Evaluation of IAQ Perception of Shopping Malls in Hong Kong
An Interactive Qualifying Project

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In Collaboration with
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Abstract

This study, sponsored by the Business Environment Council Limited, examined the public's perceptions of indoor air quality (IAQ) in shopping malls in Hong Kong. By surveying shoppers at ten malls, we found IAQ certifications and mall locations within Hong Kong do not correlate when it comes to perceptions of IAQ. We hypothesized that population density and configuration of the mall may be the issue. Also we proposed an IAQ management plan that would educate the shoppers and help mall managers.

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Executive Summary

Over the last couple of decades, people all around the world have been spending more time inside buildings. As a result, the air quality inside buildings has increased in importance. Determining how the general public perceives indoor air quality (IAQ) in shopping malls can provide valuable information on how the private mall sector should improve on air quality standards and their management.

IAQ has been a matter of increasing interest in the scientific community. There has been quite a bit of research on the harmful health effects of poor IAQ, as well as many experiments that have studied how to properly measure air quality. However, there has not been a lot of research on the public's perceptions of IAQ. How people may judge air quality inside buildings, specifically shopping malls, can depend on a variety of factors, including the mall's size, social status, popularity, and even the number of plants growing in the building.

The goal of this project was to assess the public's perceptions of IAQ in shopping malls, in Massachusetts and more importantly in Hong Kong. To accomplish this goal, we fulfilled three objectives. First, we discerned possible causes of different perceptions. We compared Massachusetts perceptions and Hong Kong perceptions as well as this year's project to last year's project to ascertain any patterns and trends. Second, we developed a plan for improving IAQ management in Hong Kong malls. This management plan was based on our analysis of the results. Third, we determined the feasibility of the management plan by consulting with experts as well as our sponsor, the Business Environment Council Limited.

These three objectives were completed by conducting surveys, and interviewing relevant IAQ experts and mall managers. One significant conclusion was that neither the mall's location

nor its official certification status seemed to influence shoppers' perceptions of IAQ. Another significant result was that a significant portion of the shopping population felt their spending was influenced by IAQ. We also found there was a drop in knowledge among shoppers about the IAQ Certification Scheme between 2014 and 2015. This lack of awareness may affect the perceptions of shoppers, especially in malls with poor perceptions but good certification levels. Another important result was that the majority of the shoppers would utilize a complaint response survey and a digital display with IAQ information, if they were available. Based on these results, we developed a management plan that included a complaint response system and an informational digital display. The recommended management plan also included an annual maintenance of the ventilation systems.

1. Introduction

Over the past several years, IAQ has become a matter of increasing interest in the scientific community (Jones, 1999). Since some people, especially in urban areas, are spending more time indoors than they are outdoors, the quality of the air they are breathing has become a significant concern (Robinson & Nelson, 1995). A recent study found that a variety of symptoms and illnesses are caused by indoor air pollution (Seltzer, 1995). IAQ and its effect on the public are still being researched.

In Hong Kong shopping malls especially, IAQ has come under investigation. Hong Kong, known as a 'Shopper's Paradise', attracts millions of tourists to its shopping malls where its local residents also spend lots of time (Li, Lee, & Chan, 2001). As a result, the air quality of the malls in Hong Kong has an important impact on people's daily life and health. However, when compared to the outdoor air quality of Hong Kong, air quality inside buildings has not received much attention. The public's perceptions of the air quality in malls are unclear. If a plan to manage the IAQ in Hong Kong malls were developed and successfully implemented, shoppers could have a more enjoyable experience, and malls would reap the benefits; however, such a plan has yet to be created.

A 2014 study in Hong Kong discovered customers would be willing to spend more money in a mall if the IAQ were improved (Anderson et. al, 2014). The study also presented data that showed the quality of air inside malls in Hong Kong and how it compared to the standards given by the Hong Kong government's IAQ guidelines. There has been other research done on indoor air pollution (Saravanan, 2004; Jones, 1999). Indoor air can have multiple physical effects on humans as measured by researchers, including various symptoms and illnesses. Some research

has also been done on people's perceptions of IAQ (Brody, Peck, & Highfield, 2004). The study showed that the way people judge air quality is not correlated with the measurements done by air monitoring stations, but rather how the elements of the immediate environment are perceived.

Despite the efforts devoted to the measurement of IAQ, there is insufficient information and analysis on the relationship between actual IAQ and the perceived IAQ, specifically in Hong Kong's malls. Not only the scientific data, but also the public's perceptions of the air quality should be fully considered when management plans and policies for shopping malls are formulated. The Business Environment Council Limited is one of the approved IAQ certificate issuing bodies in Hong Kong has been very interested to help its members address the problem of IAQ.

The goal of this project was to determine the public's perceptions of shopping malls' IAQ in both Eastern Massachusetts and in Hong Kong and from this recommend measures to improve how IAQ can be better managed. To achieve our goal we completed the following objectives. We determined people's perceptions of IAQ in malls by using surveys in Hong Kong and Eastern Massachusetts to determine the opinions of shoppers about the malls' IAQ. . We then compared this data to parallel data collected last year by other researchers. From this analysis we developed an IAQ management plan with suggestions on how to improve IAQ perceptions. Lastly, we determined the plan's feasibility for success. After implementing a successful management plan, shopping malls should be able to adjust the IAQ to better manage the public's perceptions, maintain customers' and employees' health, attract more visitors, and bring in a larger profit for malls.

2. Background

Controlling IAQ perceptions requires intricate knowledge about the environment, technology, regional standards and managing people's perceptions relating to this problem. In this chapter, we will examine information involving IAQ. First of all, since public perceptions of IAQ are closely related to the actual IAQ, we summarize the factors that affect air quality inside buildings, how measurements are made, and what technologies are used to control air quality. We also discuss research on IAQ in Hong Kong that has already been completed. We discuss HVAC management systems and their efficiency as well as their influence on indoor and outdoor air quality. Since we collected information on public perceptions about air inside malls in Massachusetts for comparison with people's perceptions in Hong Kong malls, we present basic information about the environmental and regulatory context of Massachusetts. As for Hong Kong we present its weather, regulations, past research and surveys done in Hong Kong malls. Lastly, we will present the interviews we conducted for the project.

2.1. Indoor Air Quality

IAQ can have significant influences on people's health (Axe, 2014). In the short term, indoor air pollution can cause irritated or dry mucous membranes in the eyes, nose, respiratory tract and throat. It may also cause dizziness, fatigue, fever, forgetfulness, headaches, irritability, lethargy, and nausea. Other health effects can arise with long-term exposure and are harder to link back to IAQ pollutants. Multiple chemical sensitivity or MCS is on the rise. Symptoms of MCS include burning eyes, breathlessness, cough, and chronic runny nose, among others. According to one study US residents spend 88% of their day inside buildings (Robinson & Nelson, 1995). However, most people do not notice the air quality inside the building unless the IAQ condition

exceeds their tolerances. To improve the air quality and make the public aware of problems with IAQ, many researchers have focused on IAQ and its influences on people's health over the last few decades both in Hong Kong and all over the world (Li, Lee, & Chan, 2001; Lee, Chan, & Chiu, 1999; Saravanan, 2004; Smith, 2002; Wyon, 2004).

2.1.1. Key factors that affect Indoor Air Quality

Based on the studies researchers have done over the last few decades, IAQ depends on many key factors such as temperature, humidity, climate, airborne particles, and gaseous pollutants (U.S. Consumer Product Safety Commission, 2014).

First of all, the public can easily detect temperature and humidity conditions; those factors are also closely related to the outside climate (EEOP, 2014). The normal levels of relative humidity and temperature for indoor air will vary widely from region (climate) to region (climate). Individuals can also vary widely as to what they find acceptable. According to The American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), their guidelines recommend temperatures of 68 F to 74 F in the winter and 72 F to 80 F in the summer. The ASHRAE guidelines recommend a relative humidity (RH) of 30 to 60 percent.

Secondly, air particles and gaseous pollutants are factors that have significant influences on IAQ; those factors are not easily noticed until conditions are so severe that people are affected immediately (Rao, 1996). The sources of such indoor air pollution include combustion sources such as oil, gas, kerosene, coal, wood, and tobacco products; building materials and furnishings as diverse as deteriorated, asbestos-containing insulation, wet or damp carpets, and cabinetry or furniture made of certain pressed wood products; products for household cleaning and

maintenance, personal care, or hobbies; central heating and cooling systems and humidification devices; and outdoor sources such as radon, pesticides, and outdoor air pollution.

Finally, although disease pollutants are invisible to the public, they are one of the sources of indoor air pollution (Smith, 2002). Respiratory infections are the most common disease pollutants of indoor air. Limiting exposure to pollution is one of the best solutions to reduce or eliminate the chance of contracting respiratory infections. A method to reduce respiratory infections is to install a high quality air filter or air purifier system to trap the allergens and pollutants before they get inside the building as well as the ones that are already in the building due to human illnesses among building occupants.

2.1.2. Measurement of Indoor Air Quality

In order to maintain high-level IAQ, it should be measured regularly (AppliedSensor, 2009). Measurement is a scientific and efficient way to keep precise control and maintain a high level of IAQ. Measurements can be divided into two major parts: measures of temperature and humidity and measures of volatile organic compounds (VOCs). One method is to control the temperature and humidity to obtain a comfortable (acceptable) indoor air. The climate control industry defines the quality of indoor air as a measure based on temperature, humidity and carbon dioxide (CO_2). For decades, the primary method for improving IAQ has been to dilute the amount of CO_2 and other contaminants through heating, ventilation and air conditioning systems (HVAC) or air filtration systems. The other method is to measure the volatile organic compounds (VOCs) in indoor air. As the air quality monitoring technology has become more sophisticated, it is now possible to detect the presence of VOCs such as acetone, heptane and many other metabolic products in human breath in addition to formaldehyde, cooking odors, human bio-effluents,

outdoor pollutants, paints and lacquers, cleaning supplies, and toxins. Table 1 shows the sources

of the most common chemical groups of mixed gases found in indoor air.

Table 2-1 Examples of VOCs and Sources (AppliedSensor, 2009)

Substance Group	Example	Sources
alcohols	alcohol, mineral spirits	cleaning supplies
aldehydes	formaldehyde	building materials
ketones	butanone	paints
esters	methyl acetate	glues
terpenes	pinene	glues
aromatics	xylol	paints and glues
alkanes	heptane	human breath

2.1.3. Technologies used to control and maintain good Indoor Air Quality

Technologies that are used to maintain high-level IAQ currently are ventilation systems

(U.S.DOE, 2002). All buildings need ventilation—the exchange of indoor air with outdoor air—to

reduce indoor moisture, odors, and other pollutants. To ensure adequate ventilation, ASHRAE

(2001) says that the living areas such as bedrooms or living rooms should be ventilated at a rate

of 5 cubic feet per minute per person, while the ventilation rate should be at least 7.5 cubic feet

per minute per person for retail places like malls and supermarkets.

There are many types of ventilation system used to keep good IAQ, such as Exhaust

Ventilation Systems, Supply Ventilation Systems, and Balanced Ventilation Systems (U.S.DOE,

2012). Exhaust ventilation systems (EVSs) work by depressurizing the building. By reducing the

inside air pressure below the outdoor air pressure, they extract indoor air from a building while

make-up air infiltrates through leaks in the building shell and through intentional, passive vents.

EVSs are relatively simple and inexpensive to install, however EVSs are most applicable in cold

climates such as in Massachusetts.

Supply ventilation systems (SVSs) work by pressurizing the building. They use a fan to force outside air into the building while air leaks out of the building through holes in the shell, bath and range fan ducts, and intentional vents (if any exist). SVSs are also simple and inexpensive to install, and SVSs are most applicable in hot or mixed climates such as Hong Kong.

Balanced ventilation systems (BVSs) neither pressurize nor depressurize a building if properly designed and installed. Rather, they introduce and exhaust approximately equal quantities of fresh outside air and polluted inside air, respectively. BVSs are appropriate for all climates and so could be used in both Massachusetts and Hong Kong.

2.2. Building Management

Since people spend plenty of time in buildings such as houses, offices, malls, and factories, the indoor environment affects people's everyday lives. Without proper management of the indoor environment, people will feel uncomfortable, get sick, and be less productive (Wyon, 2004). In order to control the indoor thermal and air quality at a comfortable level, management systems are designed and installed in buildings to not only monitor but also control the indoor environment.

2.2.1. Heating, ventilating, and air conditioning (HVAC) System

An HVAC system consists of heating, ventilating, and air conditioning, and it is designed to satisfy comfort, health, and safety needs of building occupants and the environmental needs of indoor equipment or processes (Angel, 2012).

Heating of the building can be divided into three main subsystems: source of thermal energy, thermal distribution, and end users (Rezaie & Rosen, 2012). The thermal energy production plant generates heat in the form of steam or hot water by combustion of fuels, geothermal resources,

solar heaters, and heat pumps. Such thermal energy is transferred, to consumers through a heat carrying medium, such as air or water, in supply pipes or ducts. After the delivery, the medium returns to the source through return pipes or ducts to absorb energy again. The size of the building is important. Heating systems are designed for different load situations such as, single family houses, commercial buildings, industrial buildings, and so on.

Ventilation maintains a proper composition of air, controls odors, and removes airborne contaminants inside buildings (Graham, 2012). It can be accomplished passively through natural ventilation or actively through mechanical distribution systems. Natural ventilation can be achieved through operable windows, louvers, or grills. These technologies consume little energy but in warm and humid climates, they are not enough to maintain the thermal comfort. Mechanical ventilation dilutes and replaces indoor air with outdoor air by using powerful fans. Such a system is able to control the IAQ better but requires much more energy.

Air conditioning refers to the control of air temperature as well as humidity (Graham, 2012). Temperature is changed by transferring heat between spaces or expelling the heat to the outside. Air can be dehumidified by condensing its moisture on a cold surface or removing its moisture through absorption. In dry climates, the air needs to be humidified for comfort by evaporation and other means.

2.2.2. Cost and Efficiency of HVAC Systems

In order to maintain a desired indoor environment, a large amount of energy is required for operating HVAC systems. They are the largest energy end use both in the residential and non-residential sector (Pérez-Lombard, Ortiz, & Pout, 2008). In developed countries, energy

consumption by HVAC systems accounts for half the energy use in buildings and one fifth of the total national energy use.

Beside the huge energy consumption, there is also a lot of unnecessary usage of HVAC systems. Almost every building wastes over 10% of the energy it consumes because of inefficient operation of the HVAC system (Barba, 2009). Many improvements can be implemented to achieve a more cost-efficient system. Finding a balance between comfort and efficiency of the HVAC system is essential to worker productivity, occupant satisfaction, and individuals' health.

2.2.3. Regulations and standards

To improve efficiency and save energy, standards and regulations have been developed for public buildings and their HVAC systems (Hong, 2009). For example, The Design Standard for Energy Efficiency of Public Buildings GB50189-2005 (The China Standard) is a national standard in China first enforced on July 1, 2005, and ASHRAE 90.1-2004 Energy Standard for Buildings except Low-rise Residential Buildings (The US Standard) is a similar standard in the US.

The China Standard aims to reduce lighting and HVAC energy use in public buildings by 50% compared with those constructed in the early 1980s (Hong, 2009). It defines minimum efficiency requirements of chillers, boilers, and package DX (Direct Expansion) units. It also provides energy efficiency guidelines on determining HVAC system types, thermal zoning, cooling and heating sources, fan and pump sizing, insulation of pipes, and air ducts, and HVAC system monitoring and controls.

The purpose of The US Standard is to provide minimum requirements for the energy efficient design of buildings except low-rise residential buildings (Hong, 2009). It tries to be strictly neutral

in the HVAC system type. It has efficiency requirements for boilers, chillers, packaged DX air-conditioners, and HVAC fan powers.

2.2.4. Relationships between Outdoor and Indoor Air Quality

Outdoor or ambient air quality is affected by both natural and man-made sources (Enviropedia, 2014). Natural outdoor air pollution includes oxides of sulfur and nitrogen from volcanoes, oceans, biological decay, lightning strikes, and forest fires, Volatile Organic Compounds (VOCs) from plants, grasses, and trees, and particulate matter from dust storms. Most of the man-made pollutants are coming from the burning of fossil fuels. Other sources are from chemical manufacture and waste incineration. It is also possible that indoor air pollutants after being vented to the outdoors are strong enough to affect the air quality outside (Smith, 2002).

There are two major factors that determine the quality of indoor air, the quality and amount of outdoor air getting inside and emissions from inside, which include materials used in building construction and the use of household chemicals (Saravanan, 2004). Ambient air can have a significant impact on the indoor environment (Yocom, Clink, & Cote, 1971). Suspended particulate matter and carbon monoxide, which are key factors in air quality, can easily penetrate private homes and buildings.

If the air is polluted outside the building, ventilation to dilute contaminants as well as filtration and source control are the primary methods to maintain the cleanliness of indoor air (Li, Wall, & Platt, 2010). The influence of outdoor air on IAQ depends on the air exchange rate. An inadequate air exchange rate causes poor IAQ, and a higher exchange rate results in energy wastage. In fact, indoor air pollution can be worse than outdoor. According to WHO (2014), 3.7

million deaths were attributable to outdoor air pollution, and 4.3 million deaths were attributable to indoor air pollution in 2012. It is important to think about the amount of time we spend indoors and how IAQ affects us.

2.3. Massachusetts Information

In order to compare the IAQ of Hong Kong malls to those of malls in Massachusetts, we will describe the setting of Massachusetts. There are differences between the two areas that affect the IAQ and management of IAQ. In this section we will discuss the climate of Massachusetts and the government standards and regulations in Massachusetts.

2.3.1. Climate of Massachusetts

For the climate of Massachusetts, we will focus on Worcester and its surrounding area as this is where we conducted our study. Worcester is located in central Massachusetts, and the climate is similar to most of New England. Massachusetts has a climate pattern described at a "humid continental climate" (Explore Massachusetts, 2012). This humid continental climate includes four seasons, summer, autumn, winter, and spring. The summers, that span the months of July, August and, September, are warm averaging about 25 degrees Celsius (77 degrees Fahrenheit) for Worcester in particular. Summer weather brings mostly sunny days; however, they can be quite humid, and some thunderstorms may occur. In the summer all the foliage is green and in full bloom. Following summer, autumn spans October, November, and December. The temperature cools down during this time and the foliage starts to go through a color change. By the end of this season most trees are clear of their leaves. The first snowfall may happen during these months. The winters, which span the months of January, February, and March, are dry and cold averaging about -2 degrees Celsius (28 degrees Fahrenheit) for Worcester in

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particular. At this point most of the plants have become dormant for the winter, and the heavier snowfall occurs. Worcester usually experiences the worst of the snowstorms for the New England area. In the winter of 2012-2013, Worcester was the snowiest city in all of the United States (Filipov, D., & Dezenski, L., 2012). Lastly, the spring season spans the months of April, May and June. During these months, the temperature starts to warm up and the foliage starts to bloom. Especially during the latter part of spring, rainfall is prevalent. The "four season" climate is quite a unique experience and presents an ever changing setting for the Worcester area. Climate is relevant for our project because weather effects how people perceive air quality. The temperature is quite noticeable, but also during winter months people spend a lot more time indoors, causing the spread of germs and other pollutants much more easily.

2.3.2. Standards and Regulations in Massachusetts

In Massachusetts, the government assesses buildings that are public such as courthouses and town halls as well as buildings that the public may enter (Commonwealth of Massachusetts, 2001). This is done for the benefit of the health of the people of Massachusetts. Massachusetts classifies IAQ problems into three groups:

1. Heating, ventilating, and air-conditioning (HVAC) operations;

2. Indoor microbial growth;

3. Indoor/outdoor sources of respiratory irritants/vapors/gases/particulates.

Addressing the first category, Massachusetts requires a ventilation rate for a range of different types of buildings and rooms. (See Table 2-2)

Table 2-2 Required Mechanical Ventilation Air in Frequently Encountered Building Spaces/Areas (Commonwealth of Massachusetts, 2001)

Facility/Area Type	Outdoor air [cubic feet per minute(cfm) per occupant]
Classrooms	15
Auditoriums	15
Dining rooms	15
Libraries	15
Gymnasiums	20
Laboratories	20
Office spaces	20
School training shops	20
Beauty salons	25
Commercial dry cleaners	30
Smoking lounges[a]	60
Dark room	0.5 cfm per square foot of floor space
Swimming pools (pool and deck)	0.5 cfm per square foot of floor space
Pet shops	1 cfm per square foot of floor space
Public restrooms[b]	75 cfm per water closet or urinal

a BOCA National Mechanical Code-1993
b exhaust ventilation required

The reasoning behind the proper airflow for inside a building is due to pollutants being created in the building. Between the building itself accumulating dust and other pollutants and the humans that occupy it creating their own pollutants, the air in the building has to be properly circulated or the building will become uninhabitable.

