1981 Four Secure Landfills in New Jersey--A Study of the State of the Art In Shallow Burial Waste Disposal Technology. Department of Civil Engineering and Center for Energy and Environmental Studies. Princeton University, Princeton, NJ.
Morrison, Allen
1981 Hazardous Waste Landfills--Can Clay Liners Prevent Migration of Toxic Leachate?. Civil Engineering-ASCE, July, 1981:61.
Mosse, David
2005 Cultivating Development. An Ethnography of Aid Policy and Practice. London: Pluto Press.
Mow, June Marie
2005 The Native Islanders of San Andrés, Old Providence and Santa Catalina: Dreaming Between Two Worlds. UNESCO. Electronic document, http://www.unesco.org/csi/smis/siv/inter-reg/comvision-panel-June2.pdf, accessed March 22, 2009.
Municipio de Soacha
2004 Sistema de Prevención de Desastres. Electronic document, http://www.disaster-info.net, accessed October 26, 2009.
Myrick, Conrad, and Ralph Whittle
2005 Enterprise Business Architecture: The Formal Link Between Strategies and Results. Electronic document, http://www.soainstitute.org/white-papers/l, accessed May, 12, 2009.
Nader, Laura
1972 Up The Anthropologist- Perspectives Gained From Studying Up. *In* Reinventing Anthropology. Dell H. Hymes Ed. Pp. 284-311.
Nahapiet J., with L. Gratton and H. Rocha
2005 Knowledge and Relationships: When Cooperation is the Norm. European Management Review, 2(2): 3-14.
National Academy of Engineering
1994 Industrial Ecology: US-Japan Perspectives. Washington D.C.:National Academies.
Neundorfer
2006 Electrostatic Precipitator Knowledge Base. Electronic document, http://

www.neundorfer.com/knowledge_base/electrostatic_precipitators.aspx, accessed July 9, 2009.

Oficina Departamental de Soacha
2008 Historia de Soacha, Cundinamarca. Electronic document, http://www.cundinamarca.gov.co/cundinamarca, accessed November 3, 2008.

Ogliastri, E.
2007 Colombia: The Human Relations Side of Enterprise. *In* Culture and Leadership Across the World: The GLOBE Book of In-Depth Studies of 25 Societies. F. C. Jagdeep Singh Chhokar. Pp. 689-722.

Ojeda, Fabricio
2009 La Tragedia de Clarines Cobró Su Víctima Número Doce.El Nacional. September 24, 2009.

OMG**,** Object Management Group
2008 Business Architecture Working Group. Electronic document, http://bawg.omg.org/, accessed February 16, 2009.

Ontario Ministry of Environment
1999 Environmental Risks of Municipal Non-Hazardous Waste Landfilling and Incineration. Technical Report Summary. Electronic document, http://www.ene.gov.on.ca/envision/techdocs/3795e01.htm, November 11, 2008.

Open Group
1999 Phase B: Business Architecture. Electronic document, http://www.opengroup.org/architecture/togaf8-doc/arch/chap06.html, accessed March 16, 2009.

Osborn, Ann
1995 The Four Seasons of the U'wa. A Chibcha Ritual Ecology in the Colombian Andes. Sean Kingston Publishing.

Oxfam International
2008 Deepening Community Engagement. Electronic document, http://www.oxfamamerica.org/publications/deepening-community-engagement, accessed February 14, 2009.

Palmisano, Samuel
2006 The Globally Integrated Enterprise. Foreign Affairs 85(3):127-136.

Piana, Valentino
2001 Exchange Rate. Economics Web Institute. Electronic document, http://www.economicswebinstitute.org/glossary/exchrate.htm#significance, accessed May 27, 2009.

PMAC
2009 Programa de Monitoreo Ambiental Social Comunitario del Proyecto Camisea-PMAC Alto Urubama. Electronic document, http://www.pmacperu.org/pmac.htm, accessed March 18, 2009.

