03D021I

SJW-HK05 – 50

# DEVELOPING CAPACITY FOR LONG-TERM AIR QUALITY MANAGEMENT IN THE PEARL RIVER DELTA REGION

An Interactive Qualifying Project Report

Submitted to the Faculty
of the
WORCESTER POLYTECHNIC INSTITUTE

in partial fulfilment of the requirements for the

Degree of Bachelor of Science

by


**Ryan Lee**

**Andy Li**

**David Malachowski-Onne**


Date: February 26, 2003

Approved:

**Professor Stephen J. Weininger, Advsior**

**Professor Lok C. Lew Yan Voon, Co-Advisor**

# Abstract

The collaboration involved in a recently launched pilot study on air quality in the Pearl River Delta region was analysed in terms of a capacity building model. Our project focused specifically on cross-border issues and the roles of the various stakeholders. The potential impact of the capacity building on sustainable development is presented.

# Executive Summary

Civic Exchange of Hong Kong is the managing organisation for a pilot study on regional air quality management in Hong Kong and the Pearl River Delta (PRD). This pilot study represents a unique initiative by non-governmental organisations (NGO), private businesses and academia for pioneering the creation of a multi-national, multi-stakeholder collaboration on environmental issues. At the core of the pilot study are two projects that aim to produce policy-relevant reports about ground-level ozone and fine particulate matters ($PM_{fine}$). It also has the goal of creating a collaborative framework among stakeholders from both Hong Kong and Guangdong to facilitate cross-border cooperation on air quality management.

Our project was an evaluation of the present level of collaboration among the participants of the pilot study and an examination of its effectiveness in facilitating the exchange of data, strategies, and solutions for alleviating the effects of air pollution. Additionally, we examined the role the pilot study played in terms of building capacity for sustainable development.

Our evaluation of cross-border and interdisciplinary multi-participant collaboration was based on the assessment of the progress and overall efficiency of the pilot study and the effectiveness in addressing the issues surfaced by the interaction between different scientific, socio-cultural, and political views of the study participants.

Civic Exchange provided the list of participants of the pilot study. These included scientists, consultants, industry and funders from Hong Kong, mainland China, the United States, and the Netherlands, who together are members of the science, advisory, and management committees. Each committee plays a specific role of contribution to the pilot study. The primary role of the science committee is to carry out the scientific experiments for the ozone and particulate matters studies. The advisory committee's role is to ensure the scientific integrity of

the study and to ensure performance audits are properly carried out. The management committee is responsible for the overall aim of the study.

Interviewing the participants at the science team meeting held in Hong Kong on January 13, 2003 was the primary means of obtaining information regarding their assessment of the collaborative process and their contribution to the progress of the pilot study. Observations were also made on the communications and interactions between the participants. Our team has compiled minutes for the aforementioned meeting, which was used for comparison with previous documents pertaining to the pilot study progress in order to identify issues raised and the steps taken to address them.

The objective of building stakeholder capacity is to develop and cultivate the ability of stakeholders to recognise and discuss an issue, resulting in their ability and commitment to find effective solutions for complex problems. An approach to capacity building for environmental management strategies is to develop, strengthen, and integrate the capacities of political and financial support, human resources, information resources, and creation and compliance of regulative policy. Our team has evaluated the role and significance of the pilot study in terms of strengthening or laying the foundation for the development of these capacities that are needed for attaining sustainability in the overall development of the PRD.

Based on participant inputs and our own research and observation, the pilot study was evaluated for its role and significance in developing the capacities needed for multi-participant cross-border collaborations and creating the foundation for sustainable development. The conclusions made from our evaluations of the pilot study were the following:

- All participants had positive assessments of the collaboration and expressed optimism regarding collaborating in upcoming phases of the pilot study.

- Good interpersonal relationship was essential to develop a positive attitude towards working together and trust between participants.

- Combining scientific expertise from various academic and scientific institutions has ensured the integrity and quality of the data gathered.

- Involvement of local participants has offered additional expertise and insights for the pilot study.

- In obtaining private funding and cross-border multi-stakeholder participation, the pilot study may serve as a model for future collaborations.

- The pilot study has played a pioneering role in building capacity for sustainable development.

Based on our conclusions, we make the following recommendations for possible improvements on cross-border collaboration and capacity building:

- Further collaborations should have governmental blessing as a way to strengthen governmental support.

- Collaboration with international scientists should involve a sensitisation process to local culture and issues as to enhance understanding and enthusiasm of participants, particularly in early phases of a project.

- In order to obtain additional public attention and support, a connection between air pollution and public health should be raised.

- There would be mutual benefits from the integration of various air pollution projects in the PRD to take advantage of data sharing and additional informational resources.

# Acknowledgements

We would like to thank our advisors Professor Stephen Weininger and Professor Lok C. Lew Yan Voon for their advice and support throughout the project. Also thanks to our liaison Christine Loh for the structure and assistance she contributed to our understanding of the project. Thanks to Lisa Hopkinson and Kylie Uebergang for their help and guidance in learning about the pilot study. Our appreciation also goes out to all of our interviewees: Michael Bergin, William Chameides, C.S. Kiang, Liu Tao, Peter Louie, Lori Ryerkerk, Sjaak Slanina, Wang Tao, Yu Jianzhen, and Zhang Yuanhang for taking time out of their busy schedules to meet with us to provide us with valuable data. We would also like to acknowledge students from Hong Kong Polytechnic University, Chan Yin Tai, Chung Chun To, and Lam Tuk Hung for helping us with our project and getting us acquainted with our surroundings in Hong Kong. Thank you to Professor Creighton Peet for his guidance during project preparation. Finally, we would like to thank Timothy Downs for his expertise and assistance in helping us understand capacity building.

# Authorship

Executive Summary ..... AL
Introduction ..... AL
Background
- 2.1 ..... RL,AL,DO
- 2.2 ..... AL
- 2.3 ..... DO
- 2.4 ..... RL
- 2.5 ..... AL
- 2.6 ..... AL

Methodology ..... RL,AL,DO
Results ..... RL,AL,DO
Conclusions ..... RL

# Abbreviations

RL – Ryan Lee
AL – Andy Li
DO – David Malachowski-Onne

# Table of Contents

# List of Tables

# Chapter 1. Introduction

Trans-boundary pollution is the central issue to much of the debate concerning the internationalization of environmental problems (Hills & Roberts, 2001). Policies pursued within one state or region of a country often inevitably cause environmental impacts in neighbouring states or regions. Effective cooperation on environmental issues is essential as the effects of environmental pollution transcend political boundaries. One such case is the problem of regional air pollution in the Pearl River Delta (PRD) region, which includes Hong Kong and major cities of the Guangdong Province of China.

Given the close proximity of Hong Kong and Guangdong, the environmental policies pursued by the two areas would invariably affect each other. The Hong Kong Special Administrative Region (HKSAR) government was established after China resumed sovereignty of the former British colony in July of 1997 (Hong Kong SAR Government Information Centre, 2002). The HKSAR has a very different political structure from the rest of China. Headed by a Chief Executive, the HKSAR enjoys a high degree of autonomy from Beijing with a partially elected legislature. Because of the different social, economic and political systems of the HKSAR and Guangdong, the citizens of the two areas have substantially different attitudes and views (Civic Exchange, 2002). Efficient cross-border collaborations are affected by the differences between these systems.

Environmental policies of Hong Kong and Guangdong differ because of their different paces of development. The lack of common environmental priorities and political separation has led to difficulties in pollution management, one result of which is the degradation of the air quality over the PRD. Cooperation between Hong Kong and Guangdong in air quality management has been nonexistent until recently.

Rapid economic growth in the PRD is a major cause of the increasingly severe problem of air pollution. One aspect of this problem is the presence of photochemical smog, characterized by hazy skies and an observable decrease in visibility (Civic Exchange, 2002). In addition, fine particulate matter (PM) present in the polluted air poses many health risks for the people in the region. In view of ensuring sustainable development and protecting the health and quality of life of the people and visitors of PRD region, both the HKSAR and the mainland government have recognised the need to develop effective air pollution and air quality management policies. However, air quality management is a complex process that involves the monitoring and regulation of pollutants, and the task is made more difficult by the complex topological and meteorological features of the PRD. Economic and urban developments in Guangdong have led to the increase of pollutant sources in some areas of the PRD. These new pollutant sources, combined with existing ones from Hong Kong and Guangdong, became the major contributors to the regional pollution. Therefore, monitoring and regulating pollutant sources in the region need the participation and cross-border collaboration between the governments as well as among various stakeholders from Hong Kong and the PRD region.

On May 1, 2002, partners from the scientific, private and regulatory communities of Hong Kong, mainland China, and the United States launched a project entitled "A pilot study on the use of atmospheric measurements to manage air quality in Hong Kong & Pearl River Delta" (Civic Exchange, 2002), with Civic Exchange of Hong Kong serving as the managing organisation of the project. One of its objectives is to build long-term air quality management capacity in Hong Kong and mainland China and to "produce a new collaborative framework through the setting-up of the Scientific Advisory Committee among stakeholders in Hong Kong

and South China to facilitate long-term collaboration in air quality air management" (Civic Exchange, 2002, p. 1).

Our project provides an evaluation of the present level of collaboration among participants of the pilot study, and examines its effectiveness in facilitating the exchange of data and strategies. In addition, we examined the role the pilot study played in terms of building the capacities for sustainable development. Lastly, we attempted to identify potential shortcomings of the current collaborations in the pilot study and make tentative recommendations for improving cooperation and efficiency.

The tasks needed to achieve the goal of this project were as follows: examine the views and opinions from different participants through observation and interviews with representatives; identify potential conflicts of interest by assessing each participant group's understanding and approach to collaboration; and examine successful cases of capacity building in order to identify possible ways to improve capacity building between Hong Kong and Guangdong around the vital issue of air pollution management and control.

Our conclusions can be used to assess the progress of the development and promotion of multi-stakeholder participation in the collaborative framework as an innovative and effective approach to regional environmental management. Cross-border collaboration aims to develop and cultivate the ability among all stakeholders to recognise the issue and participate in cooperation. The benefit is to increase their capacity and commitment to find effective solutions for the complex problems of air quality management. In doing so, our project had to evaluate the causes and effects of the social, cultural, legal, and political differences among the participants and stakeholders of the pilot study, as these factors have a role in its success.

# Chapter 2. Background

This chapter is a summary of pertinent sources for our project. The major topics covered in here are air pollution in the PRD region; issues and models for cross-border collaboration; the emissions based CH2MHill study; the pilot air quality study managed by Civic Exchange; and capacity building for environmental management.

## *2.1 Transboundary Pollution*

The PRD is located in southern China, where the Pearl River meets the South China Sea. The land surrounding the Pearl River estuary is known as the PRD region. The PRD region encompasses the Hong Kong Special Administrative Region (HKSAR), the Macau Special Administrative Region, as well as areas in southern Guangdong province that include the cities of Guangzhou, Shenzhen, and Zuhai (Pearl River Delta, 2002). Within the PRD region is the Pearl River Delta Economic Zone (PRDEZ), which includes the cities of Guangzhou, Shenzhen, Donguan, Zhongshan, Zhuhai and their surrounding areas. Since 1997 there has been growing concern in Hong Kong regarding the worsening air quality as visibility noticeably deteriorated (Hopkinson & Stern, 2003).

One of the hottest issues in environmental pollution facing the PRD region is the transport of air pollutants across the entire region, where there exists political boundaries. The problem of transboundary air pollution is made even more difficult due to the complex meteorology and topography of the region. The problem is exemplified by gradual visibility deterioration and episodes of high levels of respirable suspended particulate matter (RSP) and ozone ($O_3$) throughout the PRD region. The deteriorating air quality is the combined result of

both local pollution sources and regional sources, a problem to which both Guangdong and Hong Kong are accountable.

## 2.2 Government Study on Regional Air Quality

Hong Kong is confronting two air pollution problems. The first is street level pollution, which is caused by emissions from motor vehicles, especially diesel vehicles. The HKSAR government has been tackling this problem by introducing unleaded petrol in 1991 and low-sulphur diesel in 1995. In 1999, the HKSAR government introduced a comprehensive programme to reduce motor-vehicular emissions. Upon full implementation, the programme will reduce emissions of particulates by 80% and nitrogen oxides ($NO_X$) by 30% by the end of 2005 (CH2M HILL (China), 2002). The government has also encouraged diesel light bus owners to switch to liquefied petroleum gas (LPG) or electric light buses.

The second problem is regional air quality pollution. The regional air quality problem has its roots in the unprecedented economic growth of the PRD region, which has led to rapid industrialisation and urbanisation of the region over the past two decades. Under certain meteorological conditions, air pollutants throughout the region can reach dangerous levels that put a population of 38.7 million in the region at risk. Thus, high priority has been given both by the HKSAR and Guangdong governments to develop solutions to counter regional air pollution. Since the problem affects both the HKSAR and the PRD, the EPD of the HKSAR and the Guangdong Province Environmental Protection Bureau (GDEPB) have joined forces in a regional governmental collaborative effort to commission a study of the regional air pollution problem with a view to developing effective control strategies. The project was titled "Study of Air Quality of the Pearl Delta River Region" (the joint study). The joint study was completed in 2001 and the final report was published in April of 2002.

The joint study focused mainly on the pollutants $O_3$, RSP, and nitrogen dioxide ($NO_2$). Sulphur dioxide ($SO_2$) and volatile organic compounds (VOC) were also investigated for their roles in the formation of pollutants. The objective of the study was to investigate the regional air pollution problem related to the above pollutants in order to identify possible measures to improve regional air quality. The study produced results in the following areas:

- Existing air quality in the region.
- Pollution sources in the region.
- Predicted future air quality in the region.

In the following sections, the findings of the study and the recommendations made are described (CH2M HILL (China), 2002).

### *2.2.1 Existing Air Quality in the PRD Region*

The data used by the joint study to evaluate current air quality in the PRD region were from the period 1999 through 2000. $O_3$ and $NO_2$ data were collected at eleven monitoring sites throughout Hong Kong and nine monitoring sites at various cities in the PRD. RSP data was collected as part of the joint study at eight sites in the PRD between January and April 2000. The analysis of these data has started to lead to an accurate assessment of the current air quality in the PRD region. While air quality in terms of total suspended particulates (TSP) has been improved by 50%, primary pollutant concentrations of $NO_x$ and $SO_2$ have remained constant over the past decade.

All cities showed deterioration in visibility as a result of high RSP and photochemical smog in this period. Hong Kong had the highest frequency of days with poor visibility (defined by a visibility of less than 8 km) in 1991, but was surpassed by Shenzhen and Guangzhou in 2000. This change was attributed to the air quality control measures implemented and the

gradual reduction in manufacturing activities in Hong Kong. On the other hand, Shenzhen had seen the occurrences of poor visibility increased nine-fold while Guangzhou had a five-fold increase over the same period. This trend is one indicator of the increasing severity of air pollution in cities in the PRD region.

In addition, high $O_3$ concentrations were found to occur in warm weather during autumn and spring while $NO_2$ and RSP were high during the winter months. The sources of pollution can be found throughout the PRD region, and pollutants and their precursors were distributed across the region under certain meteorological conditions. The problem of regional air pollution was complicated by non-compliance by polluters with the HKSAR Air Quality Objective (HKAQO) and failure to meet the mainland National Ambient Air Quality Standards (NAAQS). These findings were pointing to a trend of worsening air quality as a result of increased air pollution in the region. There was an urgent need to alleviate the problem to prevent it from endangering public health, and long-term strategies in controlling pollutants had to be developed in order to protect the people and environment from air pollution. In summary, the closing points made by the joint study on the current air quality in the PRD were the following:

- Non-compliance with the HKSAR Air Quality Objectives and failure to meet the Mainland National Ambient Air Quality Standards are recorded in the PRD Region;
- High $O_3$ concentrations occur in spring and autumn, and high $NO_2$ and RSP concentrations in winter;
- $O_3$, RSP and $NO_2$ are regional pollutants but all have a local component;
- Regional air quality has been deteriorating in the past decade.

### 2.2.2 Pollution Sources in the PRD Region

The identification of pollutant sources in the PRD region was aided by an emissions inventory. The emission inventory for the HKSAR was based on the 1995 data, while in the PRDEZ the data were provided by the Guangdong Province Environmental Protection Monitoring Centre (GPEMC) of the GDEPB and prepared by a Guangdong expert team. Pollutants included in the inventory were VOC, RSP, $NO_x$, $SO_2$, and ammonia ($NH_3$). The emission source types from the HKSAR and PRDEZ were divided into four major sectors: Energy, Industry, Transportation, and VOC-containing products (Appendix F).