The second group of IAQ problems is microbial growth, and the only thing that can be controlled to limit the growth of microbes is the moisture/humidity in the building. Most microbial growth requires some form of water to grow, so if a building maintains a proper humidity, less growth will occur. Lastly, Massachusetts lists a group of products that are potential sources of indoor air pollutants (see Table 2-3).

Table 2-3 Potential Sources of Indoor Air Pollutants (Commonwealth of Massachusetts, 2001)

● building renovations	● mimeograph machines	● water heaters
● vocational shops	● chemical storage	● air fresheners
● art rooms	● new furniture	● dry cleaning solvents
● pottery kilns	● carpeting	● nail application solvents
● custodial products	● lamination machines	● spray paint
● pesticide applications	● school/clerical supplies	● spray on artificial snow
● vehicle exhaust	● fuel oil vapors	● dry erase markers
● wood stove smoke	● sewer gas from dry traps	● dry erase board cleaners
● photocopier	● janitorial supplies	● chalkboards

The solution to controlling these pollutants is to make sure the ventilation in the building is sufficient enough to keep the pollutants at a minimum so they aren't noticed and don't cause health problems.

The reason for addressing how Massachusetts handles IAQ is to be able to see if a standard may be affecting how people perceive IAQ. Another reason for knowing regulations is if a problem is found while studies are being conducted, knowing how to fix them according to code must be keep in mind. Lastly, when determining how to improve air quality perceptions, we have to see what the government's regulations are that buildings have to adhere to.

2.4. Hong Kong Information

In order to compare the IAQ of Hong Kong malls to those of malls in Massachusetts we now describe, the setting of Hong Kong. There are differences between the two areas that affect the IAQ and management of IAQ in both regions. In this section we will discuss the climate of Hong Kong, the Hong Kong government's IAQ standards and regulations, and the results of a previously completed research project that relates to our project.

2.4.1. Climate of Hong Kong

Hong Kong has a humid, subtropical climate. This climate has relatively high temperatures and a seasonal rain increase (Hong Kong Tourism Board, 2014). Hong Kong has four seasons: winter, spring, summer, and autumn. Autumn in Hong Kong is said to be the best time to be in Hong Kong. The humidity and temperatures are at a quite comfortable level, with the temperature averaging about 24 degrees Celsius. The weather is calm without a lot of changes. Hong Kong winters are dry and cool, averaging 17 degrees Celsius. Spring time brings a higher humidity and temperature increases, which average about 26 degrees Celsius. The major change in the spring is the increased rainfall. During the summer, Hong Kong is at its hottest, averaging about 28 degrees Celsius. It is also at this time Hong Kong goes through its typhoon season (Boland, 2014). Summer can be an unpleasant time to be in Hong Kong.

2.4.2. Standards and Regulations in Hong Kong

In Hong Kong, the Environmental Protection Department deals with IAQ regulations (IAQ Information Centre, 2014). Hong Kong has its own certification scheme.

1. Owner/management of premises/building to engage an HKAS approved "IAQ Certificate Issuing Body" (hereafter referred to as "CIB");

2. Approved IAQ Signatory of the CIB to carry out a walk-through inspection to check if the premises/building have any IAQ problem;

3. Owner/management of the premises/building rectifies the IAQ problems, if any, with the assistance/advice from the CIB;

4. CIB conducts IAQ measurements (sampling, etc.);

5. Approved IAQ Signatory of the CIB to certify the premises/building in compliance with IAQ objectives and issue a certificate;

6. Owner/management of the premises/building sends to the IAQ Information Centre: The certificate for registration a copy of the certification report for record, application form, and a CDR soft copy of all items submitted;

7. IAQ Information Centre to return the certificate to owner/management of the premises/building with a registration number for display in a prominent location for the public information;

8. Owner/management of the premises/building to manage post certification IAQ;

9. Owner/management of the premises/building to initiate annual re-certification.

Table 4 gives us the ranges for different parameters that the Information Centre finds acceptable. This is relevant to our project because with a certification scheme in place, we can figure out if the rating a certain mall gets would affect a person's perception of the mall and see if it would change their shopping habits.

2.4.3. Past Research

Some important points were made in a previously completed project done relating to our project. Arlina Anderson, Alan Cheung and Melinda Lei (2014) made three major points as conclusions from their project. The first point was that there was no noticeable difference between malls with good and excellent IAQ. The second point was that people said they would spend more money in malls if the IAQ was improved. The last point was that there was a need to increase people's awareness of the Hong Kong IAQ certification. This preliminary research needs to be followed up with additional research to determine if these points are widely valid.

Table 2-4 IAQ Objectives for Offices & Public Places (IAQ Information Center, 2014)

Parameter	Unit	8-hour average a	
		Excellent Class	Good Class
Room Temperature	°C	20 to <25.5 b	< 25.5 b
Relative Humidity	%	40 to <70 c	< 70
Air movement	m/s	< 0.2	< 0.3
Carbon Dioxide (CO2)	ppmv	< 800 d	< 1,000 e
Carbon Monoxide (CO)	μg/m3	< 2,000 f	< 10,000 g
	ppmv	< 1.7	< 8.7
Respirable Suspended Particulates (PM10)	μg/m3	< 20 f	< 180 h
Nitrogen Dioxide (NO2)	μg/m3	< 40 g	< 150 h
	ppbv	< 21	< 80
Ozone (O3)	μg/m3	< 50 f	< 120 g
	ppbv	< 25	< 61
Formaldehyde (HCHO)	μg/m3	< 30 f	< 100 f, g
	ppbv	< 24	< 81
Total Volatile Organic Compounds (TVOC)	μg/m3	< 200 f	< 600 f
	ppbv	< 87	< 261
Radon (Rn)	Bq/m3	< 150 i	< 200 f
Airborne Bacteria	cfu/m3	< 500 j, k	< 1,000 j, k

(Legend is in Appendix H)

2.5. Mall Industry Persons' Views on Building Management of Indoor Air Quality

We interviewed Jim McLaughlin, the Director of the WPI Campus Center because in some ways the Campus Center is like a mall: it is a large building with many people using it for many different purposes, including eating, working and just relaxing. Mr. McLaughlin gave us his opinions on the effects of IAQ in WPI's Campus Center. He believes his job is to make sure the Campus Center is a comfortable place to work and relax. As such, IAQ does affect his job responsibilities and must be taken into consideration. For example, smoking used to be a problem when the campus was not smoke free. Employees and students would go outside the building and smoke, but the air and smell would filter into the building. Steps had to be taken so as to prevent the polluted air from traveling inside. Temperature is another major factor in managing the building well. The WPI's Campus Center has many large windows and during the

summer, the windows let in a lot of sunlight, making the inside of the building hot. As a result, the air conditioning system would not only have to be at a higher setting, but it was also turned on early in the morning in order to preemptively cool the building. When asked if air quality affected business, Mr. McLaughlin answered with a definite yes, especially during summer and winter months. Temperature plays a big role in keeping people who use the building for any purpose as well as the employees who work there comfortable during the harsher months of the year.

In Hong Kong, we conducted an interview with Mr. Low Hon Wah, President of the Hong Kong Institute of Facility Management (HKFIM). He is also the Division Head (Contracts Management and Cost Assurance) at Hong Kong Polytechnic University. He has many years of experience in managing large buildings and building complexes.

First, he gave us a brief introduction of what facility management is. Facility management, when compared to facility operation, is more objective oriented. It not only helps manage the whole facility but also allows managers to achieve their objectives. The core value of facility management is to integrate people, process, and place.

He then added that facility management is changing. For shopping malls, historically managers just needed to keep them open and functioning because people didn't have many choices. Currently, however, people have many choices they can make about which mall to visit, and managers have to think more carefully about facility management to attract more customers.

Mr. Low believes that there are three points to consider when developing a management plan or system. One point is that the objective of the system is essential. A system must have a

reasonable and profitable goal in order to be reliable. The second point is that it is important to think about the people who are going to buy and/or use the system. If the system is too complicated and increases their work load, they won't be willing to use it. The third point is that the people served by such a system must be considered. For the system to work, the clientele must be positively affected by whatever changes or improvements the system makes.

Finally, Mr. Low described three examples he had encountered during his work that related to how people perceived air quality. One example was about smoking around buildings. People usually smoke outside a building near exits where the air intake system can draw the smoke into the building. This negatively affects the IAQ. The second example was that even if the readings of air quality in a room meet all the scientific standards, people may still complain about a smell due to overly sensitive noses or merely to find reasons for not wanting to be in the room. The third example explained that even if chimney outputs are filtered and emit clean air, people still don't like the visible smoke coming from the chimney and complain about it once they see it. If they don't see the chimney and its smoke, they won't feel sick or complain.

Our project team also interviewed Dr. Mui and his associate Dr. Wong from the Hong Kong Polytechnic University. Dr. Mui is very knowledgeable about IAQ and the various issues related to it. His interest in the subject derives from the challenge it provides. His opinion is that IAQ mainly has long term effects that are very hard to quantify. It requires a lot of research to learn how to efficiently measure and change IAQ based on the environment. The equipment used to measure IAQ is generally very expensive, and mall administrators are reluctant or not interested in implementing such equipment, because it may or may not provide useful results. As a consequence, everything done to measure IAQ should considered in relationship to energy

efficiency and/or financial costs because these are factors about which mall managers are concerned. When we asked Dr. Mui about people's perceptions of IAQ, he mentioned how people are spending more and more time indoors. As a result, people now tend to be more concerned with smaller details of the air quality, and there is always some percentage of the people who are dissatisfied. His personal standard is if five to ten percent of the people are dissatisfied, then nothing needs to be done. But if there are more than that, then the IAQ should be improved. Recently, Dr. Mui along with a research group developed a smart phone app that measures the air quality inside offices, classrooms and labs. The app's measurement is based on many variables, including air temperature, radiant temperature, relative humidity, air velocity, carbon dioxide levels, sound levels, lighting levels, occupancy, floor area, etc. Once each variable is inputted and a location of the room is also inputted (the app currently only accommodates Hong Kong), a rating out of five stars is given back. This rating is based on a database Dr. Mui and his research group have created. The rating can help people get an idea of how the IAQ in a said room is currently. After learning about his app, we asked Dr. Mui if his app could be applied to malls. He said that at the moment malls are next to impossible to quantify. They drastically range in size, number of people present at any point in time, and generally there are too many variables to be accounted for. People in malls also tend to be harder to satisfy, and the app would have to be tailored for each mall. However, further research may yield a prototype that could potentially measure overall IAQ in malls.

We interviewed Mr. Grant Chau, an expert at Hong Kong's IAQ Information Center. He stated that shopping malls in Hong Kong pay a lot of attention to their IAQ and managers are trying their best to improve the shopping experience. Most malls in Hong Kong have at least a good rating

on the IAQ Certification Scheme. However, some small-scale and old malls still lack good management. It is also difficult for malls to achieve and maintain good air quality inside. There are many limitations such as available budget, space, and technical support. Maintenance of the equipment can also cost a huge amount of money.

Mr. Chau believes that for shopping malls, crowds can directly affect their IAQ. They bring dust and bacteria into malls. It is also possible that the size of the crowd exceeds the design capabilities of the ventilation system.

2.6. Summary

This project deals with three major topics that affect the perception of IAQ: actual IAQ, building management of air quality, and the Hong Kong and Eastern Massachusetts environment. We discussed each of these topics so that the context for our project could be properly understood. Our project will investigate the potential of a management plan, the comparison to Eastern Massachusetts malls and the data acquired last year to see if there was any significant change over the year.

3. Methodology

The goal of our project was to study the public perceptions of IAQ in Hong Kong malls and come up with a management plan to monitor and improve perceived IAQ. To achieve this goal, we identified three main objectives for our project. First, we identified the public perceptions of IAQ in Hong Kong. We determined how valid our findings were on perceptions of IAQ based on similar research findings done by last year's project group. Second, based on the information we collected on the public's perceptions of IAQ, we developed IAQ management plans for Hong Kong malls. Third, we determined the feasibility of the proposed management plans. The methods we used to accomplish these objectives and thus our goal are discussed in the following sections.

3.1. Determining Public Perceptions of IAQ in Hong Kong

To determine the public's perceptions of IAQ in Hong Kong mall we surveyed shoppers from a selected number of malls of our choosing and learned of their perceptions of IAQ. We also interviewed individuals that have a specialty on an area of IAQ.

3.1.1. Selecting Shopping Malls

Hong Kong has a large number of shopping malls. As a result, there is a large variety of malls to choose from. In this project, we selected ten shopping malls at which to conduct a survey. The ten malls we chose were the same ten malls at which researchers in 2014 chose to carry out research (Anderson et. al, 2014). The reasoning behind this selection has two parts. One reason was our sponsor, the Hong Kong Business Environmental Council Limited, wanted to compare our project's results to last year's project results. They wanted to see if there was a change in perceptions and knowledge. The second reason was that the malls the previous research group selected were diverse in location and prestige, so they represented the range of mall types in

Hong Kong well. Lastly, ten malls was a reasonable number of malls to survey in the time span available to do our research. Each mall was given an arbitrary number to protect the mall's identity. We also recorded each mall's official IAQ certification status, and general location within Hong Kong. Table 3.1 summarizes all this information.

Table 3-1 Certification Class and Locations of the Shopping Malls

Shopping Mall	Certification Status	Location
1	Excellent	New Territories
2	Excellent	Kowloon
3	Good	Kowloon
4	Good	Kowloon
5	Good	Hong Kong Island
6	Good	New Territories
7	Uncertified	Kowloon
8	Uncertified	New Territories
9	Uncertified	Kowloon
10	Uncertified	Hong Kong Island

3.1.2. Survey

The shoppers and the employees of the malls were the subjects of our survey (see Appendix C: Questionnaire). The purpose of the survey was to measure the public's perceptions of IAQ in shopping malls. The survey we used in Hong Kong was a slight modification of the 2014 project team's survey. The congruence between 2014 and 2015 survey questionnaires was used to be better able to compare this year's data with last year's data. Some additional questions were added, however, so we could also compare the data from the survey we did in Eastern Massachusetts to our Hong Kong survey results. Lastly, some questions were taken out due to lack of relevance.

We conducted the survey between January 22, 2015, and February 13, 2015, at the ten Hong Kong Malls. Fifty questionnaires were collected at each of the malls for a total of 500

questionnaires. The survey was carried out Monday through Friday from around 11:00 to 18:00 on sunny to partly sunny days when the temperature ranged from about 15 to 21 degrees Celsius. All questionnaires were collected outside the mall due to the fact that surveying inside malls would bother customers, and the mall management wanted to avoid that. We would choose the exit with the largest exodus of shoppers and approached shoppers after they had left the mall's premises. While we randomly approached people to ask if they would participate in our survey, only people who wanted to stop and take the survey were part of the study.

The sampling method used was a convenience sample along with a quota of 50 respondents per mall. Each set of responses was kept anonymous. There is some bias in this method due to the fact that the sampling population was the individuals who filled out our survey, not all the shoppers in Hong Kong. However, we had limited time to complete our research and we believe this method was the most appropriate and time efficient.

3.1.3. Interviews

We interviewed people involved with IAQ and facility management to discover their opinions on our project. Our interviews were fairly brief and used a semi-structured format, but we had follow-up questions to further the discussion, if appropriate (see Appendix B: Interviews). We approached each interview differently and adjusted our approach appropriately. The Hong Kong Business Environmental Council Limited approved all the questions we used. The interviews were important to determine the respondents' perceptions of IAQ. Based on their responses, we also began to develop ideas on how we should create an IAQ management plan. We hoped to interview as many people as possible in order to acquire the largest amount of information,

because more information means a better understanding of the problems the malls face. In total we were able to carry out four interviews with people involved with IAQ.

3.1.4. Comparing Data of Massachusetts' Survey and Last Year's Project

After we fully analyzed our Hong Kong data, we compared the results we deemed significant and relevant to data from previously completed research. By comparing our Hong Kong data to the survey data we collected in Massachusetts we were able to determine if there were any significant differences between the two cultures and if our management plan and conclusions should be adjusted based on the location of the mall. By comparing the data from this year's project and last year's project we could determine if there were any noticeable trends or patterns among shoppers' perceptions in the same ten Hong Kong malls. Graphs were used to represent the similarities and differences between the sets of data.

3.2. Develop Indoor Air Quality management plan for Hong Kong malls

After collecting the information described in section 3.1, we analyzed the data to come up with findings and a conclusion about people's perceptions of IAQ in Hong Kong malls. Based on the information gathered, we researched what methods could be used to create better management plans through interviews.

3.2.1. Analysis of survey questionnaires and interviews

There were three main steps involved in the data analysis of our survey. We used Excel spreadsheets as the main tool for data storage, management, and analysis.

First, the survey questionnaires were checked for validity. We made sure to have exactly fifty questionnaires for each mall and counted the total number of questionnaires received to be sure. Second, the responses from the survey questions were organized and grouped for analysis. We used a spreadsheet to keep and analyze our data. Third, we used standard data analysis

techniques such as percentages, averages, and hypothesis testing. For each question, the percentage of respondents that chose each option was calculated. For the questions with rankings, we used Excel to calculate standard deviations to prove or disprove hypotheses.

Interviews produced large amounts of qualitative data. The analysis method we used was content analysis. The notes taken during the interview were the source of our analysis. The notes were initially recorded by one member during the interview and the two other members would add on anything they remembered and deemed relevant enough. After all the notes were written down, we would reflect upon the ideas the interviewee came up with. We focused upon the ideas relevant to our project and when applicable, expanded upon them. The majority of the ideas applied to our management plan, both how to create it and how to present it.

3.2.2. Research on management plan

The main method used to help us build a management plan was through interviews. In order to learn more about building management in Hong Kong, we interviewed several experts in Hong Kong recommended to us by BEC's IAQ expert, Dr. Veronica Chan. We did an interview with Jim McLaughlin, Director of the WPI Campus Center, Mr. Low Hon Wah, Chairman of the Hong Kong Institute of Facility Management Association, Dr. Mui, an IAQ specialist, and Mr. Chau, a member of the IAQ Information Centre. Through such interviews and analyzing the interview results, we obtained suggestions that improved our management plan for better managing people's perception of IAQ in Hong Kong malls.

3.3. Determine Feasibility of Plans

Two things we considered when determining a solution for improving perceptions of IAQ in malls were the cost and social factors. We decided not to do any test runs as we did not have enough time to properly test any management plans we came up with.

3.3.1. Cost Analysis

After we came up with a management plan, we had to determine how much it would cost a mall to implement the plan. Determining the cost is important because if our solution were too expensive, the cost might outweigh the benefits of having it in the first place. Determining costs consisted of determining how much money it would take to create, implement, and maintain the particular solution. The amount of money required would be determined through research of the parts on the internet.

3.3.2. Social Analysis

Social analysis of our management plan was examined in three different ways. First, we talked with our sponsor liaison, Veronica Chan. She gave us feedback on our first ideas and explained any doubts she had on the feasibility of our thoughts. Second, during each interview, we asked the interviewee about our management plan and if he had any ideas or suggestions. Third, we utilized the survey to help us determine how many shoppers would be willing to accept our management plan. Questions 1 and 2 under Management Plan (See Appendix C: Questionnaire) directly asked participants if they would use a digital display or complaint response survey, the two characteristics of the plan we were considering. Based on the results of the survey, we determined if our management plan would be accepted by the public.

3.4. Summary

Our objectives were to determine the public's perceptions of IAQ in malls in Hong Kong, to compare the perceptions of IAQ in Hong Kong and Massachusetts malls as well as between this year's and last year's data in the same Hong Kong malls, to develop a management plan for better managing IAQ in malls, and to determine the feasibility of the management plan. Our main methods were to survey people using the malls, and to interview experts in IAQ and mall management.

4. Results and Analysis

Keeping in mind our goal of discovering the public's perceptions of IAQ, in this chapter we present the analysis of the results of our survey and interviews carried out in Hong Kong. We also compare our data to a study that was conducted last year and to the data from our pre-project study of Massachusetts malls. From these findings we show how we were able to develop an IAQ management plan for Hong Kong malls.

4.1. Perceptions of Indoor Air Quality in Hong Kong Malls

For questions 1-5 of our questionnaire (see appendix C: Questionnaires) we were trying to see how people perceived different characteristics of indoor air. The questions addressed how people perceived the effects of air quality, temperature, air flow, odors, and humidity on a scale of one to five with one being the best and five, the worst. Table 4-1 shows all the averages for each mall for questions one though five and their topic. As the table shows, there isn't really a difference between malls and is relatively insignificant as they all are around 2.5. Summarizing these questions, on average people feel weekly positive about traits of IAQ of Hong Kong malls. However, focusing on questions six and seven, we can do a statistically analysis to find a more meaningful answer.