Point Carbon
2009 Carbon Market Trader. Electronic document, http://www.pointcarbon.com/, accessed June 4, 2009.
Portafolio
2008 Revaluación Amenaza el Empleo: Textiles y Confecciones Dicen que Sus Empresas no son Viables. Portafolio, Junio 19, 2008. Economía.
Powell, Walter
2006 Neither Market Nor Hierarchy: Network Forms of Organization. Organizational Behavior 12:259-336.
Powell, Walter, and Kaisa Snellman
2004 The Knowledge Economy. Annual Review of Sociology 30:199-220.
Presidencia de la República de Colombia
2009 Especial Sobre Revaluación. Electronic document, http://web.presidencia.gov.co/especial/revaluacion/index.html, accessed June 17, 2009.
Quintana Ramirez, Ana Patricia
2008 El Conflicto Por La Gestión del Servicio de Acueducto en Dosquebradas (Risaralda-Colombia). Un Estudio Desde La Ecologia Política. Ph.D. dissertation, Department of Anthropology, Universidad de Barcelona.
Reinhardt, Tim, with Ulf Richers and Horst Suchomer
2008 Hazardous Waste Incineration In Context With Carbon Dioxide. Waste Management and Research 26(1):88-95.
Renard, Yves
2004 Guidelines for Stakeholder Identification and Analysis: A Manual for Caribbean Natural resource Managers and Planners. Caribbean Natural Resources Institute. Electronic document, http://www.canari.org/Guidelines5.pdf, accessed February 13, 2009.
Rincon, Hernan, and Leonardo Villar
2000 The Colombian Economy in the Nineties: Capital Flows and Foreign Exchange Regimes. Banco de La República. Electronic document, http://ideas.repec.org/p/col**,** accessed May 17, 2009.
Ringquist, E.
2004 Environmental Justice. *In* Environmental Governance Reconsidered, Challenges Choices and Opportunities. Bob Durant, Rosemary O'Leary and Daniel Fiorino Eds. MIT Press.
Ringquist, E.
2003 Environmental Justice: Normative Concerns, Empirical Evidence and Government Action. *In* Environmental policy: new Directions for The 21st Century. N. J. Eds.CQ Press.
RLR

2009 Proclama Recicladora Número Dos. Red Latinoamericana de Recicladores. Electronic document, http://www.recicladores.net/index.php?option=com_content&task=view&id=106&Itemid=1

Roberts, Richard, and Mengfang Chen
2006 Waste Incineration-How Big is The Health Risk? A Quantitative Method to Allow Comparison With Other Health Risks. Journal of Public Health 28(3):261-266.

Roberts, Stephen, with Christopher Teaf and Judy Bean Eds.
1998 Hazardous Waste Incineration: Evaluating the Human Health and Environmental Risks. CRC Press.

Rogers, Harvey, and Betty Willis
1992 Public Health Overview of Incineration As a Means to Destroy Hazardous Waste. Agency For Toxic Substances and Disease Registry. Electronic document, http://www.atsdr.cdc.gov/, accessed June 14, 2009.

Rooney, David, with Greg Hearn and Abraham Ninan
2005 Handbook on The Knowledge Economy. Edward Elgar Publishing.

Rotterdam Convention
2010 Convention Overview. Electronic document, http://www.pic.int, accessed January 2010.

Saad, J. E.
1999 Every Breath You Take: The Demography of Toxic Air Releases in Southern California. Economic Development Quaterly 13:107-123.

Salhofer, Stefan, and Nicole Isaac
2002 Importance of Public Relations in Recycling Strategies: Principles and Case Studies. Environmental Management 30(1):68-76.

San Diego State University
2008 Environmental Health and Safety. Electronic document, http://bfa.sdsu.edu/ehs/ accessed June 18, 2009.

Santoleri, Joseph, with Louis Theodore and Joseph Reynolds
2000 Introduction to Hazardous Waste Incineration. Wiley-Interscience, second edition.

Schekkerman, Jaap
2006 How to Survive in The Jungle of Enterprise Architecture Networks. Trafford Publishing.