The overall emissions inventory of the 1997 base year for the HKSAR and PRDEZ showed that the contribution to each of the four major pollutants of VOC, RSP, $NO_x$, and $SO_2$ from the PRDEZ is 88%, 95%, 80% and 87%, respectively. The four major economic sectors were accountable for at least 90% of the total regional emission. This was correlated to the growth in population and commercial, industrial, and residential developments in the PRD Region. Table 1 below is a summary of the emission inventory for the HKSAR and PRDEZ based on data from 1997. Table 2 is pollutant emissions per capita and per unit area in the PRD Region.

| Entity | Emissions (Kilo tones/year) | | | | Population (Million) | Population Density (Per $km^2$) |
|---|---|---|---|---|---|---|
| | VOC | RSP | $NO_X$ | $SO_2$ | | |
| HKSAR | 54 (12%) | 13 (5%) | 114 (20%) | 76 (13%) | 6.5 (17%) | 5,909 |
| PRD Economic Zone | 412 (88%) | 245 (95%) | 450 (80%) | 520 (87%) | 32.2 (83%) | 772 |
| PRD Region | 466 | 258 | 564 | 596 | 38.7 | 904 |

Table 1: Emissions inventory for the HKSAR and PRD (CH2M HILL (China), 2002, p. 29).

| | VOC | RSP | $NO_X$ | $SO_2$ |
|---|---|---|---|---|
| Pollutant emission per capita (kg/person) | | | | |
| HKSAR | 8 | 2 | 18 | 12 |
| PRD Economic Zone | 13 | 8 | 14 | 16 |
| Region average | 12 | 7 | 15 | 15 |
| Pollutant emission per unit area (tonnes/$km^2$) | | | | |
| HKSAR | 49 | 11 | 104 | 70 |
| PRD Economic Zone | 10 | 6 | 11 | 12 |
| Region average | 11 | 6 | 13 | 14 |

Table 2: Pollutant emissions per capita and per $km^2$ (CH2M HILL (China), 2002, p. 30).

The emissions of the four main pollutants per capita were similar for the HKSAR and the PRDEZ, but the emission per square kilometre was substantially higher in the HKSAR than in the PRDEZ. This was due to the higher population density in the HKSAR, which translated to higher concentration of human and commercial activities than in the PRDEZ. Therefore, while the number of pollutant sources was substantially higher in the PRDEZ than in the HKSAR, the distribution of pollutant sources in terms of population and area were comparable. Pollutant sources from both the HKSAR and PRDEZ were equally responsible for regional air pollution. The total contributions by the four major economic sectors to the emission of the four main pollutants are summarized in Table 3.

| | **VOC** | **RSP** | **NOX** | **SO2** |
|---|---|---|---|---|
| **Energy** | 1% | 15% | 42% | 54% |
| **Industry** | 11% | 60% | 13% | 39% |
| **Transportation (Motor vehicles)** | 55% | 14% | 31% | 4% |
| **VOC containing products** | 23% | * | * | * |
| **Total** | 90% | 89% | 86% | 97% |

Table 3: Total emission contributions by the four major sectors (CH2M HILL (China), 2002).

### 2.2.3 Predicted Future Air Quality in the PRD Region

Future air quality in the PRD Region was assessed using projected emission inventories in combination with the PATH air quality modelling system developed by the EPD (CH2M HILL (China), 2002). From the emission inventory for base year 1997, emission inventories for 2005, 2010, and 2015 were projected. Predicted economic growth in the PRD Region and the effects of emission control measures implemented by the HKSAR and Guangdong governments were taken into account in these emission projections. Estimated economic growth was based on data and historical trends in Gross Domestic Product (GDP), population, use of land, infrastructure development, growth in number or motor vehicles, air traffic, marine freight and passenger volume, and power generation and consumption. According to projected economic growth and development, emissions in the future years were expected to increase significantly.

The total growth expected for Hong Kong between 1997 and 2015 is 111%. The predicted overall growth in GDP for PRDEZ is a staggering 655% between 1997 and 2015 (CH2M HILL (China), 2002). This economic growth is coupled with the corresponding growth in population from the current 38.7 million (1997 figure) to 49 million by 2015, with associated growth in power demand, traffic, and land developments. The overall growth in the PRD Region is expected to cause substantial increase in pollutant sources and pollutant emissions.

The effects from the implementation of current and planned pollution control measures by the HKSAR and Guangdong government were included in the prediction of future air quality in the PRD Region. These measures are either currently legislated or were officially announced before June 2000 by the two governments. In the HKSAR, air pollution control legislation includes the Air Pollution Control Ordinance (APCO), which regulates air pollution from the energy, transportation and industry sectors (CH2M HILL (China), 2002). Further measures are

programmes that aim to impose tougher motor-vehicular emission standards, introduce cleaner fuels, and apply improved technologies. In the PRDEZ, air pollution control legislation was issued by the State Environmental Protection Agency (SEPA) of the national government as well as the provincial government of Guangdong. Various programmes were announced by SEPA and the GDEPB, one of which is the "Blue Sky" project. The project aims to limit $SO_2$ emission from power generation to 480,000 and 450,000 tonnes by 2005 and 2015, respectively. Its objectives include prohibiting new coal or oil burning power plants within the PRDEZ, and the progressive closure of fifteen types of industries that are found to be heavy polluters. Plans to adopt higher standards for motor vehicle emissions were also announced for gradual implementation.

Having taken all available data into account, the projected emissions of VOC, RSP, $NO_x$, and $SO_2$ in the PRD Region are expected to grow by 36%-75%. More specifically, emission of the four pollutants from sources in the HKSAR will increase by 5-76%, and in the PRDEZ by 30%-80%. By 2015, the PRDEZ will be accountable for 82%-96% of the regional emission of the four pollutants. The sources for present and future pollutant emissions are presented in Table 4.

| | HKSAR | PRDEZ |
|---|---|---|
| **VOC** | - Industrial processes (printing and petrol filling stations)<br>- Motor vehicles<br>- Application of VOC containing products (paint, architectural coating and domestic products | - Industrial processes (printing, petrol filling stations, petrochemical works, oil depots)<br>- Motor vehicles<br>- Application of VOC containing products (paint, architectural coating and domestic products |
| **RSP** | - Electricity generation (power plants)<br>- Fuel usage (industrial, commercial, domestic)<br>- Motor vehicles | - Electricity generation (power plants)<br>- Fuel usage (industrial, commercial, domestic)<br>- manufacturing of non-metallic mineral products<br>- Motor vehicles |
| **NO2** | - Electricity generation (power plants)<br>- Fuel usage (industrial, commercial, domestic)<br>- Motor vehicles | - Electricity generation (power plants)<br>- Fuel usage (industrial, commercial, domestic)<br>- Motor vehicles |
| **SO2** | - Electricity generation (power plants)<br>- Fuel usage (industrial, commercial, domestic) | - Electricity generation (power plants)<br>- Fuel usage (industrial, commercial, domestic) |

Table 4: Current and future emission sources in the PRD region (CH2M HILL (China), 2002).

### *2.2.4 Joint Study Recommendation for Regional Collaboration*

In light of the findings and predictions from the joint study, it was suggested that a solution to the air pollution problems needed the concerted efforts of both the HKSAR government and the Guangdong provincial government. It was imperative for the two governments to set out common objectives in order to achieve more effective management of regional air quality. According to the report, this could be achieved by developing a regional air quality management plan that would enable effective implementation of regional control strategies and informed decision making processes. Collaborations between the two governments could build upon the experiences from a number of special panels set up for various specific areas under the Hong Kong-Guangdong Joint Working Group on sustainable

development and environmental protection. A management team was needed to oversee the regional air quality management plan. Its responsibilities should include the following:

- To establish goals for improvement of regional air quality;
- To identify specific control measures for the region;
- To verify the effect of control measures and air quality management plan;
- To improve and update the regional air quality emission inventory
- To establish a regional air quality monitoring network
- To track new technology and options for controlling air pollutions (CH2M HILL (China), 2002, p. 64).

### *2.2.5 Contributions and Limitations of the Joint Study*

The joint study was a significant step in cross-border collaboration between the governments of the HKSAR and Guangdong in air pollution study. A consensus was reached between the two governments on a scientific baseline for the pollutants and pollutant sources as well as policy recommendations for control strategies (Hopkinson & Stern, 2003). However, the use of an emissions-based model to measure and predict pollutant levels could have potentially produced inaccurate projections. Furthermore, the study has failed to provide any guidelines to address the many political, social, and economic ramifications of cross-border collaboration. Some of these potential problems facing cross-border collaboration are discussed in Section 2.3.

## *2.3 Difficulties of Cooperation in the PRD*

Many policies dealing with the issue of transboundary pollution have raised concerns in the neighbouring states or regions that are affected. Prompted by an initiative to resolve a global environmental problem, international and regional environmental cooperation has been gaining attention in the past 20 years to deal with these problems (Hills & Roberts, 2001). Although the

initial debate centred on transboundary pollution, over the years it has extended over a broad range of issues relating to natural resource development and conservation initiatives. Despite the active participation of numerous countries, the key issue of transboundary pollution has remained unresolved and continues to be a trans-national issue.

In the case of Hong Kong and China, the problem is magnified due to their unique political relationship. Hong Kong has a high degree of autonomy under the "One Country; Two Systems" model, which sets it apart from the rest of the PRD region. Under Hong Kong's Basic Law, the HKSAR functions under an autonomous jurisdiction with respect to its environmental policy. Thus, both regions have different institutional structures and different laws, regulations and standards when dealing with the pollution issues, making it difficult to formulate a mutually acceptable solution.

Hong Kong is not only separated from Guangdong by political differences, but by perceived cultural differences as well. After having such an economically productive history, a perceived air of superiority has grown from Hong Kong toward the mainland (Lau, January 23, 2003). Despite unprecedented growth on the mainland, some general characterisations of mainland Chinese by Hong Kong residents are "dirty, unlawful, corrupt, backward, uneducated, and poor." According to Lau (2003, January 23), Hong Kong people "blame [their] increased littering on immigrants and mainland tourists, and our filthy air on pollutants coming from the north."

Contrary to these opinions, cooperation on the government level is seen to be good, but has room for much improvement (Leu, 2003b, January 17). Indicating four key areas of improvement, Guangdong's newly elected governor, Huang Huahua, has pledged to step up cooperation between Hong Kong and Guangdong in aspects of finance, services, logistics, and

tourism. Those serving under Mr. Huang said relations between Hong Kong and Guangdong would be one of the main priorities of the government in the next five years, along with the development of the PRD and coordination of the roles of other various cities in the region. Shenzhen delegate, Wen Simei, was also optimistic about cross border prospects but hopes "that there will be more communications between provincial and SAR leaders to reach consensus and find areas of cooperation" (Leu, 2003b, January 17).

The Guangzhou-Hong Kong Cooperation Joint Conference has resolved numerous problems affecting infrastructure development, border crossings, tourism and environmental pollution. (Leu, 2003a, January 17). Lin Shusen, the mayor of Guangzhou, noted that "we have a very good relationship. Of course, many people want to move it up to the next level. That is natural but it appears some people with ulterior motives in Hong Kong are making out that we are at each other's throats. There is no such thing... We are not asking Hong Kong not to develop. In the same vein, there are some projects that we need to develop and we hope Hong Kong will not expect us not to." One effort that displays the efficacy of cross-border collaborations was one initiated by Civic Exchange.

## 2.4 The Pilot Air Quality Study in the PRD Region

In an attempt to foster multi-stakeholder cross-border collaborations, Civic Exchange has organised an air quality study that involves stakeholders from various nations and sectors, entitled "Pilot study on the use of atmospheric measurements to manage air quality in Hong Kong and Pearl River Delta" (the pilot study), with Civic Exchange serving as manager (Civic Exchange, 2002).

This pilot study started in May 2002, and is scheduled to last for 24-28 months and hopes to set a basis for a long-term study of the region. As of February 2003, the science committee

has met twice and the management committee has met once. The first science meeting established data protocols while the second meeting was a progress report of the project. Members of the pilot study agreed that the data collected has been of high standards and that the use of an Observation Based Model (see Section 2.4.2) can be useful in monitoring the air quality of the PRD region.

### *2.4.1 Overview*

This pilot study is made up of two different projects, Project 1 (P1) samples and analyses the levels of ozone ($O_3$) in Hong Kong while Project 2 (P2) samples and analyses fine particles ($PM_{2.5}$) in the PRD regional air shed. It is being used to complement the CH2M Hill study. Sponsors of this project are the Hong Kong Jockey Club, CAPCO, and the Hong Kong Environmental Department.

The objectives of this project are as follows (Civic Exchange, 2002):

1. Conduct pilot studies of ground level ozone and fine particles in order to fill in knowledge gaps in smog and visibility problems in Hong Kong and the PRD region;
2. Provide insight into policy relevant questions that could assist policy-makers in managing regional air quality in Hong Kong and South China;
3. Strengthen the ability of public sector agencies, private businesses, and the academic scientific community to develop policies to improve air quality management; and
4. Build long-term air quality management capacity in Hong Kong and Mainland China.

Members of this project include scientists from Hong Kong, Mainland China, the United States, and Europe, and private businesses from Hong Kong (see Appendix E). The gathering and collaboration of these multi-national and multi-stakeholder members is described as a unique and groundbreaking process (Civic Exchange, 2002). Five years ago, Guangdong only cared about problems in Guangdong while Hong Kong only cared about problems in Hong Kong

(Zhang, personal communication, 13 January 2003). Members on both sides of the border are realising that this is a regional problem due to the complexity of the geography, meteorology, and regional nature of air pollution, which must be solved in a collaborative effort of different technical expertise, regional expertise, and concepts of how to combat air pollution.

The members of the project have a great deal of experience (Civic Exchange, 2002). No matter how big or small of a role each person plays, they all play a critical position in this pilot study (Loh, personal communication, February 2003). Members of this project include people from Peking University (PU), Civic Exchange, Hong Kong Environmental Protection Department (EPD), Georgia Institute of Technology (GIT), Guangzhou Research Section of Environmental Sciences, Hong Kong Polytechnic University (HKPU), Hong Kong University of Science & Technology, Hong Kong Observatory, and the Argonne National Laboratory.

For this pilot study, seven measurement sites were chosen for the fine particle project, three of them in Hong Kong and four of them in the Guangdong region. Due to lack of funding, only one site was chosen for the ozone project which was selected to be at Tai O, Hong Kong. The Tai O monitoring station was chosen since it had already been established by Hong Kong Polytechnic University (Wang, personal communication, 22 January 2003); however the data gathered there has been offered to be shared to the Guangdong Environmental Protection Bureau if needed.

### *2.4.2 A Supplemental Study*

The pilot study was proposed to complement the CH2M Hill project, a study already done by the HKSAR and Guangdong governments based on Emissions-Based Models (EBM). Air quality has been traditionally measured with the use of emissions-based modelling (EBM), which estimates the pollution by looking at emission inventories supplied by industries and

archives. These data are often not of the highest quality and may be skewed, which causes uncertainty in the pollution estimates.

The new technique that has been created is the Observational Based Model (OBM), which measures actual data at monitoring stations. This method produces more reliable pollution estimates. Civic Exchange has chosen to use this methodology in its study, and hopes it can be used in parallel with the CH2M Hill study. Thus, the OBM is being used to verify the EBM.

### *2.4.3 Structure of the Pilot Study*

The pilot study consists of three teams, the Science Committee, the Management Committee, and the International Scientific Advisory Committee. It has been designed in such a way as to "foster capacity building among Hong Kong and Mainland scientists in regional air management" (Civic Exchange, 2002, p. 9). The structure also allows a new collaboration network between the scientific community and public and private sectors in the PRD. This is a crucial part in the building of capacity to understand and manage air quality issues in the future.

The roles of each team are as follows (Civic Exchange, 2002, p. 9):

1. The Science Committee monitors and analyses the air quality of the region.
2. The Management Committee ensures the project is working on schedule. This team supervises the administrative and financial aspects of the project and resolves any policy aspects of this study.
3. The International Scientific Advisory Committee consists of local, regional, and international scientists of high-ranking universities and research organisations. This team provides an independent scientific view on the data compiled by the scientific team.

All three teams must work together to produce the pilot study's deliverables. If one committee does not complete its role, then it is most likely that the entire pilot study fails. In this way, collaboration among these committees is important to the success of the pilot study. The pilot study marks the effort of building the capacity for introducing sustainability into the developments of the PRD region. Capacity building for environmental issues has been applied in other areas of the world. The following section examines some experiences in capacity building for environmental management and sustainability.