Table 4-1 Averages for Question 1-5 by Mall

Air Quality	Question 1	Question 2	Question 3	Question 4	Question 5
	Air Quality	Air Flow	Odours	Humidity	Temperature
Mall 1	2.38	2.48	2.24	2.44	2.24
Mall 2	2.94	2.9	2.32	2.76	2.66
Mall 3	2.8	2.82	2.62	2.64	2.54
Mall 4	2.92	2.88	2.52	2.66	2.78
Mall 5	2.02	2.02	1.98	2.14	2.22
Mall 6	2.56	2.48	2.22	2.46	2.52
Mall 7	2.56	2.56	2.36	2.5	2.52
Mall 8	2.62	2.68	2.3	2.3	2.66
Mall 9	2.68	2.68	2.42	2.46	2.72

We wanted to test to see how valid our results were, so we did a welch t-test. We used a welch t-test over a standard t-test because our samples were multinomial distributed. Our null hypothesis was that there is no difference between outdoor and IAQ. Our alternative hypothesis was that IAQ is better than outdoor air quality. Since we conducted all the surveys on days with similar outdoor weather conditions, we compared the all 500 participants' perceptions on outdoor air quality and used that as our base mean (2.718). We were able to do this because our sample size was big enough to have a good approximation of the normal distribution. Then we used the average from each mall as the test mean and calculated the p-Value of each mall. For this statistical test to have conclusive results, we set the significance level to 0.025. Any p-value below 0.025 would reject the null hypothesis. For 6 out of the 10 malls our null hypothesis was rejected. For malls 2, 4 and 10 not only did we retain the null hypothesis but we obtained higher averages than our base meaning that the mall's IAQ was considered to be worse than the outdoor air quality, according to our participants. Although Mall 3 had better average, it wasn't in the range of the significance level we needed.

Table 4-2 Hypothesis Test for Questions 6-7 by Mall

Mall	Average	Standard Error	Degrees of Freedom	t-value	p-Value	Outcome
1	2.3	0.115	74	3.6204	0.0005	Better IAQ
2	2.82	0.12	71	0.8469	0.3999	No Conclusion
3	2.6	0.14	64	0.8416	0.4031	No Conclusion
4	2.82	0.139	64	0.7322	0.4667	No Conclusion
5	2	0.134	66	5.3481	0.0001	Better IAQ
6	2.38	0.137	65	2.4684	0.0162	Better IAQ
7	2.42	0.128	68	2.3224	0.0232	Better IAQ
8	2.3	0.122	70	3.4172	0.0011	Better IAQ
9	2.38	0.128	68	2.6473	0.0101	Better IAQ
10	2.72	0.14	64	0.0143	0.9887	No Conclusion

Continuing the analysis, we asked participants if the mall they were visiting was satisfactory to their standards. Aligning with our previous results malls 2, 3, 4 and 10 had the lowest satisfaction rates.
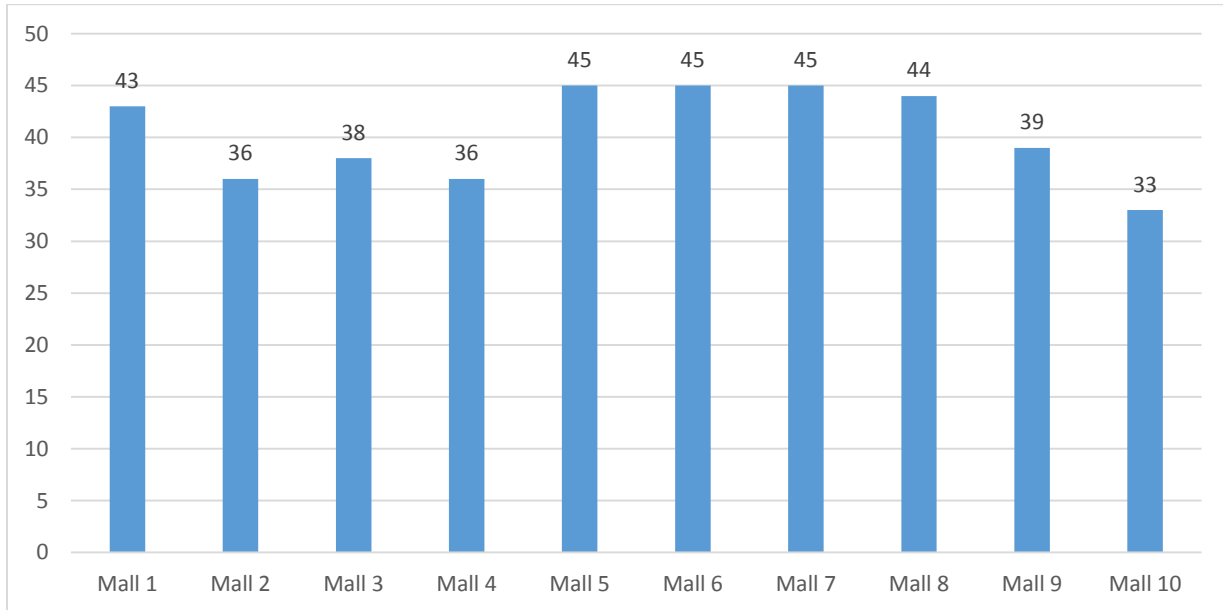
Figure 4-1 Mall Satisfaction of Survey Respondents (n=404)

The last part to discovering perceptions of malls was question 12, comparing Hong Kong malls to other malls. We prefaced the question saying it was for tourists only however some HongKongers answered it anyways. Looking at the overall results, malls 2, 3, 4, and 10 again show dissatisfaction with a higher selection of the option worse. These results also point out the better malls, malls 1 and 5. Looking at the other results mall 1 and 5 had high satisfaction rates as well as a near zero p-value shown.
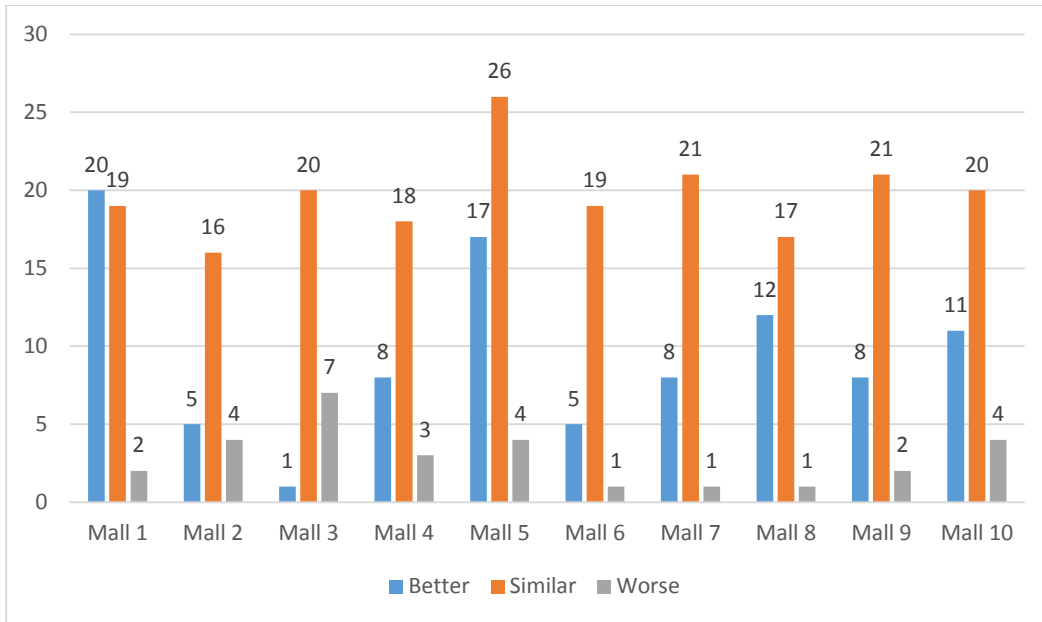
Figure 4-2 Overall Comparison with Respondent's Home Country Malls (n=321)
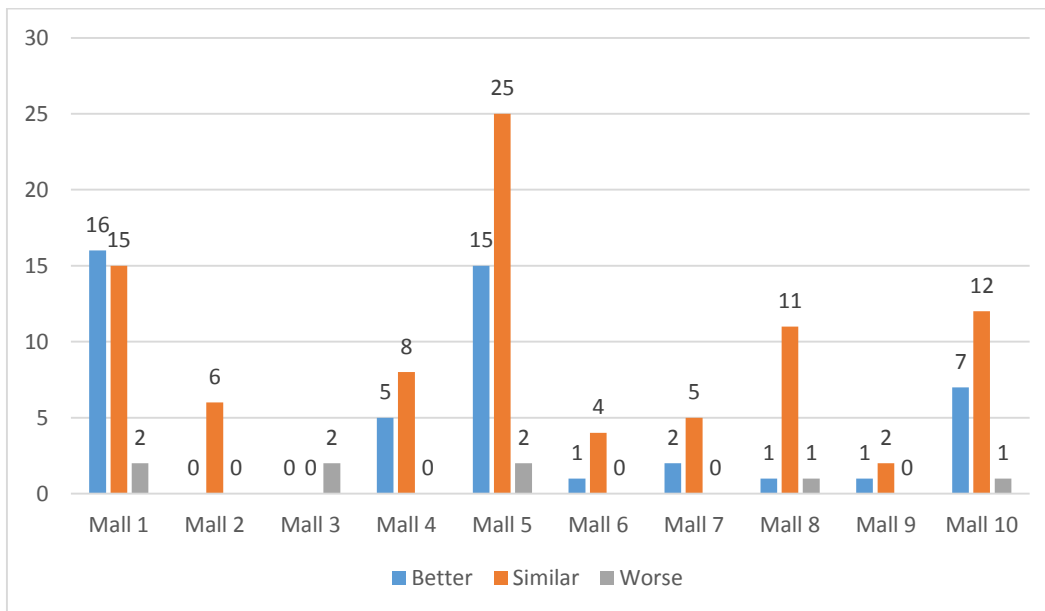
Figure 4-3 Tourist Comparison to Home Country (n=144)

Looking a little more in-depth we see more of malls 1 and 5 doing well while mall 2,4,10 and especially 3 doing poorly.

Lastly, we investigated why some HongKongers answered as tourists. We assume that they were comparing the mall they were visiting to their home area mall in another part of Hong Kong.

Again, following the rest of our data, malls 2, 3, 4 and 10 have some of the highest selection of the worse option while mall 1 has a high selection of the better option. Different from the others though is that, malls 7, 8, and 9 seem to be favorites of the HongKongers.
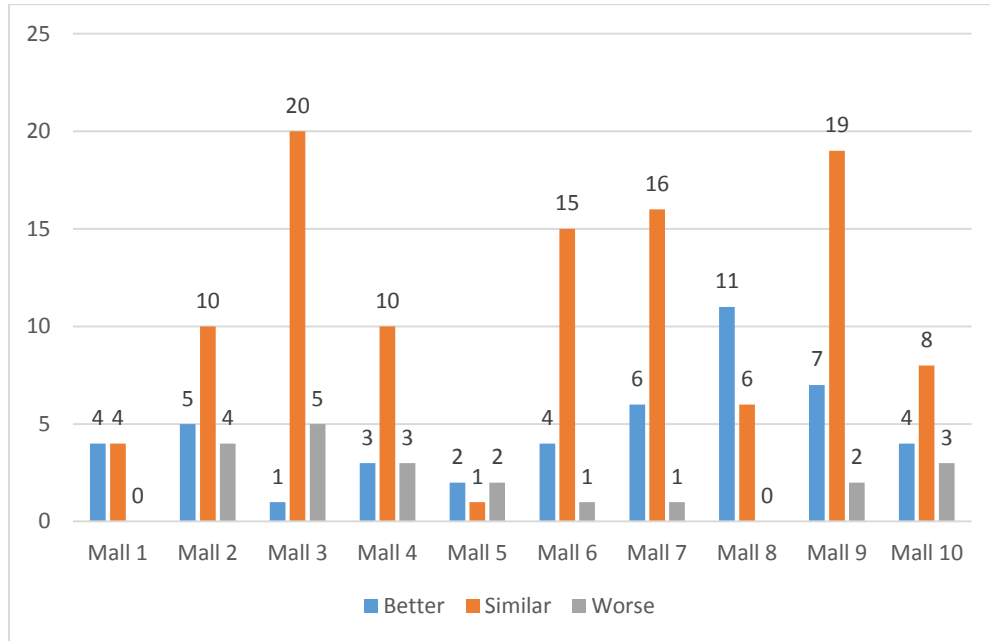
Figure 4-4 HongKonger Comparison to Home Area (n=177)

Looking at IAQ perception, neither certification status nor location was a criterion. However, malls 2, 3, 4, and 10 did seem to have a larger number of visitors and felt very crowded at times. While malls 1 and 5 were quite comfortable, having a very manageable number of visitors moving around inside the mall. We hypothesize that the size and design of the mall as well as number of visitors in relation to the size of the mall may influence people's perceptions IAQ.

4.2. Spending

We wanted to have our research provide a practical result. We believed that if the study we conducted would show that IAQ affected the amount of money spent by customers, it would be seen as important in the eyes of mall managers. In fact, 54 percent of the people we surveyed said that air quality does affect the amount of money they spend in a mall. While this may seem

neutral, we think that since over half of the respondents say it affects their spending that managers should take notice. A lot of people visit these malls, half of them may spend more money if the air quality was better. However the question did not ask if the person would spend more or less money, and so this topic should be looked into further how IAQ affects spending.
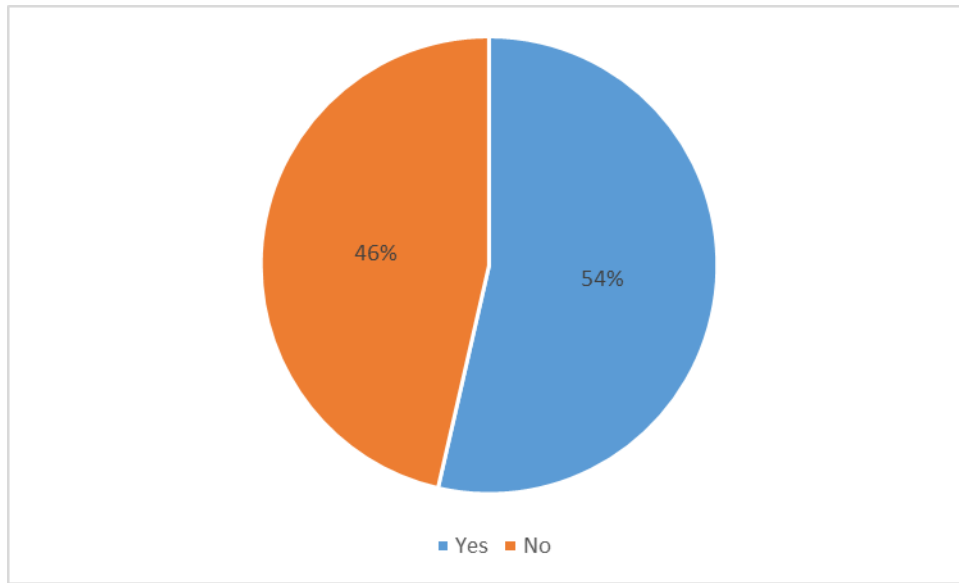
Figure 4-5 Air Quality Effect on Spending (n=500)

4.3. IAQ Certification Scheme Knowledge

Hong Kong Business Environment Council Limited wanted to know if people who shop at malls know about the IAQ Certification Scheme that the Council conducts. If they knew about it, we asked them to answer another question about what class they thought the mall they were in belonged to. With Figure 4-6 showing overall results from all responses, Figure 4-7 shows how many HongKongers knew about the IAQ Certification Scheme. We then analyzed responses from those who knew about the scheme to see if they gave the same answer as the actual classification the mall had received (see Table 4-3). We provide results from all respondents and separately for just Hong Kong residents because people from other places might not know what the BEC's certification scheme is, or they might confuse it with something similar that is used in the place

where they came from. Lastly, there were some people, who answered the question even though they didn't know about BEC's IAQ Certification Scheme, (see Table 4-3). We viewed this as an opportunity to see how people may view the mall's IAQ despite the fact that they are unaware of BEC's IAQ certification scheme. Overall there is a lack of knowledge of the scheme but comparing it to last year's results gave us a more realistic idea of how much it changed.
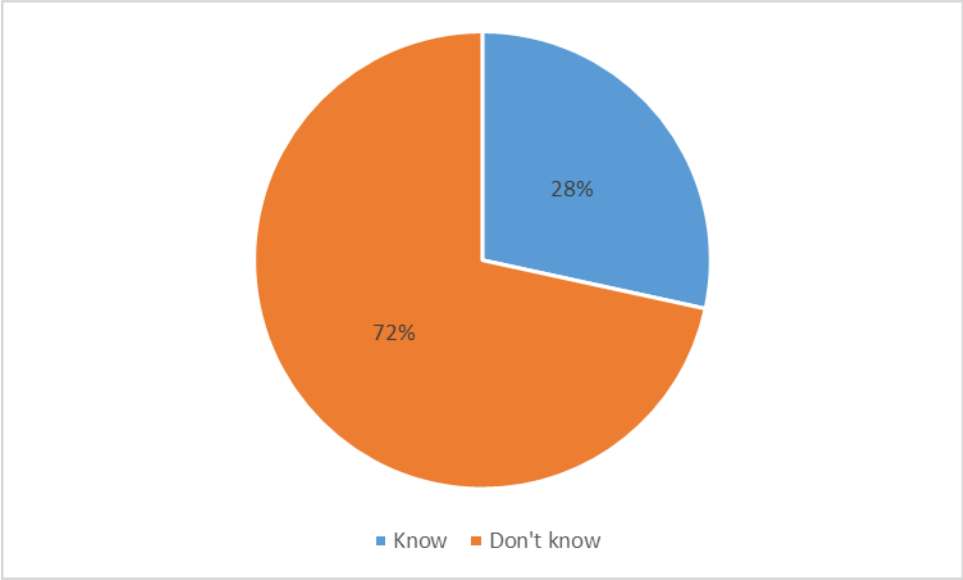
Figure 4-6 Overall Knowledge of the Certification Scheme (n=500)
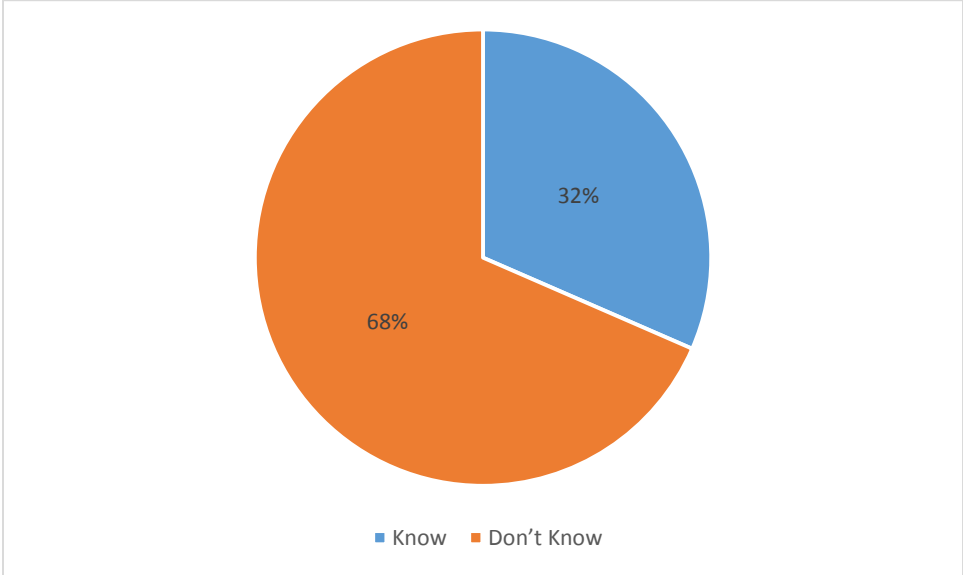
Figure 4-7 HongKongers Knowledge of the Certification Scheme (n=352)

Table 4-3 Knowledge of Certification Scheme of the Mall Visited

Population	Number Correct	Percent Correct
Total population (n=500)	96	19.20%
Know scheme (n=142)	34	23.94%
Don't know scheme (n=358)	62	17.32%
HongKongers that know scheme (n=98)	26	26.53%

4.4. Data Comparison

We were able to compare our results to those from two other studies, so we could get a more complete view on the perceptions of IAQ in Hong Kong malls. The comparison to last year's study on IAQ in Hong Kong malls allowed us to see what had changed and what hadn't. This helped because we could see what needed to be looked into more. The comparison to our own survey results in Massachusetts malls allowed us to see if there is anything interesting and different in malls in another part of the world.