Sedman, Richard and John Esparza
1991 Evaluation of The Public Health Risks Associated With Semi-Volatile Metal and Dioxin Emissions From Hazardous Waste Incinerators. Environmental Health Perspectives (94):181-187

Semana
2009 Relleno de Problemas. Revista Semana. June 17, 2009. Nación.

Semper, Frank

2006 Los Derechos de Los Pueblos Indígenas de Colombia en la Jurisprudencia De La Corte Constitucional. Instituto de Investigaciones Juridicas, UNAM. Electronic document, http://www.juridicas.unam.mx/publica/librev/rev/dconstla, accessed March 12, 2009.

SENA

2009 Titulaciones y Normas de Competencia Vigentes por Mesa Sectorial. Dirección Sistema Nacional de Formacion Para el Trabajo. Servico Nacional de Aprendizaje. Electronic document, http://observatorio.sena.edu.co, accessed July 5, 2009.

Shapiro, Carl, and Hal R. Varian.

1999 Information Rules: A Strategic Guide to The Network Economy. Harvard Business School Press.

Shy, Carl, with Darrah Degnan, Donald Fox, Saibal Mukerjee, Milan Hazucha, Brian Boehlecke, Dietrich Rothenbacher, Patsy Briggs, Robert Devling, Dennis Wallace, Robert Stevens, and Philip Bromberg

1995 Do Waste Incinerators Induce Adverse Respiratory Effects? An Air Quality and Epidemiological Study of Six Communities. Environmental Health Perspectives 103(1): 99-104

Sigman, Hillary

2003 Taxes on Hazardous Waste: The US Experience. Public Finance and Management 3(1):12-33.

Sigman, Hillary

1994 Economic Instruments for Hazardous Waste Policy. Proceedings of the National Tax Association, Vol. 86.

Skinner, Peter

1982 Testimony Before the Assembly of California, February 2, 1982.

Skinner, Peter

1980 Performance Difficulties of 'Secure' Landfills for Chemical Waste and Available Mitigation Measures. American Society of Civil Engineers. The Hazardous Waste Dilemma. Pp. 35-55.

Smith, Scott, and David Alcorn

1991 Cause Marketing: A New Direction in The Marketing of Corporate Responsibility. Journal of Consumer Marketing 8(3):19-35.

Smukowski, David

2006 Business Sustainability. Electronic document, www.bschool.washington.edu/cie/, accessed May 12, 2009.

Spence, Michael

2002 Signaling in Retrospect and the Informational Structure of Markets. American Economic Review 92(3):434-459.

Squires, Susan

2005 Telecommunication- Product Meaning and Use: Two Examples of Needs

Assessment. *In* Creating Evaluation Anthropology, Napa Bulletin 24. Mary Odell Butler and Jacquelin Copeland-Carson Eds. Pp. 79-88.

Stigler, G.J.
1990 On The Chicago School of Economics: Comment. *In* Milton Friedman: Critical Assessments, Volume 4. John Cunningham Wood and Ronald Woods Eds. Routledge.

Stockholm Convention
2009 DDT Overview. Electronic Document, http://chm.pops.int/Programmes/DDT, accessed on January 2010.

Stockholm Convention
2008 About the Convention. Electronic document, http://chm.pops.int/Convention, accessed January 2010.

Swissworld
2009a Incineration. Electronic document, http://www.swissworld.org/en/environment, accessed July 18, 2009.
2009b Hazardous Waste. Electronic document http://www.swissworld.org/en/environment/waste_management/hazardous_waste/, accessed July 18, 2009.

Tamayo, Carlos Mario
2002 Evaluación de las Necesidades, Capacidades y Prospectivas de Producción Más Limpia en Colombia. Ministerio de Medio Ambiente. Electronic document, http://unfccc.int/files/documentation/workshops, accessed February 4, 2009.

Tangri, Neil
2003 Waste Incineration: A Dying Technology. Global Alliance for Incinerator Alternatives- GAIA. Electronic document, http://www.no-burn.org/downloads, accessed July 20, 2009.