## 2.5 Capacity Building for Environmental Issues

Capacity building is a process aimed at developing and cultivating the capacity of stakeholders to recognise and discuss an issue, resulting in their ability and commitment to developing effective solutions for complex problems. We will here examine two cases where capacity building has been applied or formulated for environmental issues. The first is building the institutional capacity for environmental management in Hong Kong, using the development of the Hong Kong EPD as an example; the second case concerns capacity building for sustainable development in the context of water supply and sanitation in Mexico and on the U.S.-Mexican border.

### 2.5.1 Building the Capacity for Environmental Institution in Hong Kong

Hong Kong has been successful in developing robust environmental protection institutions and infrastructure (Holmes, 1996). In addition to the traditional disciplines of science and engineering, Hong Kong's environmental protection institutions have relied on six factors for their success. These are "a strong, unifying vision; scientific understanding of the problems; openness to face challenges; pragmatism in developing solutions; involvement of the

community; and commitment at the highest political levels" (Holmes, 1996, p. 461). The establishment and development of the Hong Kong EPD has demonstrated the importance of these six factors in contributing to the management capacity for environmental institutions.

The founding of the Hong Kong EPD has relied on the clear vision and strong commitment of those from both within and outside of the formal government structure. Their unifying vision was to create an institution apart from governmental bureaucracy amidst public indifference. The organisation and personnel of the Hong Kong EPD exemplified a model of governance that includes the following five key elements:

- People are chosen by values and attitudes instead of their credentials;
- People are socialised into an integrated system of shared values;
- Guidance is by accepted principles rather than imposed plans and targets;
- Members share responsibility, and feel trusted and supported by leaders who practised a craft style of management based on experiences;
- Performance is judged by experienced people rather than by adherence to "performance indicators" (Holmes, 1996, p. 464).

Another success factor for institutional capacity is a firm scientific understanding of the environmental problems faced. The technical capacity of the Hong Kong EPD has been continually strengthened from local scientific researchers and importation and integration of external expertise through sponsorship and collaboration. Hong Kong's EPD has been successful thus far is in part due to its openness and honesty about the environmental problems and the adequacy of existing means to deal with them (Holmes, 1996). Some inherent risks of being open to challenges are political, but the EPD was willing to take on these risks because it was not bureaucratic and was staffed by individuals with a strong unifying vision and commitment. In developing and enforcing their environmental management strategies, the EPD

has taken a pragmatic approach that emphasised accountability, equity, fiscal integrity and efficiency (Holmes, 1996).

Lastly, the success of the Hong Kong EPD is sustained by public support. Public support is obtained through continuing involvement of the community by means of community relations programmes and awareness building through education and publications on the state of Hong Kong's environment (Holmes, 1996). The Hong Kong EPD garners and sustains support from the government and legislature through organised direct exposure of government and community leaders to the environmental problems.

In summary, Hong Kong's experience on the development and success of its EPD suggested several ways to build institutional capacity for environmental management. Some particular objectives are: establish a strong vision and commitment for environmental protection; gain a clear scientific understanding of the environmental problems; involvement of the community; and obtain support and commitment from the highest level of community leadership and government (Holmes, 1996).

### *2.5.2 Capacity Building for Sustainable Water Management*

The term sustainable development as defined by the World Commission on Environment and Development is a development strategy that seeks to satisfy the survival and prosperity needs of the present as well as future human populations (Downs, 2001). As awareness of the need to maintain a sustainable natural environment heightened, increasingly sustainability has been considered and incorporated into strategies and policies for economic and social developments. Many strategies have been developed, refined, and integrated into operational protocols for incorporating and improving sustainability in environmental managements and developments. One such case was the capacity building protocol proposed by Dr Timothy

Downs of Clark University on the management of water resources in Mexico, a developing nation with a growing demand for water resources. The following section refers to this model (Downs, 2001).

In his protocol, Dr. Downs investigated and emphasised the dependence of sustainable development on capacity building, a process that could link sectors, social groups, and disciplines together and encourage collaborations amongst them. According to Downs, sustainable development is not an absolute goal and thus cannot be "achieved." It was much more appropriate to consider sustainability as "a dynamic, relative state of cultural evolution in response to changing needs and conditions" (p. 526). There exists a logical relationship between sustainability and a society's human, economic, and natural capital. The development and strengthening of scientific, political, economic, and cultural capacities to adapt and adjust to a society's changing needs contribute to these different capitals. Thus integrated capacity building could be viewed as a process of the improvement, mobilization, and integration of the different capital. Under this context, the capacity building on the water supply and sanitation sector in Mexico has focused on the institutional and socio-economic capacity in

> "the design, development, implementation, maintenance and consolidation of capacities a society requires, now and the future, to: (1) satisfy its water supply and sanitation needs; (2) protect its natural environment and the biodiversity of the ecosystem it belongs to; and (3) respect the interests of neighbouring populations and watersheds" (p. 526).

The institutional and socio-economic dimensions of capacity building are socio-political interaction (where the communities, public and private sectors, and academic groups engage in multi-group collaborations) and interaction between various technical disciplines in multi- and cross-disciplinary collaborations.

In Downs' approach, the capacity building process has three phases:

I. Conceive, diagnose and plan: develop an integrated operational framework for improving sustainability;

II. Implement and demonstrate: finance and carry out capacity building pilot projects to demonstrate efficiency and effectiveness of the approach developed in phase I;

III. Maintain, improve and consolidate. Build upon successful projects from phase II, respond to changing conditions and accommodate new knowledge (p. 529).

From comparing and evaluating prior projects on water and environmental developments, six groups of capacities were identified as critical components of integrated capacity building framework for Mexico. The ideal process of capacity building and strengthening advances sequentially from capacity group one to group six, as each successive group has certain dependency on the previous group. A project's probability of improving sustainability increases with the number of components incorporated. The six groups of capacities are as shown in Table 5, ordered sequentially.

| |
|---|
| I. Capacities strengthening political and financial support; |
| II. Capacities strengthening human resources: education, training and awareness building; |
| III. Capacities strengthening information resources: monitoring, data integration and interpretation for informed decision making; |
| IV. Capacities strengthening regulations and compliance; |
| V. Capacities strengthening basic infrastructure for water supply and sanitation; |
| VI. Capacities strengthening the market for water and sanitation products and services |

Table 5: Six Critical Component Groups of Capacities (Downs, 2001, p. 531).

This six-component framework was further deconstructed into individual elemental capacities by means of consultations and case studies, local working group discussions, and international expert workshops. The result was a set of ideal capacities that are required to be

strengthened or established. This set of ideal capacities is presented in Appendix F. From this set of ideal capacities, multi-stakeholder working groups in the Mexican municipalities, where the Downs protocol has been proposed, were formed for the analysis and planning of their water management strategies. This represented a new form of collaboration seldom practised in Mexico. In the case where the watershed spanned international borders, however, cross-border collaborations were not established due to the lack of political willingness, which Downs saw as unfortunate because cross-border collaborations offer opportunities to break down cultural barriers (Downs, personal communication, December 2002). In each of the cases where multi-stakeholder working groups performed and collaborated well, a set of strategic capacities from Table 5 was identified. The strategic capacities were the capacities that each working group has ranked as most in need of development and strengthening for ensuring sustainability in its water supply and sanitation needs.

## 2.6 Closing Points

The air pollution problem in the PRD region has been worsening with the continuing growth and development of the region. Air quality in the region can only be managed effectively through the joint efforts between the many stakeholders of Hong Kong and Guangdong. Their efforts could be bolstered by efficient and sustained cross-border collaborations that can break down and overcome the many issues facing collaborations. In light of building the institutional and socio-economic capacities needed for cross-border collaborations and the need to incorporate sustainability, the pilot air quality study aims to contribute to the foundation of a collaborative framework. Experiences can be drawn from capacity building projects locally and from other parts of the world.

# Chapter 3. Methodology

In order to assess the current level of collaboration among the participants in the pilot study, we analysed three basic components: case studies, interviews and observations. Analysis of this data was based in terms of capacity building on Timothy Downs' model (Section 2.5.2).

## 3.1 Case Studies

Case studies were studies as part of our background research in order to understand the process of capacity building, particularly with respect to cross-border problems. Thus, the case studies were chosen specifically for locations where two neighbouring regions were involved. It was also important that these regions generally showed significant cultural, economic, or social differences. Case studies that involved all of these aspects were most likely to be applicable to Hong Kong and the PRD Region and help us better understand what is needed for the development of the collaborative process.

## 3.2 Interviews

In order to examine the progress of collaboration in the pilot project, interviews with the participants were essential. The purpose of the interviews was to obtain qualitative information that represented views and opinions from key participants in order to understand their perspectives on the problem, their roles in the pilot study, and their opinions on its collaborative aspects.

The selection of interviewees was based upon the list of key pilot project participants provided by Civic Exchange, thus there was no need to utilise sampling methods in order to identify sample groups. The participants of the pilot project had a variety of different

backgrounds and played different roles in the pilot study. Therefore it was essential to interview participants from the many perspectives of the pilot study ranging from data collection and analysis to funding and project management.

One of the essential stakeholder groups we interviewed were experts from scientific institutions and regulatory agencies. These scientists conducted scientific research and data analysis for the pilot study and utilized their experiences from various locations to contribute to the project. The scientists were from Hong Kong, mainland China, United States, and the Netherlands. Questions of their scientific perspectives on the pollution problem as well as assessment of the level of collaborations were asked. The inputs of the science team members provided a first-hand assessment of the collaborative process of this multi-national, multi-institutional pilot project from a scientific point of view.

Interviews were also conducted with both members of the management team as well as members of the advisory team to assess the collaborative process from a policy point of view. The management team consisted of representatives from government agencies, non-governmental organisations (NGOs), and private institutions from Hong Kong. A list of interview questions can be found in Appendix G.

## 3.3 Observation

In addition to directly asking the participants about the collaborative process that occurred, we also had a chance to directly observe the participants. During these conferences not only did we witness scientific presentations for the advisory committee, but discussions that focused on the communication and understanding of the many perspectives of the participants around the table.

We compiled minutes for the science team meeting on January 13, 2003 for the use of the pilot study. These minutes were used in comparison with previous meeting minutes, in order to identify issues raised and the steps taken to address them. These minutes could not be included with this report, due to the privacy of the findings at this phase of the pilot study.

## 3.4 Analysis of Information

Observations and interviews provided our project team a clear understanding of the following six aspects of each participant's views, which have been based on Downs' model (Downs, 2001):

1. Understanding of the problem from his/her perspective in the pilot project;
2. Participant's expectations and objectives for the project;
3. Assessment of the effort to establish a collaborative framework;
4. Assessment of the ability to cooperate with other stakeholders, and the role the individual played in the collaborative framework;
5. Difficulties encountered during cooperation;
6. Suggestions and advice on how to improve cooperation.

Given the qualitative nature of the information being sought, and the limitations of time and participation in the pilot project, our team was only able to organise and explain the information gained from interviews and observations in terms of the collaborative effort. The underlying variables for each of the six aspects were examined and categorized as follows: economic; socio-cultural; political/legal; communicative; and emotional. Details of each category are given below.

- Economic: business cost and revenue, logistics, funding, and economic interests and incentives

- Socio-cultural: cultural differences including: assumptions, objectives, expectations, age, educational and social background and social hierarchy
- Political/legal: political differences, priority, influence, and compliance/enforcement of standards.
- Communicative: availability and accuracy of data, efficiency of exchange of information
- Emotional: risk assessment and management, mutual understanding between different social group

The evaluation of the capacity building aspect of the pilot study, in terms of promoting cross-border collaboration and contributing to the progress towards sustainable development was based on the model for integrated capacity building developed by Timothy Downs. The model was described in Section 2.5.2 of the previous chapter. Out of the six groups of capacities as identified and catagorised by Downs, four were used as the basis for our evaluation. These four groups were the following:

I. Political and financial support;

II. Human resources: education, training, and awareness building;

III. Information resources: monitoring, data integration and interpretation for informed decision making;

IV. Regulations and compliance (Downs, 2001).

# Chapter 4. Results and Analysis

The following section analyses information collected through interviews with participants, observations at science team meetings, and review of minutes of previous meetings. Through the interview process, we were able to obtain a good deal of data regarding the air quality pilot study. From the interviewees we obtained opinions regarding both the technical and non-technical aspects on the collaborative efforts of the study. The interviewees seemed to be in agreement that the process and outcome of the study had so far gone well. It was also clear that building positive attitudes between the members of the pilot study team was crucial to the success of the pilot study. Our evaluation examined the contributions the pilot study has made to the process of building stakeholder capacities to work towards sustainable development.

## *4.1 Sustainable Development in the PRD Region*

The pilot study is already proving to be useful in promoting further cross-border collaboration. PU's role in advising the Guangdong authorities on developing a sustainable development strategy is enabling continuing collaboration between PU and Civic Exchange, including the pilot study. An important example of the on-going collaboration is exemplified by a conference hosted by Civic Exchange at the US Consulate in Hong Kong on January 14, 2003 where Kiang, Chameides, Zhang and Slanina talked about their work and involvement in the pilot study to a wider audience in Hong Kong, and other speakers with other expertise also spoke. This was a condensed presentation of a larger one the presenters would make in Guangzhou later that week on ideas to achieve sustainable development for Guangdong. Professor C.S. Kiang noted that the Guangdong government is hoping to pioneer in achieving sustainable development, thus efforts have been directed in adapting new methods and policies

aimed at ensuring sustainability in the development of the PRD. The presentation of the pilot air quality study at the Guangdong convention has signified the pilot study's role in contributing to the efforts of achieving sustainable air quality management in the PRD region.

In light of its goal of setting a new model of capacity building for multi-stakeholder collaboration, a significant element of the overall capacity for sustainable development, our team has examined the contribution the pilot study has made towards the development of this capacity in the PRD. In our evaluation, inter-comparisons were made with a paradigm for integrated capacity building developed by Dr. Timothy Downs of Clark University in Massachusetts, USA. Based on his experience with water supply and sanitation in Mexico, some components of Dr. Downs' model of capacity building could be applied or serve as a reference to the current efforts in the PRD. According to Downs (2001), there exists a logical relationship between sustainability and a society's human, social, and economic capital, which includes its intellectual, technological, socio-political, and financial resources. Capacity building for sustainability means the improvement, integration and mobilization of these resources. In his model, Downs has identified individual elemental capacities that need to be strengthened or established, and categorised them into six critical component groups. Of these six groups of capacities, our team felt that four of them should be considered to some degree by those involved in the PRD. (See Section 2.5 for a more detailed description.) These four groups of capacities are the following:

I. Political and financial support;

II. Human resources: education, training, and awareness building;

III. Information resources: monitoring, data integration and interpretation for informed decision making;

IV. Regulations and compliance (Downs, 2001).

The ideal capacity building process advances sequentially from capacities group I to IV because each group of capacities has some dependence on the previous one. As an example, political and financial support could be bolstered if public awareness was high, thus showing the interdependence amongst the groups. In building the capacity for efficient stakeholder collaboration and sustainable air quality management, the pilot study aims to contribute to the strengthening or establishment of various capacities in all four capacities groups. Although not every single elemental capacity was addressed by the pilot study, it did succeed in creating the foundation for future efforts to address the unmentioned capacities. In the following sections, our team has examined the ways in which the pilot study contributes to each group of capacities.

## 4.2 Political and Financial Support

One of the two core capacities in component group 1 is financial support. To strengthen these two capacities, the pilot study aimed to generate positive support from private stakeholders in air quality management by addressing their concerns and expectations.

### 4.2.1 Expectations of Funders

Financial resources for the pilot study came from funding provided mostly by private funders, a first of its kind. There are three funding parties: the Hong Kong Jockey Club (HKJC), CAPCO (joint venture between Exxon-Mobil and CLP Power), and the HKEPD. The HKJC supported the pilot study in order to help find solutions to Hong Kong's deteriorating air quality. During conception of the pilot study, it was felt important that private stakeholders were involved in the funding process (Loh and Kiang, personal communication, 12 January 2003/February 2003). CAPCO was interested to fund a part of the pilot study in order to gain insight into the pollution mix in the region, including emissions from power plants where it had

an interest (Ryerkerk, personal communication, 11 February 2003). It wanted to ensure that any policy and regulatory changes should be based on "sound science," as opposed to guesswork and untested assumptions. The main reason for the involvement of CAPCO is because they are interested in the study findings since the information would offer valuable insights into their contribution to air pollution in the PRD region, backing them with sound scientific data for their emission policies and helping them to better tailor their pollution control strategies when needed. The credentials of the scientific members working on the pilot study increased CAPCO's confidence to fund the pilot study. There is a growing recognition among the business sector that the environment is a resource and is something of economic value that the industrial organization should be concerned about (Chameides, personal communication, 13 January 2003). HKEPD was specifically invited to participate as a minority funder and as a member of the Science Committee as well as the Management Committee in the pilot study since it is a critical stakeholder in affecting change as it has policy influence in Hong Kong. Furthermore, HKEPD also contributed their professional expertise and non-cash resources to the pilot study, without which it would not run as smoothly. The design of the pilot study was aimed at getting private sector funding and not public sector funding so that it could be free from bureaucratic constraint as well as protocol constraint between the Hong Kong and Guangdong authorities.