4.4.1. Comparison to Last Year's Results

The project that was conducted in 2014 had a similar focus to our project. The gender ratio of respondents in 2014 was 55% females and 45% females which was similar to ours. For our study we broke up the age groups of respondents somewhat differently than the study in 2014, but the age range from <18 to 30 comprised 78% of our respondents while <21 to 35 comprised 90% of last year's study (see Appendix E: Demographics). We added a Mainland China option for residency in our survey, but HongKongers still comprised 71% of our sample, while last year's sample had 78% from Hong Kong. With such similar characteristics of respondents we were able to compare our results with those obtained in 2014 with more confidence. Our study showed that malls that were certified as excellent and good class didn't mean that visitors to these malls perceived IAQ to be good or excellent. Interestingly, last year's study showed that

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"more people thought IAQ was unsatisfactory at 'Excellent' malls than at uncertified and 'good' malls" (Anderson et. al, 2014, 107). In terms of knowledge of the certification scheme our respondents had an almost identical knowledge as last year's respondents at about 28 percent of respondents. In terms of identifying the mall's certification rating correctly when the individual knew about the scheme, last year's study had a higher percentage of accurate answers with 33.6%, while ours only had 23.94% (see Figure 4-8) correct answers, a 10% decrease. To further investigate, from last year's project, 42.8% of participants answered with the incorrect certification of the mall, and 23.6% of the participants knew about the certification scheme but did not know about the certification of the mall. From our project, 50% of participants answered with the incorrect certification of the mall, and 26.1% of the participants knew about the certification scheme but did not know about the certification of the mall. Lastly, we saw a 14% increase over last year (see Figure 4-9) in the number of people who said that IAQ would affect the amount of money they would spend in malls. Since two years in a row we saw that about half of mall goers' shopping behavior could be influenced by the IAQ, we believe that this should be looked into further to learn what might be happening and how this might affect businesses' operating in these malls.
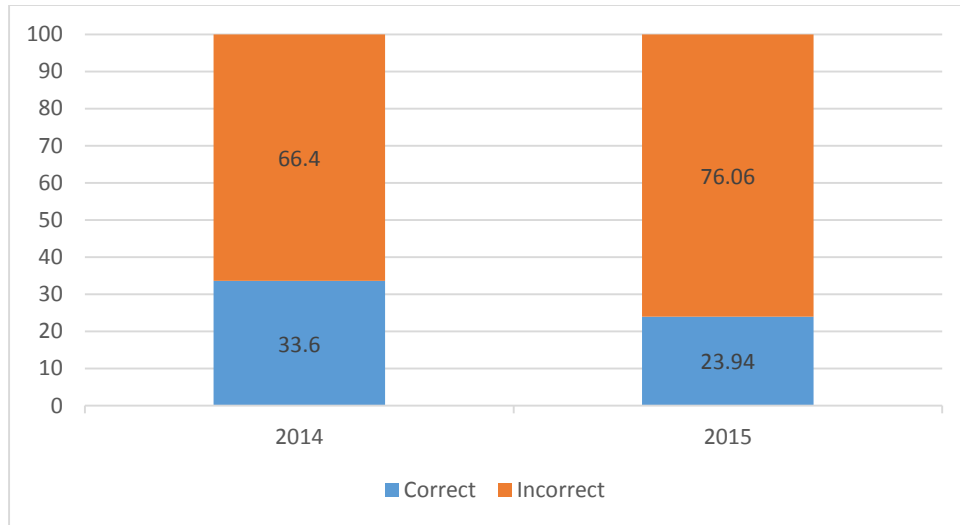
Figure 4-8 Correct Certification Answer Comparison (%)
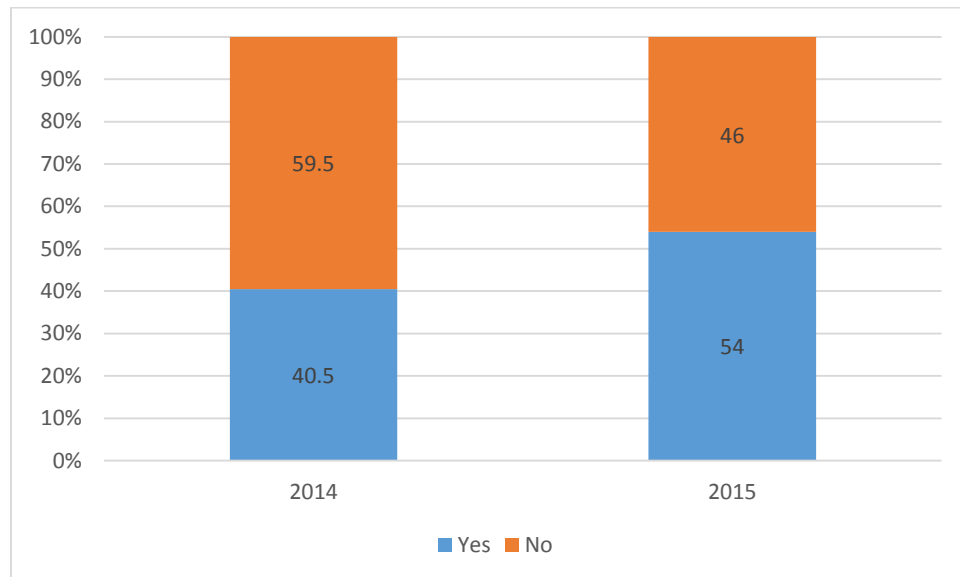
Figure 4-9 Air Quality Affects Spending Comparison (%)

4.4.2. Comparison to Eastern Massachusetts Malls

The two results we compared of our pre-test survey in eastern Massachusetts to our survey in Hong Kong were the comparison of indoor to outdoor air quality and the desire of shoppers for a digital display and satisfaction/complaint response system.

Looking at each area as an overall average and calculating a p-value gives us a better idea on how shoppers in each region view IAQ. As shown in Table 4-4, the overall view is that Hong

Kong shoppers view IAQ as being better and Massachusetts shoppers view outside air quality as better. One reason for these perceptions could be that since there isn't as much outdoor air pollution in Massachusetts, people are more critical of IAQ there, while people from Hong Kong use the indoors, such as malls, to escape the poor outdoor air quality.

Table 4-4 Analysis of the Average Difference of Air Quality by Region

Area	Outside Average	Inside Average	Difference	t-Value	p-Value	Outcome
Eastern MA	2.04	2.52	-0.48	2.9606	0.0039	Outdoor Air is Better
Hong Kong	2.72	2.47	0.25	3.8238	0.0001	Indoor Air is Better

For the comparison for how people felt about our ideas for the management plan, as seen in Figure 4-10 shoppers from both areas had a positive response about our idea for a digital display. We also got a positive response about introducing a complaint response system in both locations, as shown in Figure 4-11. Both areas received our management plan ideas positively showing us socially our plan is well received for the two areas.
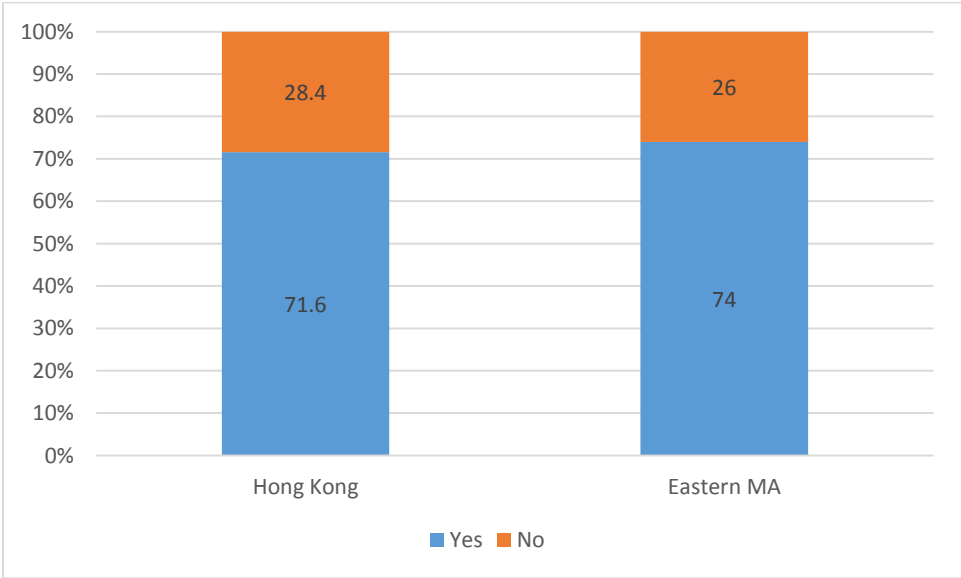
Figure 4-10 Comparison of Digital Display Results

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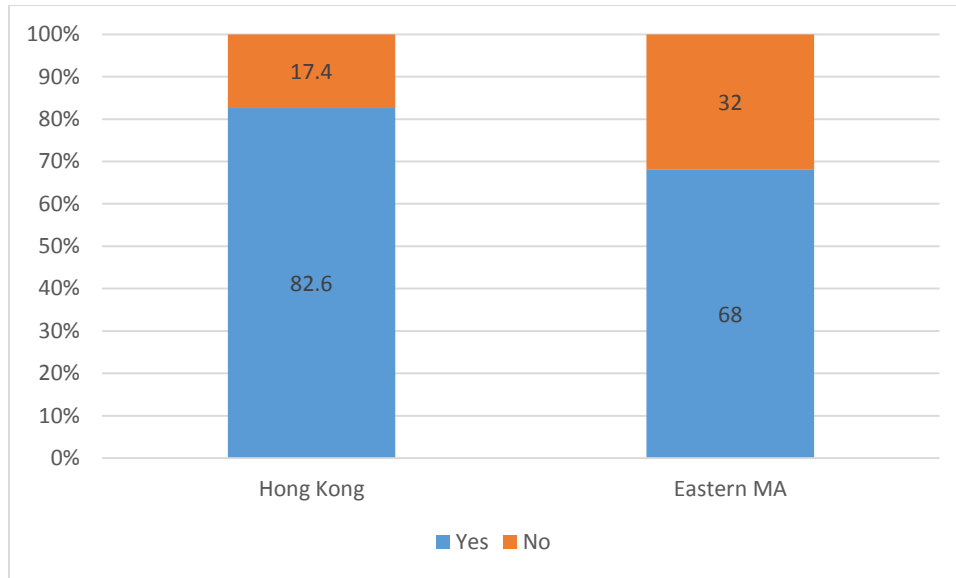
Figure 4-11 Comparison of Complaint Response System

4.5. Management Plan

From our interviews with knowledgeable people in both Massachusetts and Hong Kong, we learned how to design and improve an IAQ management plan that would be appropriate for Hong Kong malls. From Mr. McLaughlin we learned that comfort of occupants should be the number one priority when considering IAQ. As a result, when a mall managers judge customers' perceptions, they must ask if visitors are comfortable and if the mall could be more comfortable. From Mr. Low, we learned to think from the management perspective. For example, if a management plan is difficult to implement and requires a lot of work from the manager's side, that plan is less likely to be accepted and implemented. Also, if a plan does not look like it will yield any tangible results, the manager will not see the reason for implementing it. As a result, the plan we propose must be easy to implement and be able to produce results that can be useful. From Dr. Mui, we learned that IAQ has many different variables, and each should be considered when questioning customers about IAQ. We also learned that there will always be a number of customers who will be dissatisfied with some feature of the mall. The IAQ of a mall

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will never be perfect for everyone, and trying to constantly change it will only upset other customers, who may represent the majority of the people using the mall. As a result, while the management plan we propose may produce some variation in satisfaction levels among customers, only consistent patterns of complaints from many customers should be taken as grounds for making adjustments to how IAQ is managed. Using these insights we should design a digital display as well as a satisfaction/complaint response system that will satisfy the majority of shoppers, but can't be expected to make everyone happy.

4.5.1. Online Complaint Response System

Based on our results, an online complaint response system would be an effective solution to help improve perceptions of IAQ. The system could function in a variety of ways; however, based on our interviews, the most efficient method would be an automated system that regularly updates the ventilation system. How the complaint response system is advertised is up to each mall; our group suggests either including it in the mall website or including it in the mall app, if one exists. The updates would be based on the complaints customers have made. However, there would have to be a certain threshold number of complaints before the ventilation would be changed. The standards would be decided upon by the mall. Dr. Hui recommended that if more than ten percent of the mall population is unsatisfied with a certain aspect of the IAQ, then changes should be made. The standards would be decided upon by the mall. Dr. Hui recommended that if more than ten percent of the mall population is unsatisfied with a certain aspect of the IAQ, then changes should be made. However, we assume that not everyone in the mall with partake in the complaint/satisfaction survey. As a result, we recommend the malls to find the average number of shoppers that participate in the survey per week after one month. If

more than ten percent of that number is complaining about specific factors of the IAQ, then investigations should be undertaken. The reason for this standard is to avoid changing the ventilation system when only a few customers complain. There are always likely to be a minority of people who are unsatisfied with certain aspects of the mall. By changing the ventilation settings based on only a few complaints, a larger group of people may become unsatisfied with the IAQ. This system could be even more automated by connecting it to the suggested digital display and comparing the display numbers to governmental/mall standards as well as comparing it to customer complaints.

4.5.2. Digital Display

In our survey, most shoppers would like to see a digital display that shows the IAQ of the shopping mall. Moreover, our interviews also led to the same suggestion. In order to get an accurate idea of IAQ, there are 12 parameters to measure according to the IAQ Information Centre standards (see Table 2-4). Therefore, shopping malls would need to purchase different kinds of sensors to measure different parameters. Furthermore, since shopping malls usually have a large area as well as multiple floors, which may cause variation of IAQ, same sensors should be installed in different locations to account for such differences. After collecting all the information, the data can be processed into a more readable and understandable format. The IAQ will be shown on digital monitors set up in easily visible places in malls where shoppers can easily check them.

4.5.3. Cost Feasibility of Management Plan

Although shoppers are willing to use a satisfaction/complaint response system as well as a digital display of shopping mall IAQ, the economic costs of implementing these ideas need to be taken into consideration before deciding to implement them.

For the satisfaction/complaint response system, a survey can be conducted online through websites or a mobile application. There are several ways to carry out the survey of shoppers. A particular website can be designed for such a purpose. The average development cost of a small-scale website is about US$5,500 to US$12,000 depending on its functionality and size (Executionists, 2015). A website also requires about US$200 maintenance fee for domain name and hosting every year. If shopping malls already have their own website, a survey section can be added by using some online survey tools. The online survey tools usually provide templates of survey questionnaires, data analysis, and many other useful services. The cost of these online survey tools vary from free to about US$200 per month (Rich Page, 2014). Another solution for the survey system is to create a mobile application for shoppers to download and use. The cost of a relatively simple application is about US$3000 to US$8000 (Astegic, 2013). The selection of the method to implement the satisfaction/complaint response system should be based on shopping malls' demand and their budget. Further research is needed for developing such a system.

The cost of a digital display of shopping mall IAQ consists of two main parts, sensors and display devices. For sensors, 10 out of 12 parameters (See Table 2-4) of IAQ can be directly measured by electronic sensors with relatively low cost. The average prices are listed in Table 4-5. However, radon and airborne bacteria cannot be easily measured. Specialized devices are

required. For example, a device that measures radon costs about US$129.95. A device that measures airborne bacteria cost around US$8000. In addition, the cost of the sensors also depends on the number of sampling places in shopping malls. Moreover, the cost of control and communication hardware, installment, and maintenance should be studied. For display devices, monitors are widely used. Their prices are related to the size and type of the screen. A 20"-22" monitor costs about US$200 (PCPARTPICKER, 2015). The larger the size of the monitor, the more it costs. Also, multiple monitors should be set up to make sure information is accessible throughout the shopping mall. It is also possible to integrate the IAQ information into an existing digital display that shopping malls may already have.

Table 4-5 Parts Cost of Sensors for Measurement of IAQ (Information collected from digikey, aliexpress, amazon, wako-chem)

Parameter	Sensor Cost (US$)
Room Temperature	2.19
Relative Humidity	11.48
Air movement	88.37
Carbon Dioxide (CO2)	154.17
Carbon Monoxide (CO)	7.25
Respirable Suspended Particulates (PM10)	25.59
Nitrogen Dioxide (NO2)	144.35
Ozone (O3)	26.18
Formaldehyde (HCHO)	37.51
Total Volatile Organic Compounds (TVOC)	18.91

4.6. Summary

The chapter of our paper provides us with significant results that will influence our conclusion and recommendations. One significant result we ascertained was how neither location nor certification status of a mall seem to influence the perceptions of IAQ. The malls that

scored poorly in the comparison of IAQ to outdoor air quality, as well as the satisfaction of their indoor air, were located in different parts of Hong Kong and had different levels of certification. Another significant result was if IAQ affects the spending amount of shoppers. Since a little over half the respondents answered positively to this query, we determined that enough shoppers are affect by IAQ to make this statistic important. Therefore, management should consider the quality of the mall's air to affect the shoppers' budget. Also to be noted was the shoppers' knowledge of the IAQ Certification Scheme. Compared to last year's project, there was a drop of awareness about the Scheme which may affect the opinions of shoppers, especially in malls with good ratings but bad perceptions. Lastly, our management plan was analyzed and its feasibility ascertained. Based on the results, a majority of the respondents are in favor of our proposed management plan of a satisfaction/complaint response system and a digital display showing IAQ factors. The financial and social feasibility of these two components were researched and points were brought up about each.

5. Conclusions and Recommendations

In this chapter we present the conclusions and recommendations we developed based on our analyses presented in chapter 4.

5.1. Conclusions

From the analysis of the survey data, we can draw four main conclusions about the public's perceptions of IAQ in shopping malls in Hong Kong. First, a mall's location and IAQ certification status do not correlate with people's perceptions of the IAQ. Second, knowledge of the IAQ certification scheme is generally lacking among mall goers in Hong Kong. Third, the IAQ of Hong Kong shopping malls is similar to other shopping malls around the world. Moreover, it is usually perceived to be better than the air quality inside malls in mainland China. Fourth, our two proposals for a satisfaction/complaint response system and a digital display that displays IAQ indicators were well received.

5.2. Recommendations

This section has two components: recommendations for malls and recommendations for future research projects. Mall recommendations include our management plan and other ideas we have come up with. Recommendations for the Business Environment Council Limited are suggestions for future research projects about IAQ that our project did not cover.

5.2.1. Mall Recommendations

We have four recommendations for malls. One recommendation is to implement an online complaint response system. The online complaint response survey could use something similar to the questionnaire we developed, with a few different questions (see Appendix F: Satisfaction/Complaint Response Survey). How to direct shoppers to the survey is ultimately up to the mall; however, we recommend posting links or QR codes to a website or a phone app

containing the survey. To most efficiently utilize the complaint response system, the management would need to set certain standards. One standard would be the number of complaints required to initiate action on a problem that shoppers are complaining about. By setting this number, the management can save time and money by not adjusting the HVAC system for every complaint. The other standard would be how the management judges the actual IAQ. The reason for this standard is that if people are complaining about the air, but the quality is high by the mall's standards, then something may be disturbing the shoppers' perceptions. On the other hand, if the air quality is low by the mall's standards, and people are complaining, something may be physically wrong with the HVAC system. By utilizing the complaint response system with these standards, the management would save time and money.

Another recommendation is a digital display. A display could present a selection of variables; however, we suggest presenting factors shown in Appendix G: Digital Display. From our interviews, we believe these factors are the more effective and persuasive variables that will convince shoppers about the high quality of indoor air. Depending on how many and what kind of displays the mall wants, this part of our plan can be rather cheap or quite expensive.

A third recommendation for malls is to regularly service and maintain existing ventilation systems. Mr. Grant Chau has commented about how one of the easiest ways for a mall's certification rating to decrease is by simply not cleaning and checking the HVAC system on an annual basis. Last year's project findings also reinforce this recommendation. Dust particles and other bacteria can clog up ventilation shafts and fans, or be spread by the ventilation system into other parts of the mall. Cleaning the system frequently will go a long way in keeping the air inside clean.

Our last recommendation for malls is to promote awareness about their IAQ Certification. Maintaining high quality indoor air is a trait malls should be proud of and advertise to their customers. By promoting the mall's certification status, shoppers should have an improved perception of the mall's IAQ.

5.2.2. Recommendations for Business Environmental Council Limited

We have some recommended research directions for BEC to sponsor. Through further study, a better understanding of the public's perceptions of IAQ and improvement in customers' shopping experience in shopping malls in Hong Kong can be achieved.

According to our analysis of the survey, there are differences regarding the satisfaction rate and preferences between indoor and outdoor air quality. Based on observations, our hypothesis is that the perceived IAQ is affected by the population density and configuration of the shopping malls. If there is a large population of shoppers, according to Mr. Chau, this can bring a large amount of dust and bacteria into the malls and can exceed the maximum capacity of the HVAC system to handle them, which negatively affects the IAQ. Mall configuration is also related to the density of shoppers in malls. A more spacious and well-designed mall will be able to handle more people than a confined mall. Therefore, research needs to be conducted to find out how significant this factor is to the public's perception of IAQ. What are the threshold densities that should be avoided and which mall configurations have which thresholds?