Teboul, James
2006 Service is Front Stage: Positioning Services For Value Advantage. Insead Business Press.

The Environmentalist
2005 Safer Hazardous Waste Disposal? The Environmentalist 11(1):64-65.

The World Bank
2009 Doing Business. Measuring Business Regulations: Colombia. http://www.doingbusiness.org/exploreeconomies, accessed August 2, 2009.

The World Bank
2008a Colombia. Inputs For Subregional Competitiveness Policies. Electronic document, http://www-wds.worldbank.org/external/default, accessed August 2, 2009.
2008b Doing Business 2009: Regulatory Reforms Gain Momentum in Latin America and The Caribbean; Colombia, Dominican Republic are Global Leaders in Business-Friendly Reforms. Electronic document, http://web.worldbank.org,

accessed August 2, 2009.

The World Bank

2001 Community Development in Colombia. Independent Evaluation Group (IEG). Electronic document, http://lnweb90.worldbank.org/oed/oeddoclib.nsf, accessed March 18, 2009.

Tiefenbacher, J. A.

1999 Environmental Equity in Urban Texas: Race, Income and Patterns of Acute and Chronic Air Releases in Metropolitan Counties. Urban Geography 19:516-533.

UNEP

2008a Basel Convention. Electronic document, http://www.basel.int/, accessed September 13, 2008.

2008b Stockholm Convention. Electronic document, http://chm.pops.int/, accessed September 13, 2008.

UNEP

2006a Ozone Secretariat. Electronic document, http://ozone.unep.org/, accessed September 13, 2008.

2006b Strategic Approach to International Chemicals Management. Electronic document, http://www.chem.unep.ch/saicm/, accessed September 13, 2008.

UNEP

2004a Inventory of worldwide PCB destruction capacity. Electronic document, http://www.chem.unep.ch/pops, accessed September 13, 2008.

2004b Persistent Organic Pollutants. Electronic document, http://www.chem.unep, accessed September 13, 2008.

UNEP, and FAO

2004 Rotterdam Convention. Electronic document, http://www.pic.int, accessed September 13, 2008.

UNFCCC

2005 Caring for Climate. A Guide to the Climate Change Convention and the Kyoto Protocol. Climate Change Secretariat. Bonn, Germany.

University of Massachusetts

2009 Toxics Use Reduction Act (TURA). Toxics Use Reduction Institute. Electronic document, http://www.turi.org/policy, accessed March 19, 2009.

University of Michigan

1997 Environmental Justice Case Studies: Waste Technologies Industries Inc. and a Fight Against a Hazardous Waste Incinerator In East Liverpool, Ohio. Electronic document, http://www.umich.edu/~snre492/mcormick.html, accessed March 22, 2009.