In terms of building financial support for sustainable development, the fact that the pilot study was privately funded in part served to illustrate the availability of alternative financial resources for environmental projects in Hong Kong. As shown by the pilot study, private stakeholder support could be generated by incorporating their interests in the study objectives, introducing the benefits to them and involving them in the decision making process. Moreover, the lack of substantial governmental funding for the pilot study does not mean the governments

are not committed to providing financial resources. The Guangdong authorities and other mainland government units are funding other air quality studies, which PU is participating in. The EPD in Hong Kong is providing substantial non-cash support for the pilot study. To this extent, as the governments continue to emphasise the importance of sustainable environmental management, the financial support for environmental projects in the PRD region is likely to be available.

The other capacity needed for a strong base in this group is governmental/political as well as support and commitment. The pilot study has involved representatives from the Hong Kong EPD. On behalf of the Guangdong authorities, the Guangdong Environmental Protection Bureau (EPB) was coordinating with the pilot study team in the collection of air samples in Guangdong. Professor Yu Jianzhen of HKUST and Professor Zhang Yuanhang of PU observed that the enthusiasm and positive attitudes of the support personnel in Guangdong was one of the reasons the pilot study has been so successful in the collection of air samples. Thus, in a way, there is implicit political support. As for public support, it is envisaged that when the results are available that they will be made public, which will stimulate public interest and, over time, promote public support for a more intense level of scientific work and cross-border collaboration.

## 4.3 Human Resources

Capacities that incorporate the overall human resources for sustainable development include education, professional training, and raising public awareness. The human resources for the pilot study are provided through an international collaboration of scientific experts. The organisation and diversity of this expert team play a significant role in the building up of technical, management, and emotional capacities.

### 4.3.1 Structure of the Pilot Study Team

Members of the air quality pilot study included scientists of various disciplines, government representatives, business representatives and policy experts representing a variety of institutions, which were Peking University (PU), Hong Kong Polytechnic University (HKPU), Civic Exchange, Hong Kong Environmental Protection Department (HKEPD), Hong Kong Observatory, Georgia Institute of Technology (GIT), Guangzhou Research Section of Environmental Sciences, Hong Kong Polytechnic University (HKPU), Hong Kong University of Science and Technology (HKUST), and the Argonne National Laboratory. Each party played one or more key roles in the project: project initiation, project organisation, project management, funding, data collection, quality assurance/quality control (QA/QC), and data analysis.

Civic Exchange is the project manager, and its CEO, Loh, is supported by Kiang and Tang as special advisers to the pilot study. There are three committees responsible for delivering the pilot study: the Science Committee, the Advisory Committee, and the Management Committee. The Science Team is responsible for every aspect of the scientific inquiry. The Advisory Committee is made up of distinguished scientists who can offer objective advice to the pilot study. The Management Committee is responsible for the delivery of the pilot study. For details on the personnel and organisation of the pilot study please refer to Section 2.4 of the background chapter.

### 4.3.2 Diversity of Participants

The first observation about the pilot study is the sheer number of people and institutions involved. The composition of the team has great diversity in terms of nationality, institutions, ethnic backgrounds, professional experience, training, and even age and gender. The entirety of

the team has citizens of China, including residents of Beijing, Guangdong and the Hong Kong Special Administrative Region, US nationals, and a Dutchman. The team has a number of senior air quality scientists of international stature as well as more junior members ranging from mid-career scientists to younger participants. Whilst the majority of the team members are men, there are women with key responsibilities. The members received their education and training from a variety of countries resulting in a range of professional experiences. Furthermore, their experiences from the various institutions they came from also added diversity to the "mix". Each member and participating institution of the team has different interests and expectations, which is natural. For example, younger scientists are there to learn. More established ones want to work on an interesting pilot study and the chance to publish their work. The most senior scientists want to be able to share their expertise. The funders and governmental bodies want to discover more data that can determine the sources of emissions in the region and explore what policy relevant recommendations could be made. Those in management want to see the pilot study run smoothly and be able to produce useful results. Many of the participants hope the pilot study might be a stepping stone to creating further scientific and collaborative work in air quality for the region.

### *4.3.3 Challenges of Diversity*

Numbers and diversity can be both a plus and a minus. Managing large teams, particularly when they are spread out geographically is a challenge. Working with others who come from very different backgrounds and training can be confusing. Language is also an issue. Whilst the Pilot study is conducted in English, many of the participants use it as a second language even though the level of proficiency is very high. Communication styles are different among the team members, which can lead to confusion, misunderstanding and conflict. Apart

from ethnic cultural differences, there are also professional and institutional differences to deal with. For example, just because two institutions may be from one part of the world, their institutional cultures may be quite different even though the people may be from the same ethnic background. The challenge for each of the team members is to be able to relate to each other and develop sufficient sensitivity for each other as human beings as well as develop some appreciate for how each other function within their respective cultural, professional and institutional environments so that they can find ways to overcome confusion, misunderstandings and conflicts to achieve the purpose of the pilot study.

### *4.3.4 Dealing with Professional Disagreement*

The group had to deal with professional disagreements in how to deal with various aspects of the pilot study. For example, before the first batches of samples were collected for Project 2, there were numerous rounds of discussions between GIT and HKEPD on how it should be done. The HKEPD wanted the most stringent standards to be observed where GIT thought the standards could be more relaxed and still be assured of high standards. It took the efforts of many team members and several weeks before the issue could be resolved and in the end, the agreement was to use the highest possible standards because that would put the results beyond question for all parties involved, which was particularly important for the government representatives involved in the pilot study. The final results of the first batches of sampling were considered to be very good scientifically, which made all the team members feel putting in more work was worthwhile. A consequence of the disagreement and subsequent agreement also brought the different interests of the various parties more into focus – the scientists realized that when they work with government officials and official bodies, the public officials have to observe a high level of accountability. Having an appreciation of this may well make future

professional disagreements easier to deal with. Thus, "cultural" differences include institutional differences, which in this case was between scientists in an academic setting and government officials who felt they had public accountability to consider as well.

### 4.3.5 Role of Facilitator/Mediator

These cultural differences can be addressed more easily if there were people who could play the roles of facilitators and mediators. They need to be able to relate to all sides and understand the many facets of participation to pull participants together. Kiang plays a critical role in the pilot study. Not only is he the visionary who created the scientific vision behind the pilot study, he also brought the distinguished scientific team together and helps to facilitate and mediate between "cultures". He has spent large parts of his career at both GIT and now PU and understands viewpoints from both the Chinese perspective and United States perspective. His current assignment with PU also means that he is able to put the Pilot study within the context of other air quality projects being pursued in South China. Being someone who has worked in air quality science all his life and having worked with scientists in both the US and China over the years, he has the trust of everyone it appears. Trust is the essential ingredient in playing any facilitation/mediation role. "Professor Kiang has played a major role in this pilot study, in both the organisation and leadership of the project, as well as bringing influential credentials to the project" (Ryerkerk, personal communication, 11 February 2003).

### 4.3.6 Ensuring Sense of "Ownership"

In team-building, it is important to ensure that everyone's participation is seen as a critical path to ultimate success thereby creating a high level of ownership in the pilot study and that success comes with everyone pulling in the same direction. Each participant and every task

that had to be performed by each of the parties involved has to be seen to be critical to the success of the Pilot study. For example, the setting up of the samplers for sample collection, testing of the equipment and maintaining the high standard of QA/QC for data collection were critical to the validity and credibility of the Pilot study because the quality of data will influence the level of acceptance of the results in the end by policy-makers and industry. "Science acts as a bridge between social and political differences" but the science has to be able to stand up to scrutiny (Chameides, personal communication, 13 January 2003).

A good example of growing "ownership" and commitment to success can be seen from the amount of work put into the QA/QC process by the international advisory committee member Slanina, who personally visited the sampling sites to produce the QA/QC report. Another example is how each participant and institution put in more resources than they got cash sponsorship for. "Every participant was very much interested in the pilot study and solving the problem. This attitude is why it was so successful. People put in personal resources and professors use graduate students. Everybody is helpful because they are trying their best to contribute and make the collaboration easy" (Yu, personal communication, 30 January 2003).

### *4.3.7 International Participation*

Atmospheric scientists from North America and Europe are collaborating with scientists from Hong Kong and mainland China in conducting the scientific experiments. In addition, these scientists provided training to local station operators that are responsible for monitoring equipment operations and quality control issues. Numerous graduate students from Guangdong, Hong Kong and the US participated and learned from the experience.

Based on Downs' model, the ultimate goal for such training is to obtain sufficient local knowledge and expertise in order to eliminate the dependency on external experts and to make

the training of additional personnel self-sufficient. This goal was echoed by PU for helping younger scientists learn from more experienced scientists through collaborations. Due to the pioneering nature of the new technique used to analyse data from the pilot study, however, all participants have expressed the need to introduce and incorporate new techniques and methods in conducting the analyses. By having the academia of Hong Kong and the Mainland collaborating with these foreign scientists, valuable experience could be gained both by the local scientists, from using this new analytical method, and by the foreign scientists, as they learn valuable lessons in the techniques of employing and verifying this new method. The training and experience gained from participating in the pilot study were the foundations for further refinement of the method and strengthening the cause of self-sufficiency in technical training. Equally valuable was that the foreign scientists could gain experiences from the implementation and verification of these new methods from local scientists.

### *4.3.8 Local Involvement*

Since the results are most relevant to the authorities in Hong Kong and Guangdong, one important aspect of the pilot study is that local institutions in Hong Kong and Guangdong play a part in data collection and analysis. By involving local scientists and institutions, the results and recommendations would be more acceptable to the authorities (Wang and Louie, personal communication, 22 January 2003/28 January 2003). This is important because the local and overseas teams each are responsible for critical aspects of the pilot study and without trust and collaboration among them the quality of the work could not be assured. It is noted that there is much fuller collaboration with Guangdong parties in Project 2 since Project 1 focuses only on Hong Kong. It appears that Guangdong parties would like to have participated in Project 1 as well (Zhang, personal communication, 13 January 2003) but the reason for a narrower focus in

Project 1 was due to insufficient funding from the beginning (Loh, personal communication, February 2003). Nevertheless, the results from Project 1 will be shared with other scientists and are expected to be useful for other air quality work being done by PU in South China (Kiang, personal communication, 12 January 2003). One of the capacity-building goals is to promote a culture of data sharing among scientists (Kiang, personal communication, 12 January 2003). It was interesting to note that the Guangdong authorities are now paying much more attention to air pollution and are willing to participate in collaborative work. Indeed, PU has recently been appointed the adviser to them to help develop a sustainable development strategy for Guangdong Province (Kiang, personal communication, 12 January 2003).

### *4.3.9 Building Public Awareness*

Another essential factor in strengthening the human capital was the development and promotion of public awareness. At this early stage, there are few opportunities for the pilot study to build public awareness since there are no results to show yet. Indeed, the participants felt that at this stage, disclosing the preliminary data could cause confusion. However, the conference held on 14 January 2003 at the US Consulate was an attempt by Civic Exchange to let more people know about the importance of the pilot study and more broadly, the kind of cross-border collaboration that could happen.

Based on our observation, the current level of public awareness in the PRD region regarding air pollution has not reached the sufficient level needed for widespread citizen-based initiatives to find solutions. The level of public awareness is lower in the Guangdong side. One reason as observed by Professor Kiang was that the overall living standards in Guangdong are still lower than in Hong Kong. Some residents of Guangdong have lower expectations for their living standards because their basic needs have not been fully addressed yet.

## 4.4 Information Resources and Decision Making

The first capacity needing to be strengthened in this group was the sampling, monitoring and integration of the data. The scientific experiments, especially in the data collection for Project 2, have been conducted through regional, multi-institutional collaborations. A key aspect of Project 2 is to set up the region-wide sampling and monitoring network. Efforts have been made by station operators and scientists to ensure the integrity and quality of the samples, and there was mutual agreement that the quality of the samples was excellent. The collected samples were analysed by certified laboratories in the United States. In Downs' ideal model, local or state laboratories should conduct the data analysis to attain a state of scientific self-sufficiency. In order to achieve this, capacities from the previous group must be firmly established, which include training of local technicians, education at university level and professional training. In his model, Downs proposed to instigate accessible certification via partnerships with other certified institutions. The joint participation of Georgia Institute of Technology, California Institute of Technology, Peking University, Hong Kong Polytechnic University, and Hong Kong University of Science and Technology in the pilot study has established a structure for deepening collaboration.

To strengthen information resources, Downs has also emphasised the roles of a regional research and regional institutional network. The role of the regional research network was to facilitate and improve communications and collaboration among researchers. The participating partners of the pilot study formed a strong network that spans the governmental, private, and academic communities in the PRD. This collaborative network was invaluable in facilitating the exchange of information between various parties involved in the pilot study. Our team has identified one potential shortcoming of the pilot study, namely the availability of information

that links public health to air pollution. The incorporation of public health data in the pollution study could enhance public awareness of the problem and generate additional support for conducting further studies on air pollution.

Lastly, the presence of a multi-stakeholder forum was essential for facilitating communication between stakeholder representatives in order to reach mutual consensus needed for informed decision-making. According to Downs, building the institutional and socio-economic capacity involves community, public, private and academic groups engaging in multi-group collaborations. The human resources and the multi-stakeholder collaborative framework in place for the pilot study can serve as a foundation for a more extensive stakeholder forum.

## 4.5 Regulations

With such a distinguished team of scientists participating in the pilot study and with internationally renowned institutions involved, there is high expectation of the team to ultimately deliver credible scientific results with useful observations, insights and recommendations that are relevant to policy makers in managing air quality in Hong Kong and South China. There are many well-developed pollution regulations currently in placed in the region. However, previous air quality studies as well as participants of the pilot study have suggested the effectiveness of having a common standard in control strategies and regulations. In this situation, the capacities that needed to be strengthened were the responsive regulatory framework and comprehensive regulatory compliance program. Although it was not clear from our study how the pilot study affected the regulatory institutions in Hong Kong and Guangdong, the pilot study has aimed to produce a framework for enabling future studies to produce policy relevant reports that could offer insights for decision makers in air quality management.

## 4.6 Closing Points and Future Directions

According to Downs' model, the process of building the capacity for sustainability has three phases: conceiving, diagnosing and planning; implementing and demonstrating; maintaining, improving and consolidating. The current efforts in the PRD are still being directed to the first two phases. In addition to providing valuable experiences in building the capacity for collaborations, the pilot study is a significant piece in the development of an operational framework for improving sustainability. It provides valuable experience for organising, financing, and conducting future projects that will demonstrate the efficiency and effectiveness of the approach developed in the operational framework.

# Chapter 5. Conclusions & Recommendations

Based on our observations and interviews, collaboration among participants of the air quality pilot study of the PRD has gone well. Optimism about the pilot study is high and up to this point (February 2003) the pilot study has been successful in completing its tasks. Using Downs' model has allowed us to make the following conclusions and recommendations for future sustainable development.

Although the path to reaching this current level of collaboration had its share of problems, due to differences of culture, industry, and professional backgrounds, a mutual understanding over a period of time between these groups had been reached and issues due to these types of differences have been resolved. The issue of cultural differences is common and almost inevitable in a multi-national and multi-stakeholder collaboration. To minimize these issues during the initial phases of future projects involving collaboration between international scientists, a level of sensitivity towards the needs and expectations of different collaborating parties should developed amongst all participants.

The pilot study has been successful so far is because a high degree of trust and confidence of the participants. One reason for this trust is the high level of scientific credentials involved in the project, such as Madame Tang, Professor Kiang, Professor Zhang and Professor Chameides. Involving some of the most respected scientists in the field of air quality research not only brings a high level of knowledge to a project which all participants can respect and accept the decisions that are made.

The credibility of the pilot study has not only been obtained by having respected scientists in the project, but because of the Quality Assurance/Quality Control (QA/QC) involved in data sampling. The QA/QC in this pilot study is a strict and rigorous process that has ensured

the quality of data is of the highest standard. Continuing to operate under these conditions will ensure the credibility of the project, and possibly allow for future collaboration and integration with other air quality projects in the PRD region. Data sharing between these projects allows for higher data quality and credibility, which can lead to stronger influence on the policy making process.