Since an IAQ digital display will be desirable and feasible for shopping malls to implement, we suggest that what content should be displayed and how the content should be displayed need to be studied. There are many parameters that characterize air quality, as discussed in our background section. However, some of them require expensive devices to measure them and

take a relatively long time to measure. Furthermore, some of them are not applicable to an indoor environment and their effects are negligible. Thus, it is important to find out which factors most affect people's perceptions of IAQ. It is also important to figure out what the best way to display the air quality of the shopping mall on a digital display is. It is possible to either show the levels of different factors separately or show a general IAQ index, or both. In addition, the formula for calculating the index would require further study.

Another suggestion we have is to do research on how much IAQ affects shoppers' spending habits. In our survey, we determined that air quality does affect the amount of spending by shoppers. We did not determine if better IAQ increases spending, or how much excellent IAQ would increase spending. By conducting a study of the significance of IAQ on shoppers' spending patterns, malls could better understand the importance IAQ has on their business. The results of this study might also help convince mall managers to invest in IAQ measuring and maintenance equipment. As a result the malls could be more profitable and the customers would be happy and spend lots of money.

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Appendix A: Business Environment Council Limited

Business Environment Council Limited, (BEC, 2014f) an independent, non-profit membership organization, was established at 1992 by the business sector in Hong Kong (BEC, 2014). The mission of the organization is, "To advocate environmental protection amongst our members and the broader community, the uptake of clean technologies and practices which reduce waste, conserve resources, prevent pollution, and improve the environment".

BEC (2014e) determines its strategic direction from a Board of Directors, who come from different nations and local corporations. There are also two standing committees that assist the Board. The BEC Executive Committee helps the BEC Board in providing strategic direction to BEC, while the BEC Membership Committee helps the organization to attract and retain members and enhance membership services by providing strategic guidance (BEC, 2014b; BEC, 2014d). Beside the committees, there are four Advisory Groups (BEC ESG, BEC Waste Management, BEC Energy, and BEC Climate Change Business Forum) to structurally address the major environmental issues and improve the environmental performance of businesses in Hong Kong (BEC, 2014a). The management team of the organization is led by Agnes Li, who spearheads the implementation and execution of the strategies and directions set by the BEC Board of Directors (HKBE, 2014i). Our liaison, Veronica Chan, is one of the members of the management team as well. She has over 12 years of experience in environmental-related research, consultancy, and training. Her specialization is on green building assessment, which includes the modelling of the IAQ pollutants.

BEC (2014j) values the cooperation and partnership with government, business and community bodies. It has a range of partner organizations such as Hong Kong Green Business Council (HKGBC), BEAM Society, and World Business Council for Sustainable Development

(WBCSD). In addition, BEC (2014k) works on lots of partnership programs to pool resources, implement strategies and facilitate change. For example, they partner with BEAM Society on Green Building Labelling and with Hong Kong General Chamber of Commerce on a Clean Air Charter. They also work with the government, such as with the Environmental Protection Department on waste separation in public housing estates, with the Trade and Industries Department on Hong Kong Awards for Industries in Environmental Performances, and so on. Moreover, BEC (2014c) also has a division called, BEC Institute of Environmental Education, to provide various environmental education courses.

BEC (2014h) offers membership to organizations of all sizes and different fields to push forward Hong Kong's sustainable development.

IAQ is one of the core focuses of BEC (2014g). They offer professional indoor environmental related services. In addition, "BEC IAQ Solutions Centre is the first accredited Certificate Issuing Body [CIB] under the Hong Kong Inspection Body Accreditation Scheme [HKIAS] to conduct assessment, certify and audit premises under HKIAS003- IS017020".

Appendix B: Interview Components

Interview Protocol

- ❖ Email to confirm appointment time and place.

- ❖ Establish objectives before interview.

- ❖ Dress business formal: suit and tie.

- ❖ Shake hands before and after interview.

- ❖ Inform interviewee that he/she is going on record for our paper. Inform if any recording devices are being used.

- ❖ Act politely and appropriately throughout the entire duration.

- ❖ Thank person for his/her time.

- ❖ Write follow-up thank you email.

Interviewee: Jim McLoughlin

Director of WPI Campus Center

Participants: Zachary Culp

Date: 2014 Dec 9

1. Career
   a) 14 years at WPI
   b) 14 years at Plum State U in NH
   c) 28 years total as a Director of a campus center
   d) 37 years total working at a campus center
   e) 5 campus centers over the course of his career

2. Importance of IAQ
   a) Would improve IAQ as well as any other detail about the facility to make the clients more comfortable.
   b) If there were any issues about IAQ, it would be necessary to address them.
   c) Important factors: Smoking vs. smoke free, temperature, comfortability and health.

3. IAQ Management
   a) HVAC system
   b) Room temperature is modified hourly for different times of the year based on a program
   c) Because lots of glass, campus center can get very hot in summer
   d) Any complaints are dealt with accordingly.

4. IAQ Effect on Business
   a) Especially important in summer and winter months
   b) Temperature most important aspect of IAQ
   c) HVAC system does have blowers that cycle outdoor air in for indoor air. It can backfire by blowing air from food court to offices.

Interviewee: Low Hon Wah
Chair of Hong Kong Institute of Facility Management (HKIFM)
Participants: Benjamin Root, Fuchen Chen, Zachary Culp, Veronica Chan
Date: 2015 Jan 23

1. Facility Management:
    a) More objective oriented (vs Facility Operation)
    b) Not only managing facility but also facilitate managers to achieve their objectives
    c) International Facility Management Association (IFMA)
    d) People, Process, Place
2. Difference between Facility Management in past and now:
    a) Past: People have no choice and FM only needs to keep the shop open
    b) Now: People have lots of choices and FM needs to consider more
3. Considerations about management plan/system:
    a) Objective of the system
    b) Who (mall manager, developer, customer) is going to use or buy the system
    c) Who does the system serve
4. Examples about complaints:
    a) On campus, although it is smoke free, people usually smoke near the exit outside where the intake system absorb the smoke inside the building. Intake system should not be placed near the exit.
    b) Although the readings of IAQ all meet the standards, people may still complain about the smell due to sensitive nose or merely finding reasons for not moving into the room.
    c) Although the chimney output filtered and clean air, people still don't like it and complain about it if they see it. If they don't see it, they won't feel sick and complain.

Interviewees: Horace K. W. Mui and Wong Ling Tim
Professors at Hong Kong Polytechnic University
Participants: Benjamin Root, Fuchen Chen, Zachary Culp, Veronica Chan
Date: 2015 Jan 21

1. Measuring IAQ
   a) It is hard to discover problems of IAQ
   b) Long term effects (ex: lung cancer)
   c) Requires a lot of research
   d) Learn to save energy because of environment and efficiency
   e) Measure lots of pollutants: bacteria, CO_2 just for starters.
   f) Expensive equipment to measure IAQ. Mall owners are reluctant/ not interested. Long time to get results/ benefits.
   g) IAQ very related to the ventilation of building. Outdoor air dust affects IAQ. Fungi, bacteria also to be noted.
   h) Relate everything to energy efficiency and financial cost, as that is what sells solutions to management.
   i) Volume/ Surface Area of buildings are important to consider. Spacing affects IAQ.
2. People's Perceptions on IAQ
   a) People are spending a lot more time indoors than outdoors
   b) People tend to be concerned with the smaller details of the air. Always some percent of people that are dissatisfied. 5-10% people is safe. Anything more: problem.
3. AQ App
   a) IAQ app: apple and android.
   b) Works in offices, classrooms, and labs.
   c) Can measure AQ based on many variables, such as air temperature, radiant temperature, relative humidity, air velocity, CO_2 levels, Sound levels, lighting levels, occupancy, floor area, etc.
   d) Can compare the calculated number to a standard based on location. Standards are based on database.
   e) With Bluetooth, can be considered cheap equipment.
   f) Doesn't work for shopping malls. Malls are bigger, more people, more variables, people are harder to satisfy; the app would have to be tailored for each mall.

Interviewee: Grant Chau
Senior Environmental Consultant - Hong Kong Productivity Council (HKPC)
Participants: Benjamin Root, Fuchen Chen, Zachary Culp, Veronica Chan
Date: 2015 Feb 12

1. HK Shopping Malls:
    a) Most are at least good class
    b) Small scale/old are not good and lack management
    c) Space limitation
    d) Occupancy pattern varies
2. Crowd and IAQ:
    a) Number of visitors directly affect IAQ
    b) Bring dust and bacteria into malls
    c) Exceeds design capabilities
    d) Recommendation: Increase ventilation capacity and fresh air
3. Digital display:
    a) Factors: CO_2, Temperature, Humidity, RSP, VOC
    b) No reason to compare with outdoor air quality
    c) Recommended
4. IAQ index system:
    a) Too many independent parameters
    b) No easy formula
5. Malls effort:
    a) HK shopping malls tries to improve IAQ and make customers happy
    b) Limitations: money, space, technical support, geography. (Hard to get fresh air for malls beside road)
    c) Maintenance cost a lot

Indoor Air Quality Survey

1. Gender: Male___   Female___   Other___
2. Age: <18___   18-30___   30-65___   65>___
3. How often would you say you frequent this mall? _____
4. Do you have any respiratory health problems? Yes___   No__

Indoor Air Quality

5. Have you ever thought about the difference between indoor and outdoor air quality?

    Yes___   No___

6. Do you think *outdoor* air quality has ever affected your life?

    Yes___   No___

7. Do you think *indoor* air quality has ever affected your life?

    Yes___   No___

8. How do you think the air quality is *outside* today? (1 is worst, 5 is best)

    1___   2___   3___   4___   5___

9. How do you think the air quality is *inside* today? (1 is worst, 5 is best)

    1___   2___   3___   4___   5___

10. What words come to mind when air quality is brought up?

_____

_____

11. Do you think there is something in this building that affects the air quality?

    Yes___   No___

12. If so what is it?

_____

_____

13. Would an indoor air quality digital display that shows certain qualities about the air seem like something you would check or use?

    Yes___   No___

14. If so, rank what you would like this digital display to display. (1 being the most wanted, 4 being the least wanted, please only use each number once)

    Temperature___   Humidity___   Air Particles/Dust___   Air Pressure___

15. Would you use a satisfaction/complaint system for the mall regarding Indoor Air Quality if it improved your shopping experience?

    Yes___   No___

Indoor Air Quality (IAQ) Questionnaire

Personal Information

1. Gender   ☐ Male   ☐ Female   ☐ Other
2. Age   ☐ <18   ☐ 18-30   ☐ 31-64   ☐ >64
3. Residency   ☐ Hong Kong   ☐ Mainland   ☐ Other_____
4. How often would you say you frequent this shopping mall?

☐ Everyday   ☐ 2/3 times per week   ☐ Once a week   ☐ 2/3 times per month

☐ Once a month   ☐ 2/3 times per year   ☐ Less often

Air Quality

1. How does the air quality in this shopping mall affect you?

Positively - 1	2	3	4	5 - Negatively

2. How is the air flow in this shopping mall?

Perfect - 1	2	3	4	5 – Too strong/weak

3. How are the odours in the air of this shopping mall

Clean Air - 1	2	3	4	5 - Smells

4. How is the humidity in this shopping mall?

Perfect - 1	2	3	4	5 - Too Humid/Dry

5. How is the temperature in this shopping mall?

Perfect - 1	2	3	4	5 - Too Hot/Cold

6. How do you think the air quality is *inside* today?

Great - 1	2	3	4	5 - Bad

7. How do you think the air quality is *outside* today?

Great - 1	2	3	4	5 - Bad

8. According to your personal standards, is the air in this shopping mall satisfactory?

☐ Yes   ☐ No   ☐ Don't know

9. Does the indoor air quality of shopping malls affect the amount of money you spend?

☐ Yes   ☐ No

10. Have you heard of the Indoor Air Quality Certification Scheme?

☐ Yes   ☐ No

11. If you answered yes to Q10, which class do you think this shopping mall belongs to?

☐ Good   ☐ Excellent   ☐ Uncertified   ☐ Don't know

12. **TOURISTS ONLY:** How does the air in this shopping mall compare to that of malls in your country?

☐ Better   ☐ Similar   ☐ Worse

Management Plan

1. Does an indoor air quality digital display that shows certain qualities about the air seem like something you would check or use?

☐ Yes   ☐ No

2. Would you use a "satisfaction/complaint system" for the mall regarding Indoor Air Quality if it improved your shopping experience?

☐ Yes   ☐ No

Additional Comments

_____

_____

室內空氣質素問卷調查

個人資訊

1. 性別　　☐ 男　　☐ 女　　☐ 其他
2. 年齡　　☐ <18　　☐ 18-30　　☐ 31-64　　☐ >64
3. 居住地　☐ 香港　　☐ 中國內地　☐ 其他＿＿＿＿＿＿＿
4. 您一般多久來一次這個購物中心？
☐ 每天　　　☐ 每週 2 或 3 次　　　☐ 每週 1 次　　　☐ 每月 2 或 3 次
☐ 每月 1 次　☐ 每年 2 或 3 次　　　☐ 不經常

空氣品質

1. 這個購物中心的室內空氣質素對您的影響如何？

正面 - 1	2	3	4	5 - 負面

2. 這個購物中心的室內空氣流通程度如何？

合適 - 1	2	3	4	5 - 太強或弱

3. 這個購物中心的室內空氣氣味如何？

無異味 - 1	2	3	4	5 - 有異味

4. 這個購物中心的室內空氣濕度如何？

合適 - 1	2	3	4	5 - 太濕潤或乾燥

5. 這個購物中心的室內溫度如何？

合適 - 1	2	3	4	5 - 太熱或冷

6. 您覺得今天這個購物中心的室內空氣質素如何？

好 - 1	2	3	4	5 - 差

7. 您覺得今天這個購物中心周圍的室外空氣質素如何？

好 - 1	2	3	4	5 - 差

8. 根據您的個人標準，您對這個購物中心的室內空氣質素滿意嗎？
☐ 滿意　　☐ 不滿意　　☐ 不清楚

9. 購物中心的室內空氣質素會影響您消費的多少嗎？
☐ 會　　☐ 不會

10. 您有聽說過室內空氣質素檢定計劃嗎？
☐ 有　　☐ 沒有

11. 如果您聽說過，您覺得這個購物中心的室內空氣質素得到什麼評級？
☐ 良好　　☐ 卓越　　☐ 未評級　　☐ 不清楚

12. **如果您是遊客：** 這個購物中心的室內空氣質素與貴國或地區的購物中心相比？
☐ 好　　☐ 相似　　☐ 差

管理計畫

1. 購物中心內如有顯示室內空氣質素相關資訊的電子顯示幕，您是否會感興趣？
☐ 會　　☐ 不會

2. 如果「滿意度評價和投訴系統」能夠改善您的購物體驗，您會願意使用它嗎？
☐ 會　　☐ 不會

其他

＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿
＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿＿

室内空气质量问卷调查

个人信息

1. 性别 ☐ 男 ☐ 女 ☐ 其他
2. 年龄 ☐ <18 ☐ 18-30 ☐ 31-64 ☐ >64
3. 居住地 ☐ 香港 ☐ 中国内地 ☐ 其他_____
4. 您一般多久来一次这个购物中心？
☐ 每天 ☐ 每周 2 或 3 次 ☐ 每周 1 次 ☐ 每月 2 或 3 次
☐ 每月 1 次 ☐ 每年 2 或 3 次 ☐ 不经常

空气质量

1. 这个购物中心的室内空气质量对您的影响如何？

| 正面 – 1 | 2 | 3 | 4 | 5 – 负面 |

2. 这个购物中心的室内空气流通程度如何？

| 合适 – 1 | 2 | 3 | 4 | 5 – 太强或弱 |

3. 这个购物中心的室内空气气味如何？

| 无异味 – 1 | 2 | 3 | 4 | 5 – 有异味 |

4. 这个购物中心的室内空气湿度如何？

| 合适 – 1 | 2 | 3 | 4 | 5 – 太湿润或干燥 |

5. 这个购物中心的室内温度如何？

| 合适 – 1 | 2 | 3 | 4 | 5 – 太热或冷 |

6. 您觉得今天这个购物中心的室内空气质量如何？

| 好 – 1 | 2 | 3 | 4 | 5 – 差 |

7. 您觉得今天这个购物中心周围的室外空气质量如何？

| 好 – 1 | 2 | 3 | 4 | 5 – 差 |

8. 根据您的个人标准，您对这个购物中心的室内空气质量满意吗？
☐ 满意 ☐ 不满意 ☐ 不清楚

9. 购物中心的室内空气质量会影响您消费的多少吗？
☐ 会 ☐ 不会

10. 您有听说过室内空气质量检定计划吗？
☐ 有 ☐ 没有

11. 如果您听说过，您觉得这个购物中心的室内空气质量得到什么评级？
☐ 良好 ☐ 卓越 ☐ 未评级 ☐ 不清楚

12. **如果您是游客：** 这个购物中心的室内空气质量与贵国或地区的购物中心相比？
☐ 好 ☐ 相似 ☐ 差

管理计划

1. 购物中心内如有显示室内空气质量相关信息的电子显示屏，您是否会感兴趣？
☐ 会 ☐ 不会

2. 如果"满意度评价和投诉系统"能够改善您的购物体验，您会愿意使用它吗？
☐ 会 ☐ 不会

其他

_____

_____

Appendix D: Survey Data

Table D-1 Massachusetts Mall 1 Data

Mall Number	Personal Information				Air Quality								Mgmt. Plan		
	1	2	3	4	1	2	3	4	5	6	7	8	1	2	3
1	Male	18-30	Once a month	No	No	Yes	No	No	4	No Pollution, No sickness	No		Yes	4	No
1	Male	18-30	Everyday	No	Yes	Yes	No	No	4	Good Health	No		Yes	3	Yes
1	Female	65>	3 Times a week	No	No	No	No	No	5		No		Yes	2	Yes
1	Male	30-65	1 - 2 times per week	Yes	Yes	Yes	Yes	Yes	3		No		No	1	Yes
1	Female	18-30	Bi-weekly	No	Yes	No	Yes	Yes	4		No		No	2	Yes
1	Male	18-30	Very rarely	No	Yes	No	No	Yes	4		No		Yes	3	Yes
1	Female	18-30	twice per month	No	No	Yes	Yes	Yes	5		No		No	4	No
1	Male	18-30	Not very often	No	No	No	No	Yes	3		No		Yes	2	Yes
1	Male	18-30	Rarely	No	No	No	No	Yes	4		No		Yes	1	No
1	Female	65>	Twice a month	No	Yes	Yes	Yes	Yes	3	Pollution	Yes	Clothing	No	1	No
1	Female	18-30	Twice a month	No	No	No	No	Yes	2	Dust/pollution	Yes	Sick People	No	3	Yes
1	Female	18-30	Once a week	No	Yes	No	Yes	Yes	2	Environmental Issues	Yes	So many different people/perfumes	Yes	2	Yes
1	Female	30-65	4 times a year	No	Yes	No	Yes	Yes	3	Pollution	Yes		Yes	3	Yes
1	Male	30-65	Once a month	No	Yes	Yes	Yes	Yes	3	Pollution	Yes		Yes	4	Yes
1	Male									Heating / Cold weather	Yes		Yes	4	Yes
1	Male	18-30	Once a month	Yes	Yes	Yes	Yes	Yes	5	Smog	No		No		No
1	Female	18-30	once every 3 months	No	No	No	Yes	No	3	ozone, smog, coal, China, industry, dust, HEPA	No		No	1	No
1	Male	18-30	Not very often	No	Yes	No	Yes	Yes	4	dirty, pollution, clean, fresh	No		No	2	No
1	Male	18-30	rarely	No	Yes	No	Yes	Yes	4	Pollution. Smog. Respirator. Cancer. Allergies.	No		Yes	3	No
1	Male	18-30	2 times a month	No	Yes	No	Yes	Yes	4	The air quality index posted in my local newspaper	Yes		No	4	No
1	Female	18-30	once every few months	No	Yes	Yes	Yes	Yes	3	Healthy, excercise, over wight, dirty	Yes	Perfumes sprays	Yes	1	No
1	Male	18-30	Not Often	No	No	No	No	Yes	4	The amount of harmful qualities or lack thereof in a certain volume of air.	Yes		Yes	3	Yes
1	Female	18-30	Once a month	No	No	No	No	Yes	4	Pollution	Yes	food	Yes	3	Yes
1	Female	18-30	Once a month	No	No	Yes	Yes	Yes	4	Pollution	Yes		Yes	2	Yes
1	Female	18-30	rarely	No	No	No	No	Yes	3	Pollution, smog, breathing	Yes		Yes	4	Yes
1	Female	18-30	Twice a month	No	No	No	No	Yes	4	Breathing, Healthy, Filtration, Air borne, pathogens, The grinaldi device	Yes	body odor	Yes	3	Yes
1	Female	18-30	Some	No	Yes	Yes	Yes	Yes	4	Pollution and carbon admissions. Also business that admit toxic chemical fumes like dry cleaners or factories that use harsh chemicals in their work.	Yes		Yes	1	Yes
1	Female	18-30	once a month	No	Yes	Yes	Yes	Yes	2	Musty, recycled, possibly containing plague.	Yes		Yes	4	Yes
1	Male	18-30	not very often	No	No	Yes	Yes	Yes	4	Filter and oxygen bar	Yes		Yes	3	No