University of Rhode Island

2009 Healthy Landscapes: Rain Gardens. Electronic document, http://www.uri.edu/ce/, accessed April 3, 2009.

Uribe, Angela
2005 Petroleo, Economía y Cultura. El Caso U'wa. Siglo del Hombre Eds.
USAID
2006 Boosting Pride and Participation in Colombia. Electronic document, http://www.usaid.gov/stories/colombia, accessed March 13, 2009.
US EPA
2009a Hazardous Waste. Electronic document, http://www.epa.gov/epawaste, accessed April 12, 2009.
2009b Hazardous Waste Regulations. Electronic document, http://www.epa.gov/waste/, accessed April 12, 2009.
2009c Hazardous Waste Treatment and Disposal: Land Disposal. Electronic document, http://www.epa.gov/osw/hazard/tsd/td/disposal.htm, accessed April 12, 2009.
2009d Managing Wet Weather With Green Infrastructure. Electronic document, http://cfpub.epa.gov/npdes, accessed January 22, 2009.
US EPA
2007 National Hazardous Waste Biennial Report. Electronic document, http://www.epa.gov/waste/inforesources/data/br07/index.htm, accessed April 12, 2009.
US EPA
2005 The Inventory of Sources of Dioxins in The United States: External Review Draft Washington D.C.: US Environmental
US EPA
1999 Stormwater Technology Fact Sheet. Vegetated Swales. US EPA, Office of Water, Washington DC, September 1999.
Uzun, Neil
2003 The Impact of Urban Renewal and Gentrification on Urban Fabric: Three Cases in Turkey. Tijdschrift voor Economische en Sociale Geografie, 94(3): 363-375.
Valor, Carmen
2007 A Global Strategic Plan for Corporate Filantropy. Corporate Communications Journal 12(3):280-297.
Van-Asselt, B.A, and Nicole Rijkens-Klomp
2002 A Look in The Mirror: Reflection of Participation in Integrated Assessment From a Methodological Perspective. Global Environmental Change 12(3):167-184.
Versteeg, Gerrit, and and Harry Bowman
2006 Business Architecture: A New Paradigm To Release Business Strategy to ITC. Information Business Frontiers 8(2): 91-102.
Viana, Ricardo, and Margarita González
2003 Los Planes de Ordenamiento Territorial y la Actividad Minera de Materiales de Construcción: El Caso de La Sabana de Bogotá. Seminario Internacional Minería, Medio Ambiente y Ordenamiento Territorial, Bogotá May of 2003. Electronic document, http://productos.ingeominas.gov.co, accessed June 10, 2009.

Visser Wayne, with Dirk Matten, Manfred Pohl and Nick Tolhurst Eds.
2008 The A to Z of Corporate Social Responsibility: A Complete Reference Guide to Concepts, Codes and Organizations. Publication of the Institute for Corporate Cultural Affairs- ICCA.

VonRoll Inova
2009 Avi Moerdijk. Incineration of 600,000 Mg/Year of Waste. Electronic document, http://www.aee-vonrollinova.ch/var, accessed July 14, 2009.

Wadsworth, Yolanda
1998 What is Participatory Action Research? Action Research International. Electronic document, http://www.scu.edu.au/schools/gcm/ar/ari/p-ywadsworth98.html, accessed February 16, 2009.

Wallerstein, N., and B. Duran
2003 The Conceptual, Historical and Practical Roots of Community Based Participatory Research and Related Participatory Traditions. *In* Community Based Participatory Research for Health. M. Minkler and N. Wallerstein Eds. San Francisco, Jossey Bass. Pp. 27-52

Webster, Frank
1995 Theories of Information Society. New York: Routledge.

Whittle, Ralph
2005 Understanding the Enterprise Business Architecture. Electronic document, http://www.bpminstitute.org, accessed

Wiki Adapt
2009 Stakeholder Analysis and Engagement. Electronic document, http://wikiadapt.org/index.php?title=Stakeholder_analysis_and_engagement, accessed August 27, 2009.

Wikipedia
2009 Externality. Electronic document, http://en.wikipedia.org/wiki/Externality, accessed March 12, 2009.

World Economic Forum
2008 Global Competitiveness Report. Electronic document, http://www.weforum.org, accessed April 15, 2009.

World Nuclear Association
2009 Chernobyl Accident. Electronic document, http://www.world-nuclear.org, accessed January 12, 2009.

World Trade Organization
2009 Principles of The Trading System. Electronic document, http://www.wto.org, accessed July 11, 2009.

Yarrow, George and Piotr Jasisnki
1996 Privatization: Critical Perspectives on The World Economy. New York: Routledge.

Yakowitz, Harvey
1988 Identifying, Classifying and Describing Hazardous Wastes. Industry and Environment 11(1):3-10.
Yanoy, Yuval
1998 The Struggle Over the Soul of Economics: Institutionalist and Neoclassical Economists in America Between Wars. Princeton University Press.
Zuboff, S.
2003 Dioxin and Waste CoMbustion: It’s Not What You Burn, It's The Way You Burn It!. Electronic document, http://www.dioxinfacts.org/sources_trends/the_way.html, accessed February 13, 2009.