If future projects adhere to the high standard of QA/QC utilised by this pilot study, the likelihood of further funding of future projects by both the government and private stakeholders will increase. What is needed is the sustained financial and political support by these stakeholders to ensure the longevity and efficacy of air quality projects. These projects will bring a higher understanding of air pollution to the region and will hopefully allow for the introduction of effective policies for the entire region. The making of policy has not been directly addressed in this paper, mainly because the pilot study will not reach this stage, but policy making will have to involve the cooperation of both the Hong Kong and mainland China governments in regional decision-making.

Government officials were not part of this current pilot study, due to the fact that this was a purely scientific study. However, we recommend that future studies with goals of influencing policy making, should include approval from government policy makers from both sides. This link will hopefully increase the possibility and ease of creating an effective policy based solution. Policy makers should not push for a quick solution however. Time, effort, and investment on finding a solution could be wasted by forcing scientists to come to hasty conclusions. This may bring about a solution to regulate certain emissions but circumstances may be that there may be little or no effect on the problem.

Future projects hoping to influence policy should also raise the question of the connection between health effects and air pollution found in the region. We understand that Peking University is already thinking about such studies. Although not overlooked, it was not included in the drafting and proposal of this pilot study. Since this study was seen as a first step, the health impact was expected to be addressed by another study involving medical researchers. Linking health risks to air pollution will raise greater concern among the general public, thereby raising the amount of influence future air pollution studies will have on the drafting of policy.

As of February 2003, participants interviewed have all agreed that collaboration among all the participants of the pilot study has been positive and optimistic. However, there was a process to get to this present level of collaboration that was not apparent in the interviews or observations. This progression took place over months, where different cultural and occupational backgrounds stood as an obstacle towards a functional working group. The apparent success of the pilot study may be due to the excitement of the participants who have one fundamental goal: to secure reliable and credible data. As long as cooperation among stakeholders remains strong, and there is continued mutual agreement and compromise, the pilot study will be successful and credible, allowing for future collaborative air quality projects in the PRD region.

# References


Baldinger, P. & Turner, J.L. Crouching Suspicions, Hidden Potential. United States Environmental and Energy Cooperation with China, Washington D.C.: Woodrow Wilson International Center for Scholars.

Bernard, H. (2002). Research Methods in Anthropology: Qualitative and Quantitative Approaches, Third Edition. Walnut Creek, CA: AltaMira Press.

CH2M HILL (China) Limited, Hong Kong Special Administrative Region Government. (2002). Final Report Agreement No. C/E 106/98 Study of Air Quality in the Pearl River Delta Region. Hong Kong: CH2M HILL (China) Limited.

Chameides, W.L. & Cowling, E.B. (Eds.). (1995). The State of the Southern Oxidants Study (SOS): Policy Relevant Findings in Ozone Pollution Research 1988-1994. North Carolina: College of Forest Resources, North Carolina State University.

Chow, J., et. al. (2002). Critical Review Discussion – Visibility: Science and Regulation, Journal of the Air & Waste Management Association, 52. 973-999.

Civic Exchange. (2002). Pilot study on the use of atmospheric measurements to manage air quality in Hong Kong & Pearl River Delta. Hong Kong: Civic Exchange.

Downs, T. J. (2001). Making Sustainable Development Operational: Integrated Capacity Building for the Water Supply and Sanitation Sector in Mexico. Journal of Environmental Planning and Management. 44(4), 525-544

Eade, D. (1997). Capacity-Building: An Approach to People-Centered Development, UK: Oxfam GB.

Environmental Protection Department. (2002a, March 26). Environmental Department, the HKSAR. Legislation for Management of Air Quality. Retrieved November 10, 2002, from the World Wide Web: www.epd.gov.hk/epd/english/laws_regulations/envir_legislation/leg_air.html

Environmental Resources Management. (2001). Territory-wide Air Quality Modelling System: Final Report. Environmental Protection Department.

Environmental Protection Department. (2002b). Environment Hong Kong 2002. (CD-ROM, 2002 release).

Grindle, M. S. (Ed.) (1997). *Getting Good Government: Capacity Building in the Public Sectors of Developing Countries,* Cambridge: Harvard University Press.

Hills, P., & Roberts, P. (2001). Political Integration, Transboundary Pollution and Sustainability: Challenges for Environmental Policy in the Pearl River Delta Region. Journal of Environmental Planning and Management, 44(4), 455-473.

Holmes, P. R. (1996). Building capacity for environmental management in Hong Kong. International journal of water resources development. 12(4), 461-472.

Hong Kong SAR Government Information Centre. (2002). Government Structure. Retrieved November 13, 2002, from www.info.gov.hk/ef3.htm

Hopkinson, L., & Stern, R. (2003). Cross-boundary Air Pollution: Policy Issues for Hong Kong and Guangdong. to be published, China Environment Series, Woodrow Wilson Center. Issue 6.

Janicke, M., & Weidner, H. (1997). National Environmental policies: A Comparative Study of Capacity-Building. Berlin: Springer.

Lau, Nai-Keung. (2003, January 23). Pearl River Delta Integration. South China Morning Post.

Leu, Siew Ying. (2003a, January 17). Guangzhou tells Hong Kong: don't stand in our way. South China Morning Post. Pp. 1.

Leu, Siew Ying. (2003b, January 17). Guangdong governor sees room to improve cross-border efforts. South China Morning Post. Pp. 14.

Loh, Christine. (2002) An Introduction to Sustainability Tools: Using effective public dialogue to improve government-civil sector relations. Hong Kong: Civic Exchange.

Louie, P. K. K., Sin, D.W.M., & Cheung, F. (2002, June). Highlights from the Regional PM Workshop in Hong Kong and Guangzhou, China. EM Magazine, 38-40.

Pearl River Delta. (2002). Introduction. Retrieved November 28, 2002, from www.pearlriverdelta.org/Eng/intro.html

Rodgers, M. O. & Chameides, W. L. (Eds.). (1988). Atmospheric Photochemical Oxidants: A Southern Perspective. Executive Summary of Discussions and Research Recommendations. Georgia Institute of Technology, Georgia.

Russell, A. Pearl River Source Impact Analysis and Emissions Inventory Assessment. Unpublished, Georgia Institute of Technology, Georgia.

Streets, D. G. (1999). Policy and Technology for Clear Air. Forum: For Applied Research and Public Policy, 14(4). 36-42.

Streets, D. G. & Waldhoff, S.T. (2000). Present and Future Emissions of Air Pollutants in China: $SO_2$, $NO_x$, and CO. Atmospheric Environment, 34. 363-374.

Watson, J. G. (2002a, June). Visibility: Science and Regulation – A Summary of the 2002 Critical Review, EM Magazine, 36-43.

Watson, J. G. (2002b). 2002 Critical Review – Visibility: Science and Regulation, Journal of the Air & Waste Management Association, 52. 625-713.

Wong, C.M., Ma, S., et. al. (2001). Effect of Air Pollution on Daily Mortality in Hong Kong. Environmental Health Perspectives, 109(4), 335-340.

Wong, C.M., Atkinson, R. W., et. al. (2002). A Tale of Two Cities: Effects of Air Pollution on Hospital Admissions in Hong Kong and London Compared. Health Perspectives, 110(1), 67-77.

# Appendix A. Civic Exchange

Civic Exchange of Hong Kong was founded in October of 2000 (Civic Exchange, 2002). Registered as a charity organisation, it positions itself as an independent, non-profit, public policy think tank whose goal is to educate, promote and strengthen civic participation in governance and public life, as well as to undertake research and development in economic, social, and political policies and practices to help shape the breadth and depth of public policy debate. Civic Exchange's founding concept is to add intellectual capital using a cooperative structure. Its tasks include producing publications that help reframe policy debates, helping policy makers by providing the tools and information needed to make the right choices, and encouraging integrated stakeholder learning and consensus building to promote problem-solving skills. It achieves these tasks through undertaking and sponsoring research by collaborative partners and interns, direct strategic influence of decision-makers, consultation, and education. In addition, Civic Exchange provides the tools and information for the integration of skills and experiences across various social sectors.

## *Organisation Profile*

### Contact Information

| | |
|---|---|
| Location: | Room 601, Hoseinee House<br>69 Wyndham Street<br>Central, Hong Kong |
| Telephone: | (852) 2893 0213 |
| URL: | www.civic-exchange.org |

### People

**Founders and Shareholders**

- Christine Loh, Chief Executive Officer
- Lisa Hopkinson, Head of Research

**Board of Directors**

- Stephen Brown, Research Director, Kim Eng Securities

- Winston Chu, Consultant, Winston Chu & Company

**Thinkers, Researchers and Facilitators**

- William Barron
- Moira Chan
- Cecilia Chu
- Joanna Clark
- Richard Cullen
- Lynne Curry
- Tobias Forster
- Julia Gilkes
- Elizabeth Hutton
- John Hyslop
- C S Kiang
- Esther Lam
- Kelley Loper
- Simon Ka-wing Ng
- Amanda Olsson
- Pooja Pradhan
- Rachel Stern
- John Russell Taylor
- Kylie Uebergang
- Paul S Yip
- Yan-yan Yip

**Collaboration Partners and Organisations**

- The Hong Kong Polytechnic University, Hong Kong, P.R.C
- The I.S. Department Ltd.- Hong Kong, Hong Kong, P.R.C
- The Asia Foundation, San Francisco, U.S.A.
- Bloomberg L.P., New York, U.S.A.
- Hong Kong Discovery Magazine, Hong Kong, P.R.C.
- International Marinelife Alliance, Inc., Honolulu, U.S.A.
- Worcester Polytechnic Institute, Worcester, U.S.A.
- Wellesley College, Wellesley, U.S.A.
- Association for Sustainable & Responsible Investment in Asia, Hong Kong, P.R.C

## Civic Exchange Mission Statement

1. Promote civic education amongst members of the community and for such purpose to conduct research and publicise the results so as to provide objective and balanced information to the public concerning economic, social and environmental issues; and
2. Undertake research on development of economic, social and political policies and practices to help shape the breadth and depth of public policy debate and so to provide well-founded and reasoned argument on the issues identified above.

# Appendix B. The Interactive Qualifying Project

The Interactive Qualifying Project was created to encourage students to understand social implications and apply ethics by learning through professional, "real world," project work while maintaining flexibility for students to design their own educational curriculum. After completing the IQP, students are to be able to be aware of general social problems. Thus, students should gain the ability to question, criticise or reinforce prevailing ethics and value concepts as well as become aware of the interactions between society, humanity, and technology. Students should also be able to analyse these interactions and make better judgments or recommendations for political issues that affect society.

Our project qualifies as an IQP because we have analysed observations on the interactions between scientists with different social backgrounds collaborating together to solve the scientific problems of transboundary air pollution. We have identified issues pertinent to the success of such collaborations as well as made suggestions as to what can be done in the future to address these issues. The effort we have analysed hopes that it will act as a first step towards influencing public policy, and it is to these regards that we were able to make recommendations to further influence political support.

# Appendix C. Air Pollution Control Legislation

| Air Pollution Control Related Legislation in Effect as at December 2000 | |
|---|---|
| **Legislation** | **Description of Control** |
| Air Pollution Control Ordinance (Cap. 311) 1983 | Provides for the control of air pollution from stationary sources and motor vehicles. Also enables promulgation of regulations (as below). |
| Air Pollution Control (Air Control Zones) (Declaration) (Consolidation) Order 1993 | Provides for consolidated declaration of Air Control Zones. |
| Air Pollution Control (Appeal Board) Regulations 1983 | Stipulates the procedures and run down of an appeal. |
| Air Pollution Control (Asbestos) (Administration) Regulation 1996 | Provides for the qualifications and fees for registration of asbestos consultants, contractors, supervisors and laboratories. |
| Air Pollution Control (Construction Dust) Regulation 1997 | Requires contractors to take dust reduction measures when construction work is being carried out. |
| Air Pollution Control (Dust and Grit Emission) Regulations 1974 | Stipulates the emission standards, assessment procedures and requirements for particulate emissions from stationary combustion sources. |
| Air Pollution Control (Fuel Restriction) Regulations 1990 | Prohibits the use of high sulphur content solid and liquid fuel for commercial and industrial appliances. (In Shatin, only gaseous fuel is allowed except for the appliances used in construction sites or for emergency purposes.) |
| Air Pollution Control (Furnaces, Oven and Chimneys) (Installation and Alteration) Regulation 1972 | Requires prior approval to ensure suitable design for the installation and alteration of furnaces, ovens and chimneys. |
| Air Pollution Control (Motor Vehicle Fuel) Regulation 1994 | Sets out the specifications of motor vehicle fuel to be used in motor vehicles and prohibits the sale of leaded petrol. |
| Air Pollution Control (Open Burning) Regulation 1996 | Prohibits open burning of construction waste, tires and cables for metal salvage, and controls other open burning activities by permit system. |
| Air Pollution Control (Petrol Filling Stations) (Vapour Recovery) Regulation 1999 | Requires petrol filling stations and petrol delivery vehicles to be equipped with effective vapour recovery systems and to observe good practice during petrol unloading. |
| Air Pollution Control (Smoke) Regulation 1983 | Restricts emission of dark smoke from stationary combustion sources. |
| Air Pollution Control (Specified Processes) Regulations 1987 | Provides the administrative framework for the licensing of Specified Processes. |
| Air Pollution Control (Specified Processes) (Removal of Exemption) Order 1993, 1994 and 1996 | Removes the exemption granted to the owner of premises for conduct of certain specified processes. |
| Air Pollution Control (Specified Processes) (Specification of Required Particulars and Information) Order 1993 and 1994 | Provides for the supply of information and specifications by owners of certain existing specified processes to the Air Pollution Control Authority. |

| | |
|---|---|
| Air Pollution Control (Vehicle Design Standards) (Emission) Regulations 1992 | Sets out the emission standards for vehicles. |
| Building (Demolition Works) Regulations (Cap.123) 1962 | Regulates building demolition, including prevention of nuisance. |
| Ozone Layer Protection Ordinance (Cap. 403) 1989 | Gives effect to Hong Kong's international obligations under the 1985 Vienna Convention, the 1987 Montreal Protocol and any amendments to control the manufacture, import and export of ozone depleting substances. |
| Ozone Layer Protection (Controlled Refrigerants) Regulation 1994 | Requires the conservation of controlled refrigerants used in large from all countries, scale installations and motor vehicles. |
| Ozone Layer Protection (Products Containing Scheduled Substances) (Import Banning) Regulation 1993 | Prohibits the import of portable fire extinguishers containing halons and other controlled products from a country or place not a party to the Montreal Protocol unless the Authority considers that it complies with the requirements of the Protocol. |
| Public Health and Municipal Services Ordinance (Cap. 132) 1960 | Makes provision for urban services and public health; including control of nuisance caused by emissions of fumes. |
| Road Traffic Ordinance (Cap.374) 1984 | Regulates road traffic, vehicles and users of roads and related matters; includes provisions to limit pollution from vehicles. |
| Road Traffic (Construction and Maintenance of Vehicles) Regulations 1984 | Specifies smoke levels for in-service vehicles. |
| Shipping and Port Control Ordinance (Cap. 313) 1978 | Regulates and controls ports, vessels and navigation, including control of smoke emissions. |
| Summary Offences Ordinance (Cap. 228) 1933 | Provides for the control on dropping dirt in a public place, for example from trucks onto a public road. |

(EPD, 2002a)

# Appendix D. Emission Sources

## *HKSAR*

| Sector | Sub-sector | The HKSAR Source Category |
|---|---|---|
| **Energy** | Power generation | Power generation |
| | Others | Other fuel combustion |
| **Industry** | | General production |
| | | Paint manufacturing |
| | | Printing |
| | | Service station refuelling |
| | | Textile manufacturing |
| **Transportation** | Motor Vehicle | Motorcycle |
| | | Taxi |
| | | Private Car |
| | | Pass. Van |
| | | Public light bus (PLB) |
| | | Light goods vehicle (LGV) |
| | | Heavy goods vehicle (HGV) |
| | | Non franchised Bus |
| | | Single-deck franchised Bus |
| | | Double-deck franchised Bus |
| | Marine | Marine vessels - Harbour area |
| | | Marine vessels - HSAR waters |
| | Others | Airport & aircraft |
| | | Diesel locomotives |
| **VOC Containing products** | | Domestic products |
| | | Paint |
| **Others** | | Animal waste ammonia |
| | | Dry cleaning |
| | | Fuel terminals |
| | | Human sweat & exhalation |
| | | Nitrogen fertilizer usage |
| | | Other services |
| | | Quarries |
| | | Transportable construction dust |
| | | Transportable paved road dust |
| | | Transportable unpaved road dust |
| | | Waste incineration |