Table D-2 Massachusetts Mall 2 Data

| Mall | Personal Information | | | | Air Quality | | | | | | | | Mgmt. Plan | | | | | |
Number	1	2	3	4	1	2	3	4	5	6	7	8	1	2	3	4	5	6
2	Male	65>	1-2x month	Yes	Yes	No	Yes	4		Gas fumes…cigarette smoke.	No		Yes	3	2	1	4	Yes
2	Male	18-30	2 to 5 times a week	No	Yes	Yes	Yes	4		Pollution	No		Yes	4	3	1	2	Yes
2	Female	18-30	2-3 times a month	Yes	Yes	Yes	Yes	4		pollution pollen allergies asthma	No		Yes	3	2	1	4	Yes
2	Female	18-30	once a month	No	No	No	No	3			No		No					No
2	Female	18-30	monthly	No	No	No	No	5		Clean	No		No					No
2	Male	18-30	Once per Week	No	No	Yes	No	4		Fresh air, health	No		No					No
2	Male	18-30	Twice a month	No	No	No	Yes	5		Fresh	No		Yes	3	2	1	4	Yes
2	Female	<18	2 times a month	No	No	No	No	3			No		Yes	4	3	2	1	No
2	Male	18-30	1 time a year	No	Yes	No	Yes	4		pollution, febreeze, dust, cleaning sprays, germs	Yes	cleaning products	Yes	2	3	4	1	No
2	Male	18-30	5 time a year	No	Yes	Yes	No	3			Yes	Perfumes/food	Yes	1	2	3	4	Yes
2	Male	18-30	Couple times a year	No	Yes	Yes	Yes	4		Not too much concern.	Yes		Yes	2	1	4	3	Yes
2	Male	18-30	Not often	No	No	No	No	3		Pollution	Yes		Yes	1	2	3	4	Yes
2	Male	18-30	Not often	No	Yes	Yes	Yes	5			Yes		Yes	1	2	3	4	Yes
2	Male	18-30	Once a week	No	Yes	Yes	Yes	1		Petrochemical factory that I can see from my home. Smell of coal, cars, industry, politicians, factory owners.	Yes		Yes	3	2	4	1	Yes
2	Female	18-30	Once per Week	No	Yes	No	No	4		Ok	Yes	Population Density	No	4	2	1	3	Yes
2	Male	18-30	Once per Week	No	No	No	No	5		Healthy	Yes	Air Pump	Yes	1	3	2	4	Yes
2	Male	18-30	Once per Week	No	Yes	Yes	Yes	4		Illness Pollution	Yes	Illness ventaliation	Yes	1	4	2	3	Yes
2	Male	18-30	Rarely	No	Yes	No	Yes	2		Cleanliness	Yes		No	3	4	1	2	Yes
2	Male	18-30	twice a year	No	Yes	Yes	Yes	4		SMOG Check	Yes		Yes	1	3	4	2	Yes
2	Female	30-65	once a week	No	Yes	Yes	Yes	3			Yes		Yes	2	1	4	3	Yes
2	Female	30-65	3 times a month	No	Yes	Yes	Yes	4			Yes		Yes	4	1	3	2	Yes
2	Female	30-65	2-3 times a month	No	Yes	Yes	Yes	3			Yes		Yes	2	1	4	3	Yes

Table D-3 Hong Kong Mall 1 Data

Mall	Personal Information				Air Quality												Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	female	18-30	Malaysia	less often	2	2	4	3	3	3	3	yes	no	no		Similar	yes	yes
1	female	18-30	Malaysia	less often	1	2	1	1	1	1	1	yes	no	no	Don't know	Better	no	yes
1	male	<18	Taiwan	less often	1	1	3	1	2	2	1	yes	yes	no	Excellent	Similar	no	no
1	female	<18	Taiwan	less often	2	2	1	3	3	3	3	yes	yes	no	Excellent	Better	yes	yes
1	female	<18	Taiwan	less often	2	1	2	1	1	1	1	yes	no	no	Good	Better	yes	yes
1	female	31-64	Mainland	2/3 times per year	2	2	3	3	2	2	2	yes	no	no	Don't know	Better	yes	yes
1	female	<18	Mainland	less often	3	3	3	1	1	1	1	yes	no	no	Don't know	Better	no	yes
1	female	31-64	Mainland	less often	2	2	2	2	2	2	2	yes	yes	no		Better	yes	yes
1	male	18-30	Mainland	less often	3	3	2	2	2	3	3	Don't Know	yes	no	Good	Similar	yes	yes
1	male	18-30	Mainland	2/3 times per month	2	2	1	1	1	2	1	yes	no	no	Don't know	Better	no	yes
1	female	31-64	Hong Kong	2/3 times per month	3	3	3	4	3	3	3	yes	no	no			yes	no
1	female	31-64	Mainland	2/3 times per year	2	4	3	4	3	3	2	yes	yes	yes	Uncertified	Better	yes	yes
1	female	18-30	Hong Kong	2/3 times per week	3	3	3	2	2	2	2	yes	yes	no		Better	yes	yes
1	female	31-64	Hong Kong	2/3 times per month	4	3	2	3	3	3	4	yes	yes	no			yes	no
1	female	31-64	Mainland	less often	2	2	3	2	1	2	1	yes	no	no	Good	Similar	yes	yes
1	female	<18	Hong Kong	everyday	2	2	1	1	1	2	1	yes	no	no	Good	Better	no	no
1	female	18-30	Mainland	less often	1	2	1	3	1	2	1	yes	yes	no	Good	Better	yes	yes
1	female	18-30	Mainland	less often	3	3	4	4	2	2	3	yes	yes	no	Good	Similar	no	yes
1	female	18-30	Mainland	2/3 times per year	3	4	2	3	3	3	4	no	no	yes	Uncertified	Better	yes	yes
1	male	18-30	Hong Kong	2/3 times per week	3	3	3	3	3	2	2	yes	yes	no			no	yes
1	male	31-64	Mainland	2/3 times per year	2	1	1	1	1	1	1	yes	yes	yes	Good	Better	yes	yes
1	female	18-30	Hong Kong	everyday	3	3	2	3	3	3	2	yes	yes	no	Don't know	Better	yes	yes
1	female	18-30	Mainland	2/3 times per month	2	3	3	1	2	3	1	no	yes	no		Similar	yes	yes
1	female	31-64	Mainland	less often	3	3	1	3	3	3	3	yes	no	no	Uncertified	Similar	no	yes
1	female	18-30	Mainland	less often	1	1	1	1	1	1	1	yes	yes	yes	Good	Better	yes	yes
1	female	18-30	Hong Kong	Once a week	3	3	2	3	3	2	2	yes	no	yes	Good		no	no
1	female	18-30	Hong Kong	less often	2	2	2	2	1	2	1	yes	yes	yes	Don't know		no	yes
1	male	18-30	Mainland	Once a week	2	2	1	5	3	3	1	Don't Know	yes	yes	Excellent	Better	yes	yes
1	male	18-30	Mainland	less often	3	3	2	2	2	3	1	Don't Know	yes	no	Don't know	Worse	yes	yes
1	female	18-30	Mainland	less often	3	3	3	3	3	3	2	Don't Know	yes	no	Don't know	Similar	yes	yes
1	male	31-64	Hong Kong	2/3 times per week	3	3	3	3	3	3	2	yes	yes	no			yes	yes
1	male	>64	Mainland	less often	3	3	2	2	3	2	1	yes	no	yes	Good	Similar	yes	yes
1	male	18-30	Hong Kong	2/3 times per week	3	3	2	2	3	3	2	yes	yes	no			yes	yes
1	male	31-64	Mainland	less often	1	1	1	1	1	1	1	yes	no	no		Better	yes	yes
1	female	31-64	Mainland	2/3 times per year	1	1	1	1	1	1	1	yes	yes	yes	Excellent	Better	yes	yes
1	female	18-30	Mainland	Once a month	2	3	3	4	1	2	1	yes	yes	yes	Good	Similar	yes	yes
1	male	31-64	Mainland	less often	1	2	1	1	1	1	1	yes	yes	yes	Good	Similar	yes	yes
1	female	18-30	Mainland	less often	3	3	4	4	4	3	2	yes	yes	yes	Uncertified	Similar	yes	yes
1	female	18-30	Mainland	2/3 times per year	2	3	3	2	2	3	2	no	yes	no	Good	Similar	yes	yes
1	female	18-30	Hong Kong	Once a month	3	4	4	4	3	3	4	yes	yes	yes	Don't know	Similar	yes	yes
1	male	31-64	Mainland	less often	2	2	2	2	2	2	2	yes	yes	yes	Uncertified	Similar	yes	yes
1	female	18-30	Mainland	2/3 times per year	2	2	2	2	2	2	2	yes	yes	yes	Good	Worse	yes	yes
1	female	18-30	Hong Kong	Once a week	3	4	3	3	3	3	3	yes	yes	yes	Good	Similar	no	no
1	male	18-30	Mainland	less often	2	2	2	3	4	3	3	yes	no	yes	Good	Better	yes	yes
1	female	18-30	Mainland	less often	3	3	3	4	3	3	2	yes	yes	no	Uncertified	Similar	yes	yes
1	male	18-30	Hong Kong	Once a month	3	2	3	3	2	3	2	yes	no	yes	Good		yes	yes
1	male	18-30	Hong Kong	less often	2	2	2	2	2	2	3	yes	yes	no	Good	Similar	yes	yes
1	female	31-64	Hong Kong	2/3 times per week	3	3	2	3	2	2	3	yes	yes	yes	Don't know	Similar	yes	yes
1	male	31-64	Hong Kong	2/3 times per week	3	2	2	2	5	2	2	yes	yes	no	Don't know	Better	yes	yes
1	male	31-64	Hong Kong	2/3 times per week	4	3	2	3	3	3	4	yes	no	no			yes	no

Table D-4 Hong Kong Mall 2 Data

Mall Number	Personal Information				Air Quality												Mgmt. Plan	
	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
2	male	18-30	Mainland	less often	2	3	2	2	2	2	4	yes	no	no		Similar	yes	yes
2	female	18-30	Mainland	less often	2	2	2	2	2	2	2	yes	yes	yes	Good	Similar	no	yes
2	male	18-30	Mainland	2/3 times per year	3	3	3	2	2	3	4	yes	yes	no	Don't know	Similar	yes	yes
2	female	18-30	Mainland	2/3 times per year	3	3	2	4	2	2	3	yes	yes	no	Good	Similar	no	yes
2	male	<18	Mainland	2/3 times per year	2	2	2	3	3	2	1	yes	no	no	Good	Similar	yes	yes
2	female	18-30	Mainland	2/3 times per month	2	2	2	1	2	2	3	yes	yes	no	Good	Similar	yes	yes
2	male	31-64	Hong Kong	2/3 times per month	3	3	2	2	2	2	3	yes	yes	yes	Good		yes	yes
2	male	18-30	Hong Kong	2/3 times per week	4	4	1	3	3	3	3	yes	no	yes	Uncertified	Similar	no	yes
2	male	18-30	Hong Kong	once a week	3	2	2	3	2	2	3	yes	no	no			yes	yes
2	female	18-30	Hong Kong	once a week	3	3	3	3	2	4	5	yes	yes	no			yes	yes
2	female	<18	Hong Kong	once a week	3	3	1	2	4	3	4	yes	yes	yes	Uncertified	Similar	yes	yes
2	male	<18	Hong Kong	once a month	3	4	1	3	2	3	2	yes	yes	yes	Uncertified		yes	yes
2	female	18-30	Hong Kong	2/3 times per month	3	2	2	2	3	3	3	yes	yes	yes	Don't know		no	yes
2	female	<18	Hong Kong	once a week	4	4	3	3	3	2	3	no	no	no	Uncertified	Similar	no	no
2	female	<18	Hong Kong	once a month	2	2	3	3	3	2	3	yes	no	no	Don't know	Worse	no	yes
2	female	<18	Hong Kong	2/3 times per month	1	1	1	2	2	2	2	yes	no	yes	Good		no	yes
2	female	18-30	Hong Kong	less often	4	3	2	3	3	4	4	yes	yes	no	Don't know		yes	yes
2	female	18-30	Hong Kong	2/3 times per month	4	4	3	3	2	4	3	no	no	yes	Don't know	Better	yes	yes
2	female	18-30	Hong Kong	less often	3	3	3	3	3	3	2	no	no	yes	Uncertified		yes	no
2	female	18-30	Hong Kong	once a week	3	4	3	3	3	3	4	yes	no	no	Uncertified	Similar	no	yes
2	male	<18	Hong Kong	once a month	4	2	2	2	4	4	4	no	no	yes	Good	Better	yes	yes
2	male	<18	Hong Kong	once a month	4	3	2	3	3	2	3	yes	yes	no	Don't know		yes	yes
2	male	<18	Hong Kong	once a week	4	3	2	3	3	3	4	yes	no	yes	Uncertified		no	yes
2	female	<18	Hong Kong	once a month	5	4	3	4	4	4	4	no	yes	yes	Uncertified		yes	yes
2	female	18-30	Hong Kong	less often	3	3	4	3	3	3	5	Don't Know	yes	no			yes	yes
2	female	18-30	Hong Kong	once a month	2	3	2	2	2	2	4	yes	no	no	Good		yes	yes
2	female	18-30	Hong Kong	2/3 times per week	2	3	2	3	4	4	5	yes	yes	no			yes	yes
2	female	18-30	Hong Kong	less often	3	3	3	3	3	3	3	yes	no	no	Don't know		yes	yes
2	female	<18	Hong Kong	2/3 times per week	3	3	2	3	2	2	4	yes	no	yes	Good	Similar	yes	no
2	female	18-30	Hong Kong	2/3 times per month	4	4	4	3	3	3	4	Don't Know	yes	yes	Uncertified	Similar	yes	yes
2	female	<18	Hong Kong	once a week	3	3	2	3	2	3	4	yes	yes	no	Uncertified	Better	yes	yes
2	female	18-30	Hong Kong	2/3 times per month	4	3	3	3	3	3	4	no	no	yes	Don't know	Similar	yes	yes
2	female	<18	Hong Kong	2/3 times per month	3	3	3	3	3	3	3	Don't Know	yes	no	Uncertified	Worse	yes	yes
2	female	<18	Hong Kong	2/3 times per week	4	2	2	3	1	3	3	Don't Know	no	yes	Uncertified	Worse	yes	yes
2	male	<18	Hong Kong	2/3 times per month	2	2	3	3	2	3	4	yes	no	no			no	no
2	female	<18	Hong Kong	once a month	3	2	2	3	4	4	2	yes	yes	no			yes	yes
2	female	18-30	Hong Kong	once a week	3	4	3	3	3	4	4	no	no	yes	Uncertified	Similar	yes	yes
2	male	<18	Hong Kong	less often	4	4	3	3	3	4	4	no	no	no	Uncertified		no	no
2	male	<18	Hong Kong	once a month	3	3	4	2	2	3	4	yes	yes	yes	Don't know		yes	yes
2	male	18-30	Hong Kong	2/3 times per month	3	3	3	3	2	2	5	yes	no	no	Don't know		yes	yes
2	female	18-30	Hong Kong	once a month	3	3	2	5	1	4	1	yes	yes	no	Good	Better	no	yes
2	male	18-30	Hong Kong	2/3 times per week	3	4	2	3	4	3	4	yes	yes	no	Don't know		yes	yes
2	female	18-30	Hong Kong	2/3 times per year	3	3	3	3	3	2	4	yes	yes	no	Uncertified		no	no
2	female	18-30	Hong Kong	2/3 times per month	1	2	2	2	3	2	2	yes	no	yes	Good		yes	yes
2	female	18-30	Hong Kong	2/3 times per month	2	3	1	2	3	2	3	yes	no	no			no	yes
2	female	18-30	Hong Kong	less often	4	2	1	3	1	2	5	Don't Know	no	no	Don't know	Similar	no	no
2	female	18-30	Hong Kong	2/3 times per month	1	2	2	2	2	2	4	yes	no	yes	Don't know		yes	yes
2	female	18-30	Hong Kong	once a week	3	3	2	2	4	3	4	yes	no	no	Uncertified	Better	yes	yes
2	female	18-30	Hong Kong	2/3 times per month	1	3	1	2	2	2	3	yes	no	no	Good	Similar	yes	yes
2	female	18-30	Hong Kong	2/3 times per month	3	3	3	4	4	4	4	no	yes	no	Don't know	Worse	yes	yes

Table D-5 Hong Kong Mall 3 Data

Mall	Personal Information				Air Quality												Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
3	male	18-30	Hong Kong	less often	3	3	3	2	2	1	4	Yes	no	no	Uncertified		no	no
3	male	18-30	Hong Kong	everyday	2	2	2	3	3	2	3	Yes	no	no	good		no	no
3	male	<18	Hong Kong	less often	4	3	3	3	3	3	3	Yes	no	Yes	Excellent	Worse	yes	yes
3	male	<18	Hong Kong	2/3 times per week	3	3	3	4	2	3	3	Don't Know	no	no			yes	yes
3	female	<18	Hong Kong	less often	3	3	3	3	3	3	2	Don't Know	no	no			no	no
3	female	18-30	Hong Kong	everyday	2	2	1	2	2	2	2	yes	yes	no	Don't know		yes	yes
3	male	18-30	Hong Kong	2/3 times per week	4	3	3	3	3	4	4	yes	no	no			yes	yes
3	male	18-30	Hong Kong	everyday	3	4	1	3	2	3	3	yes	no	no			no	yes
3	male	<18	Hong Kong	less often	3	4	1	3	3	1	1	yes	no	no	good	Similar	no	yes
3	male	18-30	Mainland	less often	4	3	4	4	3	3	3	No	yes	no		Worse	yes	yes
3	male	18-30	(Blank)	less often	4	4	5	2	5	4	3	No	yes	no		worse	yes	yes
3	male	31-64	USA	2/3 times per week	2	2	1	2	2	2	1	yes	no	no			yes	yes
3	female	18-30	Hong Kong	everyday	3	3	3	3	3	4	3	yes	no	no	Uncertified	worse	yes	yes
3	male	<18	Hong Kong	2/3 times per week	2	3	2	2	3	3	3	No	yes	no	Uncertified	worse	yes	yes
3	female	18-30	Hong Kong	once a week	2	2	2	2	2	2	2	yes	yes	no	Uncertified	Similar	yes	yes
3	male	18-30	Hong Kong	2/3 times per week	4	4	3	4	4	3	3	No	yes	no	Uncertified	Similar	yes	yes
3	female	18-30	Hong Kong	2/3 times per week	3	4	3	3	4	4	4	No	yes	yes	Uncertified		yes	yes
3	male	31-64	Hong Kong	everyday	3	3	4	2	2	4	3	No	yes	yes	Uncertified	Similar	yes	yes
3	male	31-64	Hong Kong	everyday	3	5	4	3	3	3	2	No	no	yes	Don't know		yes	yes
3	female	18-30	Hong Kong	less often	3	3	3	4	3	3	2	yes	no	no	Don't know	Similar	yes	yes
3	male	18-30	Hong Kong	everyday	3	3	3	3	3	3	4	yes	yes	yes	good	Similar	no	yes
3	male	31-64	Hong Kong	everyday	2	2	3	2	3	3	3	yes	no	no			yes	yes
3	male	18-30	Hong Kong	2/3 times per week	3	4	3	4	2	3	2	yes	yes	no	Don't know	Similar	no	yes
3	male	<18	Hong Kong	less often	3	3	2	2	2	2	2	yes	no	no	Don't know		no	yes
3	male	<18	Hong Kong	everyday	2	2	1	2	1	2	1	Don't Know	no	yes	Don't know	Similar	no	no
3	female	<18	Hong Kong	2/3 times per week	3	2	3	2	3	2	2	yes	yes	no	good	Similar	yes	yes
3	male	<18	Hong Kong	once a week	2	2	1	1	1	1	1	yes	yes	yes	good		yes	yes
3	female	<18	Hong Kong	once a week	3	3	3	3	3	3	3	yes	yes	yes	Uncertified	Similar	yes	yes
3	female	18-30	Hong Kong	once a week	3	3	3	2	3	2	3	yes	no	no		Similar	no	yes
3	male	<18	Hong Kong	2/3 times per week	2	2	2	1	3	2	4	yes	no	no	Don't know	Similar	yes	yes
3	male	<18	Hong Kong	less often	4	3	4	3	2	3	3	yes	yes	no	Uncertified	Similar	yes	yes
3	male	31-64	Hong Kong	2/3 times per month	3	4	3	3	4	4	5	No	yes	yes	Don't know	Similar	yes	no
3	male	<18	Hong Kong	everyday	4	4	3	4	3	4	3	yes	no	no	Uncertified	Similar	no	yes
3	male	<18	Hong Kong	everyday	2	2	2	1	1	2	1	yes	no	yes	Excellent		yes	yes
3	male	<18	Hong Kong	2/3 times per week	4	2	2	3	2	2	3	yes	no	no	good		yes	yes
3	male	<18	Hong Kong	everyday	2	2	1	2	2	3	5	yes	no	yes	good	Similar	yes	yes
3	male	<18	Hong Kong	everyday	2	2	3	3	4	2	2	yes	yes	no	Don't know	worse	yes	yes
3	male	<18	Hong Kong	everyday	3	3	2	3	2	1	2	yes	no	no			yes	no
3	male	<18	Hong Kong	2/3 times per week	3	2	3	3	2	2	2	yes	no	no	Don't know		yes	yes
3	male	<18	Hong Kong	everyday	4	4	5	4	3	4	3	No	yes	yes	Don't know	worse	yes	yes
3	male	<18	Hong Kong	2/3 times per week	2	3	3	4	1	2	4	yes	no	no	good		yes	yes
3	male	<18	Hong Kong	2/3 times per week	2	3	3	3	2	3	4	yes	no	no	Don't know	Similar	yes	yes
3	male	18-30	Hong Kong	2/3 times per week	3	3	2	2	2	3	1	yes	no	yes	good		yes	yes
3	male	<18	Hong Kong	everyday	4	2	4	3	3	2	1	yes	no	no	Don't know	Similar	yes	yes
3	male	<18	Hong Kong	2/3 times per week	2	2	1	3	3	3	3	yes	no	no			yes	no
3	male	<18	Hong Kong	everyday	2	2	4	2	2	2	2	yes	yes	no	good	Similar	no	yes
3	male	<18	Hong Kong	2/3 times per week	1	1	1	1	1	1	1	yes	no	no	Excellent	better	yes	yes
3	male	<18	Hong Kong	everyday	1	1	1	1	2	2	2	yes	no	no	Don't know		yes	yes
3	male	31-64	Hong Kong	once a week	2	3	3	1	1	1	3	yes	yes	yes	good		no	yes
3	male	<18	Hong Kong	2/3 times per week	4	4	3	4	4	4	4	yes	no	no	good	Similar	yes	yes

Table D-6 Hong Kong Mall 4 Data

Mall	Personal Information				Air Quality													Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
4	female	18-30	Korean	once a week	4	3	2	2	3	3	4	yes	yes	no		Similar	yes	yes
4	female	18-30	Korean	less often	2	2	2	2	1	2	4	Yes	yes	no		Similar	no	yes
4	female	31-64	Mainland	less often	3	3	2	3	3	3	3	yes	no	no		better	yes	yes
4	male	31-64	Hong Kong	once a month	3	3	3	3	3	3	3	yes	no	no			no	no
4	female	18-30	Mainland	less often	4	4	1	1	1	2	3	yes	no	no	Good	better	yes	yes
4	female	18-30	Mainland	2/3 times per year	1	1	2	1	1	1	1	yes	yes	no	good	better	yes	yes
4	female	18-30	Mainland	2/3 times per year	1	1	1	1	1	1	1	yes	no	no	Don't know	Similar	yes	yes
4	female	31-64	Mainland	2/3 times per month	2	2	1	1	2	2	3	yes	yes	no		better	no	yes
4	female	18-30	Hong Kong	everyday	3	4	2	3	2	3	4	yes	no	no	Don't know	worse	yes	yes
4	female	18-30	Hong Kong	everyday	3	4	2	3	2	4	5	yes	no	no	Don't know	worse	yes	yes
4	female	<18	Mainland	less often	4	3	4	3	3	4	4	yes	no	no	Good	Similar	yes	yes
4	female	31-64	USA	less often	3	2	1	1	2	2	2	yes	yes	no			no	no
4	male	18-30	Hong Kong	less often	3	3	3	3	3	3	3	yes	no	no	Don't know	Similar	no	no
4	female	18-30	Hong Kong	once a week	3	3	1	2	4	2	3	Yes	Yes	no			yes	yes
4	female	18-30	Hong Kong	2/3 times per month	2	3	2	3	3	2	3	yes	yes	no			yes	yes
4	male	31-64	Hong Kong	2/3 times per month	3	3	3	3	3	3	3	yes	yes	no			yes	yes
4	male	18-30	Hong Kong	once a week	2	2	2	2	3	1	3	yes	yes	no			yes	yes
4	female	18-30	Mainland	less often	3	2	3	2	2	2	2	yes	yes	yes	good	better	yes	yes
4	male	18-30	Hong Kong	less often	3	3	3	3	2	2	5	yes	yes	yes	good		yes	yes
4	female	31-64	Hong Kong	2/3 times per month	2	2	1	2	2	2	3	yes	no	yes	Excellent		yes	yes
4	female	18-30	Hong Kong	less often	3	4	5	3	3	4	4	no	no	yes	Don't know		yes	yes
4	male	18-30	Hong Kong	2/3 times per year	2	2	2	2	2	2	2	yes	no	yes	Don't know		yes	no
4	female	18-30	Hong Kong	2/3 times per year	2	2	2	2	2	2	2	yes	yes	yes	Don't know		no	yes
4	female	18-30	Hong Kong	2/3 times per month	3	3	2	4	4	3	5	yes	no	no	Don't know		no	yes
4	female	18-30	Hong Kong	once a week	3	2	2	1	2	2	2	Yes	no	no	Don't know		no	no
4	male	31-64	Mainland	less often	2	2	2	2	2	2	2	yes	yes	no		Similar	no	no
4	female	<18	Hong Kong	less often	3	2	3	3	3	3	3	yes	no	yes	Don't know		yes	no
4	male	31-64	Hong Kong	everyday	2	2	2	2	2	3	4	yes	no	no	Excellent		yes	yes
4	female	18-30	Hong Kong	2/3 times per year	3	2	3	3	4	3	2	no	yes	yes	Uncertified		yes	yes
4	female	18-30	Hong Kong	less often	3	4	4	4	4	4	4	yes	no	no	Good	Similar	no	no
4	female	18-30	Hong Kong	less often	3	4	3	4	5	3	3	Don't Know	yes	no	Don't know	better	no	yes
4	female	18-30	Hong Kong	less often	4	3	3	3	3	3	5	yes	no	no	Good	Similar	no	yes
4	female	<18	Hong Kong	less often	5	5	3	4	5	4	4	no	yes	no	Don't know	worse	yes	yes
4	female	<18	Hong Kong	less often	3	4	4	4	4	4	4	Yes	no	no	Good	Similar	yes	yes
4	female	<18	Hong Kong	less often	5	5	4	4	4	4	3	no	no	no	Don't know	Similar	no	no
4	female	<18	Hong Kong	2/3 times per week	3	4	4	4	4	3	3	yes	no	no		Similar	yes	yes
4	female	18-30	Hong Kong	2/3 times per month	2	3	3	3	3	2	3	No	yes	yes	Don't know	Similar	yes	yes
4	male	18-30	Mainland	less often	3	3	3	2	2	3	3	yes	yes	no		Similar	yes	yes
4	Female	18-30	Hong Kong	less often	5	4	3	3	3	4	1	No	Yes	no	Don't know	Similar	No	Yes
4	female	18-30	Mainland	2/3 times per year	4	4	3	4	3	5	2	No	No	no	Uncertified	Similar	yes	yes
4	female	18-30	Hong Kong	less often	3	3	2	4	4	3	4	Yes	Yes	no	Don't know		Yes	yes
4	female	18-30	Hong Kong	once a month	2	2	2	2	3	3	3	Yes	yes	no			Yes	yes
4	female	18-30	Mainland	less often	3	4	3	3	2	3	3	Don't Know	yes	no	Don't know	similar	no	no
4	male	18-30	Hong Kong	2/3 times per month	3	2	3	3	1	2	5	Don't Know	no	yes	Uncertified	similar	yes	yes
4	female	18-30	Hong Kong	once a week	3	4	4	3	2	4	4	No	yes	yes	Uncertified	better	yes	yes
4	female	18-30	Hong Kong	everyday	3	4	3	3	4	4	5	Don't Know	no	no			no	yes
4	female	18-30	Hong Kong	Everyday	4	3	2	4	4	4	4	No	no	no	Don't know		yes	yes
4	female	18-30	Hong Kong	everyday	4	2	2	3	4	3	4	no	yes	no	Don't know		no	yes
4	male	18-30	Hong Kong	less often	2	1	2	1	3	2	2	yes	no	no	good	better	no	no
4	female	<18	Hong Kong	less often	2	2	2	2	2	3	4	yes	no	no	Don't know	similar	yes	yes

Table D-7 Hong Kong Mall 5 Data

Mall	Personal Information				Air Quality												Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
5	female	18-30	Mainland	less often	3	2	4	3	3	3	1	yes	no	no	Don't know	Better	yes	yes
5	male	31-64	Italy	2/3 times per year	3	5	3	5	5	1	2	yes	no	yes	Don't know	Worse	no	yes
5	male	>64	Mainland	2/3 times per year	2	1	2	2	1	2	1	yes	yes	yes	Good	Similar	yes	yes
5	male	31-64	Mainland	less often	1	1	1	2	1	1	2	yes	yes	no	Don't know	Better	yes	yes
5	male	18-30	Thailand	2/3 times per year	2	2	3	3	2	2	3	yes	yes	yes	Good	Similar	yes	no
5	female	18-30	Mainland	less often	3	4	3	3	3	2	1	yes	yes	no	Good	Better	yes	yes
5	male	31-64	USA	less often	3	3	3	3	3	3	3	yes	yes	no		Worse	yes	yes
5	male	18-30	Mainland	2/3 times per year	2	2	2	1	1	1	1	yes	yes	no	Good	Better	yes	yes
5	male	31-64	Mainland	less often	2	2	1	3	3	3	1	yes	yes	no		Similar	yes	yes
5	female	18-30	Mainland	2/3 times per year	2	2	2	2	2	2	2	yes	yes	no	Don't know	Better	yes	yes
5	female	31-64	Poland	less often	2	1	1	1	1	1	1	yes	yes	no	Excellent	Similar	yes	yes
5	female	18-30	Poland	less often	2	1	1	2	2	1	1	yes	yes	no		Better	yes	yes
5	female	18-30	Poland	less often	1	1	1	1	1	1	1	yes	yes	no		Similar	yes	yes
5	female	18-30	Mainland	less often	3	3	3	3	3	3	3	yes	yes	no	Good	Similar	yes	yes
5	female	18-30	Hong Kong	2/3 times per year	2	1	2	2	2	2	1	yes	yes	no	Don't know	Similar	no	yes
5	female	<18	Mainland	less often	2	1	5	3	2	2	1	yes	no	yes	Uncertified	Similar	no	yes
5	female	18-30	Malaysia	less often	3	3	3	3	3	2	2	yes	no	no	Don't know	Similar	yes	yes
5	female	18-30	Malaysia	less often	2	2	1	2	2	2	2	yes	no	no	Don't know	Similar	no	yes
5	female	18-30	Brazil	less often	2	2	3	2	2	2	3	yes	yes	no		Similar	no	yes
5	female	18-30	UK	less often	2	1	2	1	2	2	1	yes	yes	no		Similar	no	yes
5	female	18-30	Mainland	less often	2	1	1	3	1	2	1	yes	no	no	Good	Better	yes	yes
5	male	18-30	Mainland	less often	2	3	2	3	3	3	3	yes	no	no	Don't know	Better	yes	yes
5	female	18-30	Mainland	less often	3	2	2	1	2	3	1	yes	yes	no	Good	Better	yes	yes
5	female	18-30	Mainland	less often	2	4	1	1	1	2	1	yes	yes	yes	Good	Similar	yes	yes
5	male	18-30	Mainland	less often	2	2	1	2	3	2	1	yes	yes	no	Good	Better	yes	yes
5	male	18-30	Brazil	less often	2	3	2	3	2	2	2	yes	no	no	Good	Similar	yes	no
5	male	31-64	Poland	less often	1	1	2	1	2	2	1	yes	yes	no		Similar	yes	yes
5	male	31-64	Other	2/3 times per year	3	2	2	2	2	2	3	yes	no	no		Similar	no	yes
5	female	<18	Korea	less often	1	1	2	2	1	1	1	yes	yes	yes	Excellent	Better	yes	yes
5	male	31-64	Mainland	less often	2	3	2	3	3	3	4	Don't know	yes	yes	Uncertified	Similar	yes	yes
5	female	31-64	Mainland	less often	4	3	4	3	3	3	3	Don't know	yes	no	Uncertified	Similar	yes	yes
5	male	31-64	Hong Kong	less often	1	1	1	3	1	1	1	yes	no	no	Good		no	yes
5	male	31-64	Mainland	less often	2	2	2	2	1	2	1	yes	no	no		Better	yes	yes
5	male	31-64	Hong Kong	less often	2	2	1	2	3	2	2	yes	no	no	Uncertified	Better	no	no
5	male	31-64	Mainland	less often	1	1	1	1	1	1	1	yes	yes	yes	Excellent	Better	yes	yes
5	Male	31-64	USA	Once a month	1	1	1	1	1	1	3	yes	no	no			no	yes
5	Female	31-64	UK	Less Often	1	1	2	1	2	1	2	yes	no	no		Similar	yes	yes
5	Female	18-30	UK	Less Often	1	1	3	1	2	2	3	yes	no	no		Similar	yes	no
5	Female	18-30	Australia	Less Often	1	2	1	2	1	1	2	yes	no	no		Similar	no	no
5	Female	31-64	Australia	Less Often	1	1	1	1	1	1	2	yes	yes	no		Better	yes	yes
5	male	31-64	Mainland	less often	3	2	2	3	3	3	1	yes	yes	no		Similar	yes	yes
5	male	31-64	Mainland	less often	3	2	1	2	2	2	1	yes	yes	no		Similar	yes	yes
5	male	18-30	Mainland	less often	2	3	3	3	3	4	2	Don't know	yes	no	Don't know	Similar	yes	yes
5	male	18-30	Mainland	less often	1	2	1	1	1	1	1	yes	no	no	Good	Better	yes	yes
5	female	18-30	Mainland	2/3 times per year	3	2	2	3	3	1	1	yes	yes	no		Similar	yes	yes
5	female	18-30	Mainland	2/3 times per year	2	2	2	2	3	2	2	yes	yes	no	Don't know	Similar	yes	yes
5	male	18-30	Hong Kong	less often	2	2	1	1	5	4	1	Don't know	no	no	Don't know	Worse	yes	yes
5	female	<18	Hong Kong	less often	3	4	4	3	4	3	4	Don't know	yes	no	Uncertified	Worse	yes	yes
5	male	<18	Hong Kong	2/3 times per week	2	2	2	3	5	4	1	yes	yes	no	Excellent	Better	yes	yes
5	female	<18	Hong Kong	less often	1	3	1	1	2	1	2	yes	yes	no			yes	no

Table D-8 Hong Kong Mall 6 Data

Mall	Personal Information				Air Quality												Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
6	female	<18	Hong Kong	once a week	4	3	4	3	4	4	4	yes	yes	no	Excellent		yes	yes
6	female	18-30	Hong Kong	once a month	3	3	2	2	3	2	3	yes	yes	no			yes	yes
6	female	<18	Hong Kong	less often	2	2	2	2	2	2	2	yes	no	yes	Don't know	Similar	no	yes
6	female	18-30	Hong Kong	2/3 times per week	3	3	3	2	2	3	3	yes	no	yes	Uncertified	Similar	no	no
6	male	18-30	Hong Kong	2/3 times per week	3	3	4	2	3	3	4	Yes	No	no	Uncertified	Similar	yes	yes
6	female	18-30	Hong Kong	less often	3	4	1	3	1	4	4	No	no	no	Don't know	Worse	yes	yes
6	female	18-30	Hong Kong	once a week	2	2	2	2	2	2	3	yes	yes	no			yes	yes
6	female	18-30	Hong Kong	less often	2	2	1	2	2	1	2	Yes	Yes	no	Don't know		yes	yes
6	male	18-30	Hong Kong	once a month	4	3	3	4	3	4	4	No	yes	no			yes	no
6	female	<18	Hong Kong	once a month	3	3	2	2	2	3	4	Yes	Yes	no	Uncertified	Similar	yes	yes
6	male	18-30	Hong Kong	less often	2	2	2	2	3	2	3	yes	no	yes	good		yes	yes
6	female	<18	Hong Kong	less often	3	2	1	3	2	2	3	Yes	Yes	yes	good	better	yes	yes
6	female	<18	Hong Kong	2/3 times per month	2	2	1	2	3	2	2	yes	yes	yes	good		yes	yes
6	female	18-30	Hong Kong	less often	1	1	1	3	3	3	3	yes	yes	yes	good		yes	yes
6	male	18-30	Hong Kong	2/3 times per week	3	3	3	3	2	3	3	No	yes	no	Don't know		yes	yes
6	male	18-30	Hong Kong	once a month	1	2	1	3	4	2	4	yes	no	no	Don't know	Similar	no	no
6	male	18-30	Hong Kong	2/3 times per week	3	3	1	1	1	1	2	Yes	yes	yes	good		yes	yes
6	male	18-30	Hong Kong	less often	3	3	3	3	2	3	2	Don't Know	yes	no	Don't know		yes	yes
6	female	18-30	Hong Kong	once a week	3	2	3	2	2	2	3	Yes	no	no			yes	yes
6	female	31-64	Hong Kong	2/3 times per week	3	3	3	3	3	2	3	Yes	no	no	good	Similar	no	no
6	male	<18	Hong Kong	2/3 times per week	2	1	1	2	2	1	1	Yes	no	no	Don't know	Similar	yes	yes
6	female	<18	Hong Kong	2/3 times per week	1	1	1	2	2	2	2	yes	yes	yes	Excellent		no	yes
6	male	31-64	Hong Kong	2/3 times per week	4	4	4	4	4	4	4	yes	yes	yes	good	Similar	yes	yes
6	female	18-30	Hong Kong	2/3 times per week	2	2	2	3	2	2	2	yes	yes	no	Don't know		yes	yes
6	male	18-30	Hong Kong	2/3 times per week	3	3	2	2	3	3	2	yes	yes	no	Don't know		yes	yes
6	female	18-30	Hong Kong	less often	4	3	3	4	3	3	4	yes	no	no	good	Similar	no	Yes
6	male	18-30	Hong Kong	2/3 times per month	4	2	2	3	2	4	2	yes	yes	yes	good		yes	yes
6	female	18-30	Hong Kong	less often	4	3	4	3	4	3	3	yes	no	yes	Uncertified		yes	yes
6	female	18-30	Hong Kong	2/3 times per week	1	1	1	1	1	1	3	yes	no	no	good	Similar	no	no
6	female	18-30	Hong Kong	once a week	2	3	3	3	4	4	2	Yes	no	yes	Don't know		yes	no
6	male	18-30	Hong Kong	2/3 times per week	3	3	2	2	4	1	2	yes	no	no			no	no
6	female	18-30	Hong Kong	2/3 times per week	3	2	1	3	1	2	4	yes	yes	no	Uncertified	Similar	yes	yes
6	male	18-30	Hong Kong	less often	3	4	1	2	2	2	3	yes	no	no			yes	yes
6	male	18-30	Hong Kong	2/3 times per week	2	2	1	2	2	2	2	yes	yes	no		Similar	yes	yes
6	female	18-30	Hong Kong	less often	3	3	3	2	3	3	4	Yes	no	no	good		no	yes
6	female	18-30	Hong Kong	once a week	2	2	2	2	2	2	2	yes	no	yes	Excellent		no	yes
6	male	18-30	Hong Kong	once a month	2	2	4	3	3	2	4	yes	no	no	Uncertified	Similar	no	no
6	male	18-30	Hong Kong	once a month	2	3	3	2	3	3	2	yes	yes	no	Excellent	Similar	no	yes
6	female	<18	Hong Kong	everyday	2	1	3	2	2	1	1	Yes	no	yes	Excellent	Similar	no	yes
6	male	18-30	Mainland	once a week	4	3	3	2	4	3	2	Yes	yes	yes	good	Better	no	no
6	female	31-64	Hong Kong	2/3 times per week	3	2	2	3	1	3	3	Yes	no	yes	good	Better	yes	yes
6	male	18-30	Hong Kong	2/3 times per month	3	4	1	3	2	2	3	yes	no	no	Uncertified	Better	yes	yes
6	female	18-30	Hong Kong	2/3 times per month	2	2	3	3	2	3	4	yes	no	yes	Don't know		yes	yes
6	male	18-30	Hong Kong	2/3 times per month	3	5	4	4	4	3	3	No	yes	yes	Uncertified		no	yes
6	female	18-30	Hong Kong	everyday	2	2	3	3	4	2	4	Yes	yes	yes	good	better	yes	yes
6	male	18-30	Hong Kong	2/3 times per year	2	3	2	3	3	2	4	yes	no	no			yes	yes
6	male	18-30	Mainland	less often	2	1	1	1	1	1	2	yes	no	no		Similar	yes	yes
6	male	18-30	Mainland	less often	2	3	3	2	3	2	3	yes	yes	no	good	Similar	yes	yes
6	male	31-64	Mainland	less often	2	2	2	2	2	2	2	yes	yes	no		Similar	yes	yes
6	male	<18	Mainland	less often	1	1	1	1	2	1	1	yes	no	no	Excellent	Similar	no	yes