## *PRD Economic Zone*

| Sector | Sub-sector | PRD Economic Zone Source Category |
|---|---|---|
| **Energy** | Power generation | Power generation |
| | Others | Other fuel combustion |
| | | Domestic coal consumption |
| | | Domestic LPG consumption |
| | | Domestic other fuel consumption |
| **Industry** | | Alcoholic beverage production |
| | | Chemicals/Rubber/Plastic |
| | | Construction |
| | | Electronic manufacture |
| | | Food and beverage |
| | | Gas, water & Sanitary works |
| | | Manufacture - Heavy |
| | | Manufacture - Light/Medium |
| | | Mining/Mineral Extraction |
| | | Non-metallic mineral products |
| | | Oil refinery |
| | | Petrol distribution & handling |
| | | Printing |
| | | Pulp and paper industries |
| | | Transportation |
| **Transportation** | Motor Vehicle | Motorcycle |
| | | Small petrol vehicle |
| | | Large petrol vehicle |
| | | Diesel goods vehicle |
| | Marine | Pots |
| | | Waters |
| | Others | Guangzhou airport |
| | | Shenzhen airport |
| | | Zuhai airport |
| | | Railway |
| **VOC Containing products** | | Domestic products |
| | | Paint |
| **Others** | | Agricultural waste burning |
| | | Agriculture |
| | | Ammonia production |
| | | Animal waste ammonia |
| | | Dry cleaning |
| | | Grain drying |
| | | Human sweat & exhalation |
| | | Human waste - Rural households |

| | | |
|---|---|---|
| | | Human waste - Urban without sanitary facilities |
| | | Industrial waste incineration |
| | | Nitrogen fertilizer usage |
| | | Nitrogen fertilizer production |
| | | Pesticide application |
| | | Transportable construction dust |
| | | Transportable paved road dust |
| (EPD, 2002, pp. 25-26). | | Transportable unpaved road dust |

# Appendix E. Pilot Air Monitoring Study Contact List

| PILOT AIR MONITORING STUDY CONTACT LIST - SCIENCE COMMITTEES | | |
|---|---|---|
| **NAME** | **POSITION, DEPARTMENT** | **COMPANY / INSTITUTION** |
| BERGIN, Mike | Assistant Professor, School of Civil and Environmental Engineering and School of Earth and Atmospheric Sciences | Georgia Institute of Technology |
| CHAMEIDES, Bill | Regents Professor and Smithgall Chair, School of Earth and Atmospheric Sciences | Georgia Institute of Technology |
| CHAN, Chak | Associate Professor, Department of Chemical Engineering | Hong Kong University of Science and Technology |
| CHANG, W.L. | Senior Scientific Officer | Hong Kong Observatory |
| CHEN, Gao | Senior Research Scientist, School of Earth and Atmospheric Sciences | Georgia Institute of Technology |
| HO, Kevin | Safety, Health & Environment Manager, Generation | CLP Power Hong Kong Limited |
| KIANG, C.S. | Professor, College of Environmental Science | Peking University |
| KENDALL, Gail | Managing Director | CLP Research Institute |
| LAU, Alexis K.H. | Associate Director, Centre for Coastal & Atmospheric Research | Hong Kong University of Science and Technology |
| LIU, Tao | | Guangzhou Environmental Monitoring Station |
| LI, Yok-Sheng | Chair Professor and Head, Department of Civil & Structural Engineering | The Hong Kong Polytechnic University |
| LI, Zisen | Deputy Chief Engineer | Guangdong Environmental Protection Bureau |
| LOUIE, Peter | Environmental Protection Officer | Hong Kong Environmental Protection Department |
| MEAGHER, James | Research Chemist | NOAA Aeronomy Laboratory R/AL |
| SALMON, Lynn | Research Engineer, Environmental Science & Engineering | California Institute of Technology |
| SLANINA, Sjaak | Senior Scientist - The Netherlands Energy Research Foundation and Professor - Department of Environment of Wageningen University | The Netherlands Energy Research Foundation and Department of Environment of Wageningen University |
| STEINER, Allison | Graduate Student, Earth & Atmospheric Sciences | Georgia Institute of Technology |
| STREETS, David | Senior Scientist | Argonne National Laboratory |
| TANG, Xiaoyan | Professor, Centre for Environmental Sciences | Peking University |
| WANG, Tao | Associate Professor, Department of Civil & Structural Engineering | The Hong Kong Polytechnic University |
| WILLIS, Gayle | Graduate Student, Environmental Engineering, Civil and Environmental Engineering | Georgia Institute of Technology |
| YU, Jianzhen | Assistant Professor, Chemistry Department | Hong Kong University of Science and Technology |

| | | |
|---|---|---|
| ZHENG, Mei | Research Scientist II, School of Earth and Atmospheric Sciences | Georgia Institute of Technology |
| ZHANG, Yuanhang | Professor and Director, Center for Environmental Sciences | Peking University |
| ZHU, Tong | Professor, Centre for Environmental Sciences | Peking University |
| **OTHER** | | |
| KONDO, Yutaka | Professor, Research Centre for Advanced Science and Technology | The University of Tokyo |
| MEAGHER, Jim | Research Chemist | NOAA Aeronomy Laboratory R/AL |
| WEBER, Rodney | | Georgia Institute of Technology |

| PILOT AIR MONITORING STUDY CONTACT LIST - MANAGEMENT COMMITTEE | | |
|---|---|---|
| **NAME** | **POSITION, DEPARTMENT** | **COMPANY / INSTITUTION** |
| EASTWOOD, Richard | General Manager - Generation | CLP Power Hong Kong Limited |
| KIANG, C.S. | Professor, College of Environmental Science | Peking University |
| LOH, Christine | Chief Executive Officer | Civic Exchange Ltd. |
| RYERKERK, Lori J. | General Manager & Director | Exxon-Mobil Energy Limited |
| UEBERGANG, Kylie | Finance & Research Associate | Civic Exchange Ltd. |
| LOUIE, Peter | Environmental Protection Officer | Hong Kong Environmental Protection Department |

# Appendix F. Framework for Capacity Building

# (Downs, 2001, pp. 536-537)

Component I: strengthen socio-political and financial support

1. Strengthen socio-political support
2. Strengthen financial support

Component II: strengthen human resources

1. Water and sanitation education in communities schools
2. Promote a sustainable water and sanitation culture
3. Train the local trainer
4. Education at university level
5. Professional training

Component III: strengthen information resources and decision making

1. Sampling, monitoring, data integration
2. Analysis by certified laboratories
3. Periodic sustainable diagnosis
4. Regional applied research network
5. Regional institutional network
6. Local water and sanitation user network
7. Multi-stakeholder forum

Component IV: strengthen regulations

1. Responsive regulatory framework
2. Regulatory compliance programmes

Component V: strengthen basic infrastructure for supply and sanitation

1. Aquifer recharge protection
2. Pollution prevention
3. Supply, treatment, reuse and holistic sanitation

Component VI: strengthen market for supply/sanitation products and services

1. Utility company efficiency
2. Water supply and sanitation tariffs and rights schemes
3. Water supply and sanitation service quality
4. Develop water supply and sanitation market
5. Stimulate sector investment

# Appendix G. Interview Questions

## *Scientific Template*

1. What is your role in this project? What do you see as the main value of this project?
2. How does the collaborative process contribute to it?
3. How does collaboration among the project participants contribute to the following:
   - Data gathering, sharing and analysis
   - Ensuring integrity and quality of the findings
   - Implementing and enforcing policies (made based on findings from scientific research)
4. What are the difficulties in engaging in cooperation? Identify specific aspects: political; economic; socio-cultural? What can be done to address these difficulties?
5. Is the current level of collaboration sufficient? Does it need to be strengthened? What are the driving forces behind collaborating?
6. What kind(s) of collaboration is(are) the most effective (e.g. face-to-face meetings, data sharing, one-on-one training, technology transfer, equipment donation etc.) ?

## *Advisory & Management Template*

1. What is your role in this project? What do you see as the main value of this project?
2. How does the collaborative process contribute to it?
3. What types of cooperation are currently in place for this project? How effective are they? Who is/are supporting the current collaborations? Is the support sufficient?
4. How does collaboration among the project participants contribute to the following:
   - Obtaining support from the public and private stakeholders for finding air pollution solutions
   - Facilitating discussions among stakeholders, and between stakeholders and government about their concerns and conflicts of interest, and incorporating them into the final recommendations
   - Bridging the political and social differences between Hong Kong and Mainland China
   - Implementing and enforcing policies (made based on findings from scientific research)
5. What are the difficulties in engaging in cooperation? Identify specific aspects: political; economic; socio-cultural? What can be done to address these difficulties?
6. What kind(s) of collaboration is(are) the most effective (e.g. face-to-face meetings, data sharing, one-on-one training, technology transfer, equipment donation etc.) ?

# Appendix H. Interview Transcripts

Summary of Interview with Bill Chameides and Mike Bergin
January 13, 2003
Exxon-Mobile conference room

Bill sees his role as analyzing data. Bill is the head of the Ozone project
Mike sees his role as gathering data. Mike is the head of the Particulate Matter project

- There have been many air quality studies done in Hong Kong and the Pearl River Delta Region before.
- One of the unique aspects of this study is asserting a slightly different paradigm or methodology that is based in a large part on making very accurate and careful measurements of the levels of pollution and contributors of that pollution in the atmosphere itself as opposed to having a larger dependence on what we call emission inventory which is a paper exercise of adding up all the emissions that are occurring in the city or region.
- A major aspect of this project contribution is reoccurring. We will be putting together a really unique and high quality data base on air pollution concentrations and distributions in HK and PRD and using that data to analyse specifically the quality of the air pollution in the region.
- Our roles are also slightly different in that Mike does among other things measures stuff in the field leading the project in making measurements.
- Collaboration makes the project possible
    - Quite often, government agencies, environmental groups, and the industrial and business communities used to be in opposition with each other and looked upon each other with a large distrust.
    - Recognition that solving environmental issues is a technical issue. Getting rid of industry and going back to pre-industrial times is obviously not going to work.
    - Need to work with industry and high technology in order to actually solve the problem and therefore the way to solve the problem is to get together and collaborate rather than fight with each other.
    - One of the important aspects of these collaborations is not only collaboration between governments of nations but also between sectors.
        - Significant amount of funding is coming from business private sector, they are involved in a real way and making decisions about directions the research is taking.
        - Regulatory agencies are also involved, like HKEPD and university committee, so you see a very important collaboration between the various stakeholders within the environmental issue itself.
        - What will potentially contribute to the success of this program is that we are all in it together we are all working on it together and we are all invested in making it work and buy into it.
    - It is important that people not look for someone to blame but to find a solution to the problem.
    - Data sharing allowed for more accurate and pertinent data that helped with decision making.
    - Science acts as a bridge between social and political differences.
    - The acceptance of the repeatability of science requires the sharing of data and techniques.

    - Data sharing is fundamental to agreement of methods to find and solve a problem which leads to the rest of the collaboration and cooperation.
- Growing recognition that the environment is a resource and is something of economic value that the industrial organization should be concerned about.
- It is important for people to accept the results of the study. Should not be any concern about accuracy of the findings.
- Potential problems include:
    - Language barriers
    - Red tape and documentation; bureaucracy is an irritation for science which just wants to address the scientific questions.
    - Regulatory people and scientific people have different points of view and different objectives.
- Potential areas of improvement:
    - Scientists need to realise and address regulatory aspects.
    - Need more scholars and scientist who understand Chinese language and culture.

Need critical analysis and communication of data to make sure everybody is doing it in a universally accepted way

INTERVIEW NOTES
Interviewees: C.S. Kiang, Sjaak Slanina
Date: 12 January 2003
Location: YMCA Hotel Lobby

C.S. Kiang: First I would like to note how much I dislike the term capacity building. The reason for this is capacity building infers one party helping another. Both sides need to be involved in the project. Hong Kong isn't better than Guangdong and Guangdong isn't better than Hong Kong. The word I would like to use is communication. If we continue to use the word capacity building, nothing will get better. You need to find the common denominator and respect that for both sides.

WPI: What are your roles in this project?
CS:
- Started project

SS:
- Managing

WPI: What do you see as the main value of this project?
CS:
- Any policy must have science basis
- Local and international people are working on this project
    - Based on knowledge and experience of people
- This is a pilot study which has never been done before.
- It's important to work together.
    - Don't know how
- Industry, government, etc.
- Government never interacted with locals, always hired consultants

SS:
- Capacity in China is not where it should be at.
- Project will set a science foundation.
- Problem was thought to be only local, but didn't realize this was a regional problem.
- Awareness of fact that a lot of money could be invested locally and have little or no effect overall.

WPI: How does the collaborative process contribute to it?
CS:
- HKEPD does everything by the book.
- Three different parties have their own way of doing nothings.
    - Need to have a common root.
- Mainland thinks they have a better empirical understanding. Hong Kong believes that Mainland should follow EPA advisory by the book, MC doesn't under why thinking EPA is wrong. Therefore HK thinks MC is substandard.
- Scientifically speaking, must support Peter Louie of Hong Kong. However collaborative compromise must occur to get the job done.

SS:
- Need to have collaboration in all aspects. If there is no collaboration, there will be huge damage.

CS:
- Not enough time and resources.
- If the principal is right, can you execute it?

- There is no absolute right and wrong.

SS:

- There are scientific principles to meet credibility.
- We have reached it, but not in a straightforward way.

CS:

- Making mistakes is ok.
- Humanity and science must have balance.
- There is no absolute science principal.

WPI: What types of collaboration are currently in place for this project? How effective are they? Who is/are supporting the current collaborations? Is the support sufficient?

CS:

- We want different views.
- Consensus building / Team building
- Need to have an open mind

SS:

- Agreed.
- Americans have American solution.

WPI: How does collaboration among the project participants contribute to the following:

- Obtaining support from the public and private stakeholders for finding air pollution solutions
- Facilitating discussions among stakeholders, and between stakeholders and government about their concerns and conflicts of interest, and incorporating them into the final recommendations
- Bridging the political and social differences between Hong Kong and Mainland China
- Implementing and enforcing policies (made based on findings from scientific research)

CS:

- We have facilitating support, from management, science, and accounting.
- Both sides incorporated into each support.
- It has to come back to communication.
- It is too early to talk about implementation and enforcement.
- We have international experts.. This makes a more believable alliance, increases acceptability. Easier to be recommended; issues are already addressed in creation.

WPI: What are the difficulties in engaging in cooperation? Identify specific aspects: political; economic; socio-cultural? What can be done to address these difficulties?

CS:

- We have a standard which must be acceptable together. Even if there is a mistake, it is mistake made together.
- There must be a methodology to the process. It needs to be established.
- Collaboration needs management.
    - System development is more difficult (?)
- Value of China is economic development. In the US it is quality of life. Once economy is satisfied the demand for environment becomes a higher priority.
- Integration development is important – common standard, more involvement. Contracting was disastrous.
- Methodology and process is more important than results.

SS:

- American and European problems do not work because of different (climate, geography, etc. etc.)
- Should be based on data from region.
- This is leading to equal economic problems and environmental problems.

WPI: What kind(s) of collaboration is(are) the most effective (e.g. face-to-face meetings, data sharing, one-on-one training, technology transfer, equipment donation etc.) ?

CS:

- "Technology transfer" is a bad term.
- Must modify equipment to region.
- Mindset and management is most effective.
- Equipment donation is not a problem.

SS:

- Equipment is not hard to make, it's how to use it? How to implement it?
- Region needs to find their own need to use equipment.

Final words:

CS:

- Numerical modeling is better in China
- Mindset must be changed from the view that Hong Kong is helping Mainland when in fact, they are really helping each other. If it doesn't change, they will be 5-10 years behind. In some ways, China are better than Hong Kong and in others, Hong Kong is better than China. Interaction is different, no one is better than the other – they are like a family.

SS:

- This was done by American firms. Would have been adequate 10 years ago.

CS:

- Respect the differences.
- Realize the common denominator. → Communication

SS:

- It's important to make the right choices.
    - Loss of money.
    - Loss of faith.
    - Loss of credibility.

Transcript of Interview with Prof. Yuan Hang Zhang & Prof. Tao Liu
Date: Jan. 13, 2003
Location: St. George's Building, Hong Kong
Transcribed, translated and edited from audiotape by Andy Li

Interviewer: Andy Li, Ryan Lee
Interviewee: Prof. Yuan Hang Zhang, Prof. Tao Liu

Abbreviations: Andy Li – AL, Ryan Lee – RL, Prof. Zhang – YZ, Prof. Liu – TL

AL: Can you tell us what your role is in the (pilot) project?
YZ: I am in charge of PM 2.5 sampling and the study in the Pearl River Delta part. We have a team to take care of performance of PM 2.5 sampling, and also the maintenance of the four (sampling) stations (in Guangdong). We help the (pilot) project team to do the audit, and also QA/QC. Mr. Liu is in charge of PM2.5 sampling in Guangzhou urban area and also Conghua site.
AL: What do you see is the main value of this project?
YZ: We see that the PM pollution is (a little bit more) serious than other pollution, like carbon dioxide, $NO_x$, and CO. Although we did some measurement in year 2000 in PRD, but because of many reasons the data (are) still questionable and the chemical analysis (were) mostly focused on the common components like irons elements (OCEC), although we did have detailed chemical species of particulates. And also because of limitations of funding and also the equipment, our purpose of measurement are mostly located in the southern part of PRD like Shenzhen, (Xin Tian), Guangzhou, (Hua Du). We didn't have a good database to (understand) the air pollution data (of) PRD especially background's situation. So this project … Guangzhou is the pilot project, project has four stations in PRD are well (distributed). We have a background station in Conghua, urban station in Guangzhou, and also we (inaudible) influence between PRD and Hong Kong, then we have a station in Shenzhen opposite of Yuan Long , so we can see (somehow, some cases) can see the (transport/emit phenomenon). We also have a station in Zhongshan. So after this project maybe we will have some idea what is (contributing) to Pm2.5 pollution in PRD and also HK. And also give (us) idea what is (the) chemical characteristics of PM (in) HK and also PRD. From the first (month's) measurements we (have) already found out (the) chemical characteristics in HK and the PRD (are) somehow different and also not (inaudible).
AL: How do you think the cooperation of the people in Guangdong, Hong Kong and Georgia Tech are going? How well do you think it (cooperation) is?
YZ: So far so good. Because (the) project is well coordinated by Georgia Tech, Hong Kong and also Peking University and as well as Guangdong (local) supporting institutes like Guangzhou Environmental monitoring station and Conghua and also Zhongshan, and Shenzhen. Because in Shenzhen, the site is located in Peking University Shenzhen campus so there's no problem for cooperation. And the project's team especially (Georgia Tech) made great efforts try to make everything in detail. From the calibration of equipment, QA/QC audits, training, that took care of everything. The local people (are) very pleased to cooperate with this project and did a lot of work to help the project run (the stations) well. You can say that from first month's operation (we were) only missing one data, in Zhongshan, that (was) a misunderstanding of date, not a real big problem. So in general the project worked quiet well and coordinated quiet well.
AL: You have anything to add Mr. Liu?
YZ: Repeated question to Prof. Liu in Chinese.
TL (Translated from Chinese): There wasn't any problems, like you (Prof. Zhang) already said.
AL: How do you think collaboration with other people from other areas will help you to get better data and better quality (of data) and on QA/QC issues?
YZ: For Guangdong sites or Peking University sites, we somehow you can see from the (pilot) project (that) we are involved in the project very actively. Although we only have very small part of task, that means we help, we are in charge of sampling data importation in the final stage of the project. But this

project is very important for us because (it is a) very important pilot project (in) PRD with a very good international team. So that makes things for us, although we didn't have a very big task in the project. From this project we can learn some experiences for international collaboration, QA/QC, and also the scientific study. So that makes things very important to lay down a good basis for us to have further, deep scientific research in PRD.
AL: When you are collaborating with other people, did you come across any difficulties or any disagreements that you think really affected the way how you can cooperate/work better together?
YZ: Not yet. Because the project (has) just started for 3 months, and the data just came out and the data need to be analyzed in detail. Given this is a science meeting the people only gives a very brief, preliminary results. So at this stage no difficulty in collaboration. We'll see in further stage.
AL: How about you Mr. Liu?
TL (Translated from Chinese): Not yet so far. We been working together for a while, in terms of collaboration all is well.
AL: Do you anticipate to come across any problems that will affect cooperation?
YZ: I am not sure. There is something that might be a problem (in the) data. Because in Hong Kong and PRD has different policies for data distribution, and somehow it is also difficult for us to get data from local environmental monitoring stations. And even if we get to the data, there is also the release and maintenance problems of data research. I am not sure, I have to check that. But the data (are) somehow limited for some research and not for the international community, scientists community. In this morning people said that it was quiet hard distribute data. In our project, especially in Guangdong, we are only in charge of PM 2.5 sampling, we did not have responsibility to collect data for other pollutants. That could be a problem for our project because nobody (inaudible).
AL: So obviously we can see that there are some disagreements on how to interpret the data.
YZ: Well that's a scientific question. Scientists always have different opinions. In this project there are different views, and of course there's a very normal thing. People can argue, and every scientist should have solid scientific concept or attitude to do (things). This is not a problem for scientists.
AL: So how would you compromise those differences and come to a mutual conclusion?
YZ: Well depends. Everyone has individual expertise and somehow you have to compromise. If people have very strong evidence to persuade, or to accept those scientific finds.
AL: So you are saying that we should all get together in a meeting like this and talk about it, everyone express their opinions and try to work out an agreement?
YZ: Sure.
AL: So the way to compromise is by communicating and trusting each other?
YZ: I think so. Because if the majority of people have get to one conclusion and there is very strong supporting evidence, either (from) modeling or data, then other ones have to accept. Otherwise you want to (be) against, you have to get more strong supporting data to convince other people. But of course even the science meeting gets a conclusion, scientist always can keep your own opinion then we can continue to study to demonstrate our ideas.
AL: What type of collaboration do you find most effective?
YZ: Of course meeting is very important. For me the most important way to cooperate is to work together. Not just data sharing or training, but work together. That's a very effective way, but for some people who need training then most people think training is the most effective way. But for me, work together.
TL: Face to face meeting is important.
YZ: I mean by work together includes everything. Meeting, join measurements, joint data importation, everything. But the most important is work together.

Transcript of Interview with Dr. Peter Louie
Date: 2:00 PM, Jan. 28, 2003
Location: 33 Fl. Revenue Tower, Wanchai, Hong Kong
Transcribed and edited from audiotape by Andy Li

Interviewer: Andy Li, Ryan Lee, David Onne
Interviewee: Peter Louie, HKEPD

Abbreviations: Andy Li, Ryan Lee , David Onne – CE3, Dr. Peter Louie – PL

CE3: What is your role in this pilot study? What do you see as the main value for this project?
PL: I serve as a member for both the science team and management team for Christine's project (the pilot study). I think this is extremely important, I see this (pilot study) as a vehicle for involving all the stakeholders, the government, and the counterparts in Guangdong as well. I must have to say that it would be strange and foolish for me to suggest to you that any single project will solve all the problems (of air pollution) (because) it's not (the case). I think we should do it as a step-wise process. Meaning that, resources are always limited, so we always have to be very careful about the objective and what you needed to allow us to take, to feel the direction. Because if we spend a lot of money or too much money on something that in fact is not a problem, that would be wasteful project. I think this kind of step-wise approach is extremely relevant. And also I think this is a tremendous opportunity for the participation of reputable universities like Georgia Tech, and the union of that we have our people in both the quality assurance and sampling team for Hong Kong to be involved, and also the sampling team over in Guangdong to be involved. You probably know that the sampling work in Hong Kong is conducted by our team. How we have that operate is that we don't do it ourselves. We have standard operating procedures and we employ outside contractors to perform the sampling work, but they adhere to the same set of procedure as other people and as our counterpart operates in Guangdong site.
CE3: Is that quality standard unique to Hong Kong or is that adopted from somewhere else in the world?
PL: It's not actually unique to Hong Kong. In fact we modified it, or adopted it from the US EPA guideline, the PM2.5 sampling guideline. Also we have the help from Desert Research Institute (DRI) before on similar project only involving Hong Kong on PM2.5. Professor John Watson and Professor Judith Chow also serving on the technical advise team also helping us along for resolving all the technical and quality issues.
CE3: How does the collaborative process contribute to (the pilot study)? What is you opinion on the current progress of collaboration?
PL: I think the collaborative process is function well. Let me put it like this, this is a very interesting team, and a very progressive team. Here we have Georgia Tech as the cutting edge university doing the research work. An as government we are always more conservative and we take a more careful look at the quality process. The reason being that research is something that we don't do much, but then when we list figures of information, we jealously guard the quality of those information we give out. So we make sure everything is correct and everything is up to the prescribed quality standards. For example, when we say we adhere to the USEPA standards for our standard operating procedures for PM2.5 sampling, we mean it. Because not only do we have it written down and follow it, we have an independent audit team looking over our shoulders and make sure everything is done right. How it is done is by ways of performance audit and system audit. As for (my) opinion of the current progress of collaboration, it is working well. Because we have people looking at the cutting-edge research side, also we look at the quality issue side. As you know, Professor Sjaak Slanina also looked from his auditor perspective and make sure everything is done right. This is extremely important and this is progressing well.
CE3: What types of cooperation are currently in place for this project?
PL: Well as I have said before, (for) the sampling team, we provided the sampling team for the project for the three sites in Hong Kong. Mainly the Tap Mun site, the Tung Chung site, and the central and western site. The sampling is done by us. Our quality assurance team also make sure everything is done right in

terms of flow, performance audit, system audit, and we teamed up also with Prof. Slanina to make sure we have audit everything and adhere to the operating procedures.
CE3: Can you elaborate on which party is responsible for what aspect of collaboration?
PL: Georgia Tech is responsible for the sample analysis. I understand that they also team up with people from Caltech to do the analysis and filter weighing. For our part we do the sampling for the three sites I mentioned. We also have the audit team to make sure our contractors are doing the right things for their sampling works. Also we provided the sites for the project so that other complimentary gaseous monitoring and other meteorological factors will be available. Also we provided some addition VOC data to supplement the project. For example, as you know this (pilot study) project has two parts, one part is the observational based modelling, Prof. Chameides and Prof. Tao Wang are doing; the second part is for the PM2.5 monitoring, and we provided the VOC data to supplement the observational based modelling part. Because we feel that just using one site at Tai O to gauge the whole of PRD for observational based modelling work will be a little bit risky so we provided additional data. Namely the Tap Mun site will provide VOC data, the Tung Chung site will provide additional VOC data and also on the Central and Western site. So that will supplement the observational based modelling. Also we are currently trying to provide additional filter-based measurements filters to the project. That would again enhance the understanding of the nature and cause for high particulate levels in Hong Kong.
CE3: How about the people from Guangdong and Peking University, what is their contribution?
PL: They worked like a dream. Over there, Peking University as their sampling team worked out with the Guangdong monitoring stations and they have Mr. Li, is responsible for the quality (control) and the sampling work over in the PRD sites. They have four sites over there, Zhongshan, Guangzhou, Conghua, and Shenzhen. They are responsible for the sampling works over there. It works out very well, because there are seven sites and Peking University is taking of all the sampling work over there in the PRD site. I have to mention this, otherwise we miss out a major role. Civic Exchange is doing the overall project management for the pilot study. They are doing a find job, putting together a fine team and taking care of all the sampling and analysis things. I think some results are emerging and I'm looking forward for more importation for better understanding of the situation. Is the support sufficient? I say it's fine, it is okay for now.
CE3: How does the collaboration among the project participants contribute to:
Obtaining support from public and private sectors for fining solutions for air pollution?
PL: I say Christine (Loh) is doing a fine job in terms of securing the funds for the project. Also I think they got the China Light and Power people involved. Exxon-Mobile I think is a major stakeholder for China Light and Power. They also got the (Hong Kong) Jockey Club involved funding the project, and it's good. The union of those parties is powerful. I think it's appropriate because in a lot of those studies, if you just study along, it doesn't help much. But if you have different stakeholders involved, they have their opinions expressed and together we have a better chance to solving the problem.
Facilitating discussions among stakeholders about their concerns and conflicts of interest incorporating into the final recommendation?
PL: I think it's going on fine. Because many of the meetings the CLP people were involved. Also as you can see in the last science meeting, a whole roomful of people. Their opinions are heard and I think this is the beginning of good collaboration. I don't see any problem with communication with all the stakeholders and team members. As you can see, Prof. Slanina is a very good professor in terms very strict and direct about, well if the document is not well, not right, he'd say it and he make sure things are done right.
Bridging the political and social differences between Hong Kong and China?
PL: I think there will be always some different aspects of their characteristic. They have their local politics and their local concerns about different things. I think through these kind of projects we will certainly have a better understanding of each other, what are their concerns, what are their issues governing the high pollutant concentrations. There are many people that have said this before: knowing the problem is half way through solving the problem. I think right now we do have a good set of data, given more time we should have a better chance figuring out the sources and also the factors for

controlling the particulate concentrations and also the high ozone situation. The particulate part we do have some kind of handle on t, but I think if we have this kind of regional data we will have a better feel of the situation. If it is a regional problem it needs a regional solution, there's no doubt about it. I think over time, this kind of understanding and consistent data set will help us to better understand what are the factors governing all these pollution issues.
Implementing and enforcing regulations?
PL: This may be a little bit early, but I think this is a first step, a very important step. Because it would take time to digest the information and inform policy makers of what is going on. We have to be very careful about what are the scientific basis and make sure everything is right.
CE3: Do you think by having local participants from Hong Kong and Guangdong involved in the pilot study will make it easier for policy makers to accept the recommendations?
PL: Absolutely. Based on the projects before, that was exactly the kind of mentality and framework we are working on. Put it this way, if we involve them in the beginning, the whole process is transparent, and I think they are more receptive to the ideas of looking at the data as a tool to improve quality. We shouldn't loose sight on this, because whatever we do, we have one common goal, that goal is to have cleaner environment. Maybe the approached are different, as long as we have a common goal I think the future is bright. I am optimistic about the outlook in terms of solving the problem.
CE3: What are the difficulties in engaging in cooperation? Is it political? Economical? Socio-cultural? What can be done to address them?
PL: Not so much in engaging our counterparts to cooperate. I think this is a very subtle point in terms of getting the right people to work on it. So far I don't see much difficulties. There are certain understandings, this is very different from the U.S. or European cultures, that they want to get to know each other first before they start doing something. I think we don't have that barrier anymore. The understanding that we share one common air shed, and pollutant respect no boundary, be it political or geographical. We have to work together. I think probably some of the difficulties will be having consistent sampling equipment and understanding of what we should do. For example in ozone monitoring, I think despite the fact that we need more ozone data, the reality is that it is a very expensive monitoring set-up and finding the proper site. This is very important, if we keep putting our ozone-monitoring site in an urban environment, you won't detect the problem. Those are the things we need to iron out in future in getting hold of more supplementary gaseous monitoring information to supplement our understanding. As I elaborated, I don't see much political difficulties. Still right now we need to be very careful about the sensitivity of not to portray something which "we know a lot, we don't know" much kind of thing. We work as a team, because of the air pollutant don't really knows what the boundary is, we have to come together, work together, and solve the problem together. I think because we have upfront our common goal stated there is little difficulties in the beginning. As we progress we don't know, for now it is very straight forward.
CE3: What is capacity building? In you opinion, is the pilot study a case of capacity building or collaboration?
PL: I noticed this term capacity building has been discussed a little bit at the science meeting. From my perspective, I don't see it as a negative term. We are open for new suggestions and new ideas to solve our problems. If someone comes along and points us to a direction or look at something obvious we have not looked at before, why not? I can certainly agree with the philosophy, whoever is coming to do project or teaming up with the local teams, they have to be careful about the sensitivity.
CE3: What kind of collaboration is the most effective?
I think all collaborations has to be long term. If you going to do it, do it right. We can't just have someone just move in and be in a 12 month project, a 24 month project, and they are gone. They write up papers and their job is done. That is something I don't want, I think it's a longer term collaboration. We should have a longer term view, long term and sustainable.
CE3: Do you see the role of the participants from U.S. and Europe is trying to provide the expertise, or trying to build the scientific capacity in HK and Guangdong?

PL: They are part of it. I don't want to give you the picture that we have not done anything. In fact prior to this project, we have a 12-month PM2.5 project, it was very extensive, and was conducted in HK. With the involvement of Georgia Tech and the research from Europe, it is a complimentary process, it enhances the capacity. It's not like any team just walk in and single-handedly solve all the problems. It's a process, and that process has to be refined and taking into the situation and adapted to the changing environment. With the involvement of Georgia tech team we learned a lot and we certainly appreciate the opportunity.

Transcript of Interview with Prof. Tao Wang
Date: Jan. 23, 2003
Location: Rm. TU702, Hong Kong Polytechnic University, Hong Kong
Transcribed and edited from audiotape by Andy Li

Interviewer: Andy Li, Ryan Lee, David Onne
Interviewee: Prof. Tao Wang

Abbreviations: Andy Li, Ryan Lee , David Onne – CE3, Prof. Wang – TW

CE3: Can you tell me your role in the (pilot) project?
TW: This project has two parts, one is about ozone and the other about particulate matter. Our role is sampling of part one of the project, which is focusing on ozone pollution. We are responsible for taking measurements at the Tai O station, at the western part of Lantau Island. The data will be provided to the science team for analysis and modeling of ozone chemistry, the results can be used to provide control options. Basically our role is to take a set of high quality measurements at the station and validate the data and finalize data to provide the data set for the entire science team.
CE3: What do you see is the main value of your part of the project?
TW: Our part is the crucial part of the ozone part of the project. Without the data, all the follow-up analysis won't be based ambient data, the data we have collected. Without data you cannot analyze, you have no data to analyze. So it is importance is very obvious. Also we are going to use this model called observation-based model, meaning that this model has to use observations, so without observations (the project) will not have a model.
CE3: How does your role in the ozone project contribute to the overall collaboration in the pilot study?
TW: The ozone part (of the pilot project) is in fact a collaborative effort between (Hong Kong) Poly U. and Georgia Tech. You (CE3) have meet Professor Chameides the other day, him and I are co-investigators of the ozone part (of the pilot project). I am mainly responsible for the measurement part (of the ozone project). For the experimental part, and the data analysis part, the modeling, will be carried out by (Professor) Bill Chameides. So our role is quiet clear. We are (both) responsible for the experiment.
CE3: How well do you think this collaboration (of the pilot project) is going in terms of carrying out the (pilot) project and its overall success?
TW: So far actually the work is mainly carried out by our own group because we are responsible for the measurements of the pollutants for the (pilot project) study. Later on the real collaboration, or more collaboration is afterwards involving the data analysis part. We provided data to the science team, and we also provided some local knowledge (to) help to work with foreign scientists to interpret data. So we will have a much closer collaboration after collection of data. The data (collection) part is mainly carried out by our own team. The data gathering and data analysis, and also the integrity of the findings, these parts I would rate as very important for our collaboration among scientists in the ozone project. We know a lot more about the local situation. There are (people who are involved in the collaboration) who have broad knowledge, especially from studies in the U.S. This is very nice for our cooperation.
CE3: So you are combining the information you have gathered with their expertise in trying to find solutions?
TW: Yes. We are trying to apply that knowledge to (the) local situation.
CE3: We noticed at the meeting that there were a lot of discussions from different sides and different points of view, what do you think are the difficulties in engaging in cooperation?
TW: So far, as I have said, our part of the work has been primarily done by our own group. All these work we've presented from the Tai O station had been carried out by our own group. So we have not really (done our work with) much outside involvement for that part. So far I would think that based on the science (team) meeting that collaboration is in general not an easy thing. Cooperation can be quiet easy to have different politics. Overall I think people getting together to try to do things, to agree to do things

according to the agenda, then that would already be a success. So it'll be more interesting to work on data together and to analyze. I see so far the cooperation has done pretty well. We have met twice, we exchanged data and we also were working with the Georgia Tech people.
CE3: So far you said that everything is going well, do you think the collaboration is good enough? Do you think you should have been working more (closely) with Georgia tech people?
TW: So far for this particular work I think, as I have said, the Tai O operations were our responsibility and we did a good job. I think the plan was that we were solely responsible for the Tai O operations during the measurement (phase). Perhaps it would be nice to have other people taking additional measurements, the more data we have the better. (inaudible).
CE3: In the first (science team) meeting they just went over what you have to do for the protocol and you just followed?
TW: Yea we pretty much have a plan (of what we are going to do). (inaudible). We did even better than planned. We wanted to do more sampling during episode days, but episode days are difficult to forecast. I think overall it is quiet well that we have taken many samples and (recorded) all these high (ozone) events. So the data was quiet rich.
CE3: Why do you think there is a need for many people to collaborate on this kind of project?
TW: The air pollution issue (is) a regional pollution issue. The process of science (study of pollution) is very complex. No single group (has) enough expertise or resources to address the issue and related issues of air pollution. We have chemistry, physical transport, and we need someone to make measurements, someone to monitor. Normally one group or one person can only do a subset of these overall tasks. So it's very important and has to be the case in many instances. To address these kinds of issues all the groups have to get together to do things. This (pilot study) is one example, probably one of the first few examples here (in Hong Kong).
CE3: Is there any parts of the plan (for collaboration) that you wish were different or could have been improved upon?
TW: So far, I think overall we have done quiet well for our part. The planning I think is one of the most successful collaboration we have. Also (inaudible due to excessive background noise). The ozone part I think the experimental work has gone very well. Again as I have said before, the more data we have the information is more complete.
(inaudible).
CE3: Is there any type of collaboration which is more effective than the others?
TW: Well the list here are essentially different steps of collaboration. Right now face-to-face meeting is definitely a very effective way for discussion. Emails are also important to provide background information and laying out final (preparation) for face-to-face meetings, which is most important as we get closer to the final stage. Training, transfer of technology, and equipment donation, these are also important mainly for helping out with the observation, and those with lack of equipment or lack of personnel. So I think all of these aspects, including data sharing are important. (Data sharing) is actually one of the important (reason) that we are collaborating. If we can't collect data, if we don't share (data) then there is no collaboration. Collaboration is not people coming together, collect data, and take the data away. Collaboration is we contribute and share the data that we collected. Data sharing is probably one of the most important aspect of collaboration as far as I'm concerned. Collaborators would like to share information among partners.
CE3: You have talked about the different levels of collaboration like technology transfer and equipment donation. Do you think that's the case in this collaboration where everyone are on the same level?
TW: Well it's not on the same level in many cases. It is quiet obvious that a group from a more advanced country, the U.S., is collaborating with other developing country. Normally developing countries lack the resources, especially expensive equipment manufactured in the west. And also they lack the human expertise to operate (the equipment) and do the data analysis. That is generally the case, although not necessarily has to be the case but is most likely the case. In that situation (the developing country) may need help from (foreign) scientists to get training or the access to better technology and better ways to look at the data.

CE3: Do you say in this pilot project, one side is trying to help to build the capacity of another side or is this more of a mutual collaboration?
TW: I think this is more of a mutual collaboration. Mutual collaboration in a sense that our measurement (techniques) are comparable to U.S. standards. Also we look at data carefully and publish paper on mainstream journals. In that respect, our work is, not necessarily the best, but is definitely of international standard. By working together, since the issue (of air pollution) is very complex, so it's helpful to have outside expertise, and working with scientists, people who look at the problem from different aspects and try to find the best explanation and best solution. I think we definite will have more knowledge of the situation. The overseas collaborators have extensive knowledge in the United States, and also they have research funding there. In general we have broader experience (by collaboration with outside scientists), which is very nice.
CE3: Based on our information, this pilot project is funded mostly through private money. How do you think it is important to have private sector to take the initiative to support this kind of research? Why do you think they are interested in supporting this research?
TW: I think it's very important to have private support. Because we are looking at the issue that is of concern to the whole society. It is a community-wide air pollution, everyone contributed to air pollution, everyone is hurt by the air pollution. So it should be the concern of the entire society. In that sense, not only government, but also industry, have an obligation to contribute to the understanding and improvement of the problem. Every stakeholder has to share that responsibility, industry is obviously contributing more to the pollution in general, but they also should contribute more to the wellbeing of the future. In terms of industry sponsored research, it is quiet common in the United States. We have air pollution studies (in the US) that were funded by chemical industries, the auto industries, power plants. I think they should fund the study not only because they contribute (to pollution), also they probably want to know whether and how their industry contribute to air pollution and how to improve their process to try to reduce their contribution. They (the private industry) should be interested (in the pilot study) if out research can deliver.

Notes from Interview with Jian Yu:
28 Jan 2003
HKUST

What is your role in this pilot study?

- Provide assistance to Georgia Tech in terms of setting up samplers in HK and GD province
- Group will try to help sample collection and sample transportation once the sampling starts
- After the components of the project are completed group will analyze data collected look at data and try to understand overall picture of project

What do you see as the main value for this project?

- Main value of this project is to understand collect the samples outside Hong Kong
- Project enables them to look at AP not only in HK but also in GD
- Since in the past for various reasons it is very difficult to get air quality information from GD part, no opportunity to allow them to take samples in both regions
- Human resources and financial resources prevented data collection and sharing of the regions.

How does the collaborative process contribute to the study?

- Collaboration is crucial to this project; all the sides are needed.
- Too early to talk about data sharing and analysis.
- Everybody contributes to the data gathering, everyone is responsible for a part of this project.
- Data gathering would be disrupted without the cooperation of everyone involved.
- Collaboration sets a standard for QA/QC.

How does collaboration among the participants contribute to the project?

- Different participants always communicate with each other trying to solve different kinds of problems.
- Not many difficulties so far. Many operators in GD don't speak English.
- When it's not possible to contact operators directly she has stepped in multiple times to help translate.
- They are interacting with each other.
- Collaboration is very good from all sides, she is happy about how it goes.

In terms of data gathering, sharing and analysis?

- Face to Face meeting is useful in trying to understand the data.
- Email is effective and efficient for data sharing.
- One on One training is necessary in the beginning when first set up sampling network.
- Georgia tech some technologies we don't know and we learned from collaboration effort, but I also think that they are not only giving and we are receiving we are also giving our expertise especially to the later part of the project.
- Equipment donation is always nice to get some free equipment.

Why was this study so successful?

- Every participant was very much interested in the project in solving the problem. The attitude is why it is so successful. Everybody thinks it's a worthwhile project. People put in personal resources, professors use graduate students. Everybody is helpful because they are trying their best to contribute and make the collaboration easy. This is a good example for future projects.

Notes from interview with Lori Ryerkerk:
ExxonMobil Building 14/f
11 Feb 2003

- What is your role in the project?

Chairman of CAPCO, joint venture between ExxonMobil and CLP, role is sponsor of the project, pay for it. Serves on management committee for study. See the results and make sure the money is spent appropriately.

- What do you see as the main value of this project?

To me the main value of this project is to try to put the science into play. I don't know how much you know about ExxonMobil but our position strongly revolves on ownership of the report is that public policy should be based on sound science, not just on the whims of environmental groups or institutional groups who may have their whole heart in it but may not be basing it on science. To me the value of the pilot study although it won't show us everything, is that it will give us some sign to decide what the right thing to do is in Hong Kong, you only have to look out the window to see in Hong Kong there's a pollution problem. We're no way saying there's no problem, we know there's a problem, but as a company we're concerned that we don't know enough about where the problem is coming from and the best way to address the problem. We think as a society we want to find out what is the problem, what is most confident(?) way to address the problem and then everybody put their resources towards that versus everybody trying to put it on somebody else. We're fully prepared if we may be the problem as far as Hong Kong, 'Ok that's us,' we're happy to step up and do our part. But we don't want everybody to … very complex air shed, we're not sure what the problem is. And from a science standpoint the worst thing we can do, for several billion US$ is clean up these power plants here and then have the air look just like it does today because the consumers of Hong Kong are going to have paid a lot of money for nothing. So we would rather see the money … if it's us, it's us, we'll take it, but if it's not us then we want to help find out where…

- How does the collaborative process in general contribute to the pilot study?

Industry on it's own doesn't have in general the expertise, scientific knowledge or public credibility to do this kind of study on our own. I mean yes, I think we could hire people to do this study on our own, but the point is if ExxonMobil releases the results and say that they are somewhat favorable to us then people would say 'oh, well you've skewed the data.' But by collaborating with well known experts in the field, who are doing it on a purely scientific basis, yes we are funding it, but we have no hand in what the results are, I mean they're doing the study. Then whatever the data is, that's what the data is, and it will have credibility with the government it will have credibility with the public from their standpoint it would be very hard to believe … the private sector because the government wasn't ready to pitch in enough money to do a fully academic (study).
Then there are people like Civic Exchange help bring a public perspective. They can help make sure other point of views are represented as well. This project isn't a public policy study, it's a little different in that it's a truly scientific study, eventually, hopefully that is will have some influence eventually on public health.

- How do you think the different participants from HK, MC, US are working together?

On appearances they are working together quite well. Professor Kiang clearly has the credibility within Guangdong to get things done that would be very hard for US scientists to get done on their own. Whereas the US scientists have access to a lot more technology, computing resources to help the scientific people along. In this case, the collaboration process within the scientific community is absolutely necessary, for the scientists to have access to the locations they want and areas they want particularly in Guangdong and on the other hand the Chinese scientists need the support from the American side.

- What types of cooperation are going on right now? How are they meeting, how are they working together?

I know they had several rounds of sampling, I know the science committee is dialoging frequently via email and meeting in person…

- How are discussions among stakeholders facilitated? How do you show your concerns?

We have two representatives who sit on science committee and two who sit on the management committee. So our opportunity to have input is for example when Gail [Kendall] sat down with the science committee and they go into great detail into their results and methodology about what they've done and all the scientific comments on each other, kind of like a peer review process. That's an opportunity for Gail or Kevin to say 'gee I'm concerned about how you did that' or 'this doesn't make any sense.' I know for a fact that at the very beginning of the project Dr. Kendall had a lot of concerns about the lack of criteria being used for selection of sampling sites, and had a lot of say in terms of saying 'look put these site anywhere you want, but make sure you pick a criteria so that they make sense and at the end the results are meaningful.'

On the management committee side we kind of get science light, we get a presentation of here we are on the science, and here we are on the budget. And we get a chance to voice our concerns and ask questions. We're not focusing on the results, we just make sure everybody's happy with quality control. Are you comfortable that your department will accept these results are you comfortable with the quality of the data. Our interests with the information is to ensure that the scientific input eventually into the public policy process. We want to make sure that the government is on board and accepts the quality of the data, that's how we try to influence.

- How do you think the project bridges the political and social differences between Hong Kong and Mainland China?

I'm not sure it will, that's really my biggest concern, about the whole transboundary problem of water and air. I hope we have scientific data which may suggest a solution that both sides will line up and agree to a way forward. I'm not fully convinced yet that both government are there yet. I'm not convinced that Guangdong may be in a position to be there yet, they have a lot of work to do on their own. My hope is that with real data versus pointing fingers that the governments will come to agreement because ultimately the governments have to be in agreement. I just don't know yet that they will work it out.

- Do you think including scientists from Beijing and Peking University will increase the acceptability of the study?

Absolutely, I think without Peking University and particularly Dr. Kiang's information and the work he's already doing with the Guangdong government and the high credibility he has with Guangdong I think the study would be a waste of time. Because I don't think Hong Kong doing the study and telling Guangdong 'well see here's the problem,' regardless what the problem was that would never fly I mean this has the greatest chance of success the way it's structured, what I just don't know is if would be accepted. The key is getting Guangdong, the governor of Guangdong interested. Guangdong's goal is to quadruple their GDP by 2020. You don't have to look at any charts to know that energy usage and GDP rise in developing nations in step, almost percentage by percentage. This is still a developing nation where they are now, it's going to be a real challenge for Guangdong to hold emissions constant let alone to try to decrease them. They're going to have to make a choice between economic growth and environmental treatment, which are they going to chose, you'd hope they can find a way not to have to chose that they can do both, I hate to say that most places in the world first have their economic growth, then when they reach a certain state of comfort then people realise that the environment is important and then they start working on their environment.

- You mentioned the importance of the involvement of the governor of Guangdong for future collaborations, who would be important to include from Hong Kong government?

It's going to have to go through Sarah Liao's group environment transport and works, but it will also likely have to be in agreement with the PRD.

- Did you see any difficulties in engaging in cooperation?

Not really, because it's a scientific study, and we're not trying to decide public health. A controversy may arise if there's varying interpretation of the results among the scientists. That's where controversy is more apt to occur.

- How do you think this study can contribute towards future collaborations?

This study has at least proven that scientists from China, from Hong Kong, from the US from Holland, and other countries can work together in studying a cross-boundary problem. I think this is the first time anybody's really attempted a true scientific study across the border into China. I think that if results of the study are clear enough that they impact public policy either in Hong Kong or in China, hopefully in both then I think that bodes very well for future studies. If the science is clear and both governments chose to ignore it, then it bodes very badly for future studies of this type. I'm happy for the science to come out where it comes out, but I want them to pay attention to it wherever it is. If no one pays attention to it, then nobody will ever sponsor a study in the future. The hardest thing is if this study is inconclusive, if in fact we get this data, it could be possible that it's still not clear. Then the question is will people be willing to step up and sponsor further work to respond to data to get additional data, I would hope that would be the case. There are people who say 'well it's too hard to understand, let's just go back to the old guess at a solution and try it if it doesn't work guess again.'