Table D-9 Hong Kong Mall 7 Data

| Mall | Personal Information | | | | Air Quality | | | | | | | | | | | | Mgmt. Plan | |
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
7	female	31-64	Hong Kong	everyday	3	2	1	1	2	2	1	yes	yes	no	Good	Similar	yes	no
7	male	<18	Hong Kong	less often	2	2	2	2	2	2	2	yes	yes	no	Excellent	Similar	yes	yes
7	male	<18	Hong Kong	once a week	2	1	2	3	3	3	3	yes	yes	no	Excellent	Similar	yes	yes
7	male	<18	Hong Kong	everyday	3	3	2	2	3	3	4	yes	yes	yes	Excellent	Better	yes	no
7	male	<18	Hong Kong	once a month	2	1	1	3	2	2	1	yes	yes	no	Uncertified	Similar	yes	yes
7	male	18-30	Hong Kong	less often	3	2	2	2	2	1	2	yes	yes	yes	Excellent		no	yes
7	female	18-30	Hong Kong	less often	2	2	2	2	2	2	1	yes	yes	yes	Good	Better	yes	yes
7	female	18-30	Hong Kong	2/3 times per week	2	2	1	2	3	2	2	yes	yes	no	Excellent		no	yes
7	female	18-30	Hong Kong	2/3 times per week	3	4	3	3	3	4	4	no	yes	no			yes	yes
7	female	31-64	Hong Kong	2/3 times per week	3	2	1	3	2	2	3	yes	yes	no			yes	no
7	female	31-64	Hong Kong	2/3 times per week	1	2	1	1	1	1	2	yes	no	no	Good		yes	yes
7	male	31-64	Hong Kong	once a month	3	3	2	2	2	2	2	yes	yes	no			no	yes
7	female	18-30	Hong Kong	everyday	3	3	3	3	3	2	3	no	no	no	Uncertified	Worse	no	no
7	male	31-64	Hong Kong	2/3 times per week	3	4	4	5	4	5	5	yes	no	yes	Uncertified	Similar	yes	yes
7	female	31-64	Hong Kong	everyday	4	4	3	4	3	3	3	yes	yes	no			yes	yes
7	male	31-64	Hong Kong	less often	3	3	2	3	2	3	3	yes	no	no	Don't know		yes	yes
7	female	18-30	Hong Kong	2/3 times per week	2	2	2	2	3	2	4	yes	no	no			no	yes
7	male	18-30	Hong Kong	2/3 times per week	1	1	1	2	3	2	4	yes	yes	no			yes	yes
7	female	18-30	Hong Kong	2/3 times per week	3	4	3	4	4	4	4	no	yes	no			yes	yes
7	female	31-64	Hong Kong	2/3 times per year	2	2	2	2	2	2	2	yes	yes	yes	Uncertified		yes	yes
7	male	<18	Hong Kong	2/3 times per month	3	2	2	3	1	2	4	yes	no	yes	Don't know		yes	yes
7	male	18-30	Hong Kong	2/3 times per week	2	2	2	2	2	2	3	yes	yes	no	Excellent	Better	yes	yes
7	female	<18	Hong Kong	less often	3	2	2	2	2	2	2	yes	yes	no	Don't know		yes	yes
7	female	18-30	Hong Kong	less often	3	3	3	3	3	3	3	yes	no	no			yes	yes
7	male	31-64	Hong Kong	2/3 times per week	2	2	3	2	3	2	3	yes	yes	yes	Good	Similar	yes	yes
7	male	31-64	Hong Kong	2/3 times per week	3	3	2	2	2	2	2	yes	yes	no	Don't know		yes	yes
7	female	31-64	Hong Kong	2/3 times per week	3	3	4	3	3	2	3	yes	yes	no	Don't know		yes	yes
7	female	31-64	Hong Kong	2/3 times per week	3	3	3	2	2	2	4	yes	yes	no	Don't know	Similar	yes	yes
7	male	18-30	Hong Kong	once a week	3	2	4	3	2	3	2	yes	no	no	Good	Similar	yes	no
7	female	31-64	Hong Kong	2/3 times per week	2	3	2	3	3	3	3	yes	yes	no	Don't know	Better	yes	yes
7	female	18-30	Mainland	less often	2	2	3	2	3	3	3	yes	yes	no	Don't know	Better	yes	yes
7	female	18-30	Hong Kong	once a week	2	3	3	2	3	3	3	yes	no	no		Similar	no	no
7	male	31-64	Hong Kong	less often	3	3	4	4	3	3	3	no	no	no	Don't know	Similar	no	yes
7	female	31-64	Hong Kong	2/3 times per week	3	2	2	3	3	2	3	yes	no	no	Uncertified		yes	yes
7	female	31-64	Hong Kong	2/3 times per week	3	4	4	3	2	2	5	no	yes	no	Uncertified	Similar	yes	yes
7	male	18-30	Hong Kong	everyday	3	4	4	3	3	3	3	yes	no	no	Uncertified	Similar	no	no
7	female	31-64	Hong Kong	2/3 times per week	4	3	3	3	3	3	3	yes	yes	no	Uncertified	Similar	yes	yes
7	female	31-64	Hong Kong	everyday	3	3	5	4	3	4	3	yes	yes	yes	Uncertified		yes	yes
7	male	31-64	Mainland	2/3 times per week	1	1	1	1	1	1	1	yes	yes	no	Good	Better	yes	yes
7	male	18-30	Hong Kong	2/3 times per week	3	3	2	2	2	2	2	yes	yes	no	Uncertified	Similar	no	no
7	female	31-64	Hong Kong	2/3 times per week	2	3	2	2	2	2	2	yes	yes	no	Uncertified	Better	yes	yes
7	female	18-30	Hong Kong	2/3 times per week	4	4	3	4	4	4	4	yes	yes	no			yes	yes
7	male	<18	Hong Kong	2/3 times per week	3	3	2	3	3	3	3	yes	yes	yes	Good	Better	yes	yes
7	female	31-64	Hong Kong	everyday	3	2	1	1	2	2	1	yes	yes	no	Good	Similar	yes	no
7	female	31-64	Hong Kong	2/3 times per week	3	3	3	2	2	2	4	yes	yes	no	Don't know	Similar	yes	yes
7	male	18-30	UK	less often	2	3	2	3	3	2	4	yes	no	no		Similar	yes	no
7	male	18-30	Mainland	less often	2	2	1	1	1	1	2	yes	yes	no		Similar	yes	yes
7	male	18-30	Mainland	2/3 times per week	2	3	3	2	3	2	3	yes	yes	no	Good	Similar	yes	yes
7	male	31-64	Mainland	less often	2	2	2	3	3	3	4	yes	yes	no	Good	Similar	no	no
7	male	18-30	USA	less often	1	1	1	1	3	2	3	yes	no	no		Similar	yes	yes

Mall Number	|1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
	|Personal Information				Air Quality												Mgmt. Plan	
8	female	31-64	Hong Kong	everyday	3	3	3	4	2	3	2	yes	no	no	Uncertified		yes	yes
8	female	31-64	Hong Kong	2/3 times per week	3	2	3	2	5	4	3	no	yes	yes	Uncertified		yes	yes
8	male	<18	Hong Kong	2/3 times per week	3	4	2	3	3	4	4	no	no	no	Don't know		yes	yes
8	male	<18	Hong Kong	2/3 times per week	3	3	1	1	3	2	2	yes	yes	no	Good	Similar	yes	yes
8	female	18-30	Hong Kong	Once a month	3	3	1	3	2	3	2	yes	no	no	Uncertified		yes	yes
8	male	18-30	Hong Kong	Once a week	3	3	3	3	3	3	2	yes	yes	no			yes	no
8	male	<18	Hong Kong	2/3 times per week	2	1	1	1	1	2	3	yes	no	no	Excellent	Better	yes	yes
8	male	<18	Hong Kong	less often	3	3	3	3	2	2	4	yes	no	no	Don't know	Similar	no	no
8	male	31-64	Hong Kong	Once a month	3	3	2	3	5	3	3	yes	yes	no			no	yes
8	female	<18	Hong Kong	Once a week	3	3	3	3	2	2	4	yes	yes	no	Don't know	Similar	yes	yes
8	female	<18	Hong Kong	2/3 times per week	1	3	3	2	2	2	2	yes	no	no	Excellent	Better	yes	no
8	female	18-30	Canada	less often	3	3	3	3	3	3	3	yes	no	no		Similar	no	no
8	male	18-30	Mainland	2/3 times per year	2	2	2	2	1	2	2	yes	no	no			yes	yes
8	male	18-30	Hong Kong	2/3 times per month	2	2	2	2	3	2	3	yes	yes	yes	Don't know		yes	yes
8	male	18-30	Hong Kong	2/3 times per week	2	2	1	2	2	1	2	yes	yes	no			yes	yes
8	male	18-30	Hong Kong	everyday	3	3	2	3	4	3	3	yes	no	no	Don't know		yes	yes
8	male	31-64	Hong Kong	2/3 times per week	2	2	2	2	2	3	3	yes	yes	yes	Good	Better	yes	yes
8	female	18-30	Hong Kong	Once a week	3	2	2	2	2	2	3	yes	no	yes	Don't know	Better	no	no
8	female	<18	Hong Kong	everyday	4	4	3	2	3	3	2	no	yes	no	Don't know	Better	yes	yes
8	female	18-30	Hong Kong	everyday	3	3	2	3	4	3	3	yes	no	yes	Uncertified		no	no
8	female	31-64	Hong Kong	Once a month	2	2	1	2	2	1	1	yes	yes	no	Good		yes	yes
8	male	31-64	Hong Kong	everyday	5	4	3	3	3	3	3	no	yes	yes	Uncertified		no	yes
8	male	31-64	Mainland	2/3 times per week	2	2	1	2	2	1	1	yes	no	no	Don't know	Better	yes	yes
8	female	18-30	Hong Kong	2/3 times per week	3	2	2	2	3	2	3	yes	yes	no		Better	yes	yes
8	female	18-30	Taiwan	less often	4	4	4	3	4	3	3	no	no	no	Uncertified	Similar	yes	yes
8	female	31-64	Hong Kong	2/3 times per week	2	2	2	3	4	1	1	yes	yes	no			no	yes
8	female	>64	Hong Kong	2/3 times per week	3	3	2	2	2	2	2	yes	no	yes	Excellent		yes	yes
8	male	31-64	Hong Kong	2/3 times per week	3	3	3	3	3	3	3	yes	no	no			yes	yes
8	male	18-30	Hong Kong	everyday	3	2	1	1	1	1	1	yes	yes	no			no	yes
8	male	<18	Hong Kong	everyday	3	3	1	2	4	3	2	yes	no	no	Uncertified	Better	no	yes
8	male	18-30	Hong Kong	less often	2	3	5	1	4	2	3	yes	no	yes	Good	Better	yes	yes
8	female	<18	Hong Kong	everyday	2	2	1	2	1	2	2	yes	no	yes	Don't know	Better	no	no
8	female	<18	Hong Kong	everyday	2	2	2	2	3	2	2	yes	no	yes	Excellent	Similar	yes	no
8	female	18-30	Taiwan	less often	2	2	2	2	3	2	3	yes	yes	no		Similar	yes	yes
8	male	<18	Hong Kong	2/3 times per week	3	2	3	2	4	2	2	no	no	no	Don't know		no	no
8	male	18-30	Hong Kong	2/3 times per week	3	2	2	2	2	3	4	yes	no	no	Don't know		yes	yes
8	male	18-30	Hong Kong	2/3 times per week	3	2	2	2	2	2	2	yes	no	no	Uncertified	Similar	no	no
8	male	31-64	Hong Kong	2/3 times per week	1	2	3	2	3	1	3	yes	yes	yes	Good	Better	yes	no
8	male	<18	Hong Kong	Once a week	3	3	3	3	3	3	3	yes	yes	no	Good	Similar	yes	yes
8	male	<18	Hong Kong	everyday	3	2	2	2	2	2	2	yes	no	no	Excellent	Better	no	no
8	male	31-64	Hong Kong	2/3 times per week	2	2	2	2	2	2	2	yes	no	yes	Good		yes	yes
8	female	18-30	Taiwan	less often	1	3	3	2	1	2	1	yes	yes	yes	Uncertified	Similar	yes	yes
8	female	18-30	USA	Once a week	3	3	5	3	5	3	4	yes	yes	no		Worse	no	yes
8	female	18-30	Mainland	less often	2	3	3	4	4	3	5	yes	no	no	Good	Similar	no	yes
8	female	18-30	Mainland	everyday	2	4	1	2	1	1	1	yes	yes	no		Similar	yes	yes
8	male	18-30	Mainland	2/3 times per year	3	3	4	3	3	3	2	yes	no	no	Don't know	Similar	yes	no
8	male	18-30	Mainland	less often	3	4	4	2	2	2	2	yes	yes	no		Similar	yes	yes
8	female	18-30	Mainland	everyday	3	3	2	3	3	3	3	yes	yes	no	Good	Similar	yes	yes
8	male	18-30	USA	less often	1	3	1	1	1	1	1	yes	no	no	Excellent	Similar	no	no
8	male	18-30	USA	less often	3	3	1	1	2	2	4	yes	no	no		Similar	no	no

Table D-11 Hong Kong Mall 9 Data

Mall	Personal Information				Air Quality												Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
9	male	<18	Hong Kong	2/3 times per month	3	4	4	2	4	2	3	yes	no	no	Good	Similar	no	no
9	female	18-30	Hong Kong	2/3 times per month	3	3	3	3	5	3	2	Don't Know	yes	yes	Uncertified	Similar	yes	yes
9	female	18-30	Hong Kong	2/3 times per month	3	2	3	3	3	3	4	Don't Know	no	no	Uncertified	Similar	no	yes
9	female	18-30	Hong Kong	2/3 times per week	3	3	2	2	3	3	3	no	no	no	Uncertified	Worse	yes	yes
9	male	<18	Hong Kong	2/3 times per week	2	2	2	2	2	3	3	yes	no	no	Excellent	Similar	no	no
9	female	18-30	Hong Kong	2/3 times per week	3	4	4	4	3	4	5	no	no	no	Uncertified	Worse	yes	yes
9	male	<18	Hong Kong	2/3 times per week	3	3	3	3	3	3	3	yes	no	no	Don't Know	Similar	no	no
9	male	<18	Hong Kong	2/3 times per week	3	4	2	3	4	2	3	yes	yes	yes	Don't Know		yes	yes
9	male	18-30	Hong Kong	2/3 times per week	3	2	2	2	1	2	3	yes	no	yes	Uncertified		yes	yes
9	female	18-30	Hong Kong	2/3 times per week	2	2	1	2	1	1	2	yes	yes	no	Excellent		no	yes
9	female	18-30	Hong Kong	2/3 times per week	3	3	5	4	3	3	5	yes	no	no	Uncertified		yes	yes
9	female	18-30	Hong Kong	2/3 times per week	3	3	2	2	2	2	3	yes	no	no	Uncertified	Similar	yes	yes
9	female	<18	Hong Kong	2/3 times per week	3	2	1	1	2	1	3	yes	yes	no	Good	Similar	yes	yes
9	female	<18	Hong Kong	2/3 times per week	2	3	1	1	1	2	3	yes	yes	no	Excellent	Similar	yes	yes
9	male	18-30	Hong Kong	2/3 times per week	4	4	4	3	3	3	3	yes	yes	no	Good	Better	yes	yes
9	female	18-30	Hong Kong	2/3 times per week	3	4	3	3	4	3	2	yes	yes	no	Don't know		yes	yes
9	male	18-30	Hong Kong	2/3 times per year	3	2	3	4	4	3	4	yes	yes	no	Don't Know		yes	yes
9	female	18-30	Mainland	2/3 times per year	2	1	1	1	1	1	1	yes	yes	yes	Good	Similar	yes	yes
9	male	<18	Hong Kong	Everyday	3	3	3	3	4	3	3	yes	no	yes	Excellent		yes	yes
9	female	18-30	Hong Kong	Everyday	1	1	1	2	1	1	3	yes	yes	no	Excellent		no	yes
9	female	18-30	Hong Kong	Everyday	2	2	2	2	2	3	2	yes	yes	yes	Good	Better	yes	yes
9	male	18-30	Hong Kong	Everyday	2	2	2	3	2	2	2	yes	no	no			yes	yes
9	female	31-64	Hong Kong	Everyday	2	2	2	2	2	2	2	yes	yes	yes	Don't Know		yes	yes
9	male	18-30	Hong Kong	Everyday	2	1	4	2	2	2	2	yes	yes	no	Good		yes	yes
9	male	<18	Hong Kong	Everyday	1	2	1	2	3	1	1	yes	no	no		Better	yes	no
9	female	18-30	Hong Kong	Everyday	3	4	2	1	1	2	1	yes	no	no		Better	no	yes
9	female	18-30	Hong Kong	Everyday	4	4	4	4	3	4	3	yes	yes	no	Don't Know		yes	yes
9	female	18-30	Hong Kong	Everyday	2	3	2	3	2	2	5	yes	no	no	Good	Similar	yes	yes
9	female	18-30	Hong Kong	everyday	2	2	2	3	3	2	3	yes	yes	no	Good	Similar	yes	yes
9	female	18-30	Hong Kong	everyday	1	2	1	2	3	1	1	yes	no	no	Excellent	Better	no	yes
9	female	18-30	Hong Kong	everyday	3	2	3	2	4	3	4	yes	no	no	Good	Similar	yes	yes
9	male	18-30	Hong Kong	everyday	3	4	2	2	3	3	4	no	no	no	Uncertified	Similar	yes	yes
9	male	18-30	Hong Kong	everyday	4	4	3	2	3	2	3	yes	yes	yes	Excellent	Similar	no	no
9	male	<18	Hong Kong	Less Often	4	3	1	1	3	1	2	yes	no	yes	Excellent	Similar	yes	yes
9	male	<18	Hong Kong	Less Often	3	2	3	2	4	3	4	no	yes	yes	Uncertified	Similar	yes	yes
9	male	18-30	Mainland	Less Often	2	3	2	3	3	3	4	yes	no	no	Good	Better	yes	yes
9	male	18-30	Hong Kong	Less Often	2	2	2	2	3	2	2	yes	yes	no	Don't Know		no	no
9	female	18-30	Mainland	Less Often	2	3	3	2	4	3	1	Don't Know	yes	no	Don't Know	Similar	yes	yes
9	female	18-30	Hong Kong	Less Often	3	3	3	3	3	3	3	no	no	no	Uncertified	Similar	no	no
9	male	18-30	Hong Kong	Less Often	4	4	3	3	4	4	5	no	no	no	Don't Know	Similar	no	no
9	male	<18	Hong Kong	Less Often	4	3	3	3	2	2	4	Don't Know	no	no	Uncertified	Better	no	yes
9	male	18-30	Hong Kong	Once a month	2	2	1	3	2	1	1	yes	yes	yes	Excellent		no	yes
9	female	18-30	Hong Kong	Once a month	3	3	3	4	4	2	4	Don't Know	no	yes	Don't Know	Similar	no	no
9	male	<18	Hong Kong	Once a month	3	2	2	3	2	2	2	yes	yes	yes	Good	Better	yes	yes
9	male	31-64	Hong Kong	Once a month	2	2	2	2	2	2	3	yes	yes	yes	Good		yes	yes
9	male	18-30	Hong Kong	Once a month	2	2	1	1	1	2	3	yes	no	no			no	yes
9	female	18-30	Hong Kong	Once a week	4	4	3	3	3	3	4	yes	yes	no	Uncertified	Similar	yes	yes
9	male	18-30	Hong Kong	Once a week	3	2	3	1	2	3	3	yes	no	yes	Good		yes	yes
9	male	<18	Hong Kong	Once a week	3	2	4	4	4	3	3	yes	no	no	Don't Know		yes	yes
9	female	18-30	Hong Kong	once a week	2	3	2	3	3	3	3	yes	no	no	Don't know		yes	yes

Table D-12 Hong Kong Mall 10 Data

Mall	Personal Information				Air Quality												Mgmt. Plan	
Number	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2
10	female	31-64	Hong Kong	2/3 times per month	2	2	2	3	2	2	5	yes	yes	no	Uncertified	Similar	yes	yes
10	female	18-30	Hong Kong	2/3 times per week	3	3	3	3	3	3	3	yes	yes	no			yes	yes
10	female	18-30	Hong Kong	less often	3	4	3	3	3	2	3	yes	no	yes	Don't Know		yes	yes
10	female	18-30	Hong Kong	2/3 times per month	4	3	1	2	2	3	5	yes	yes	yes	Good	Similar	yes	yes
10	female	31-64	Hong Kong	less often	4	3	3	4	5	3	3	no	no	no	Uncertified		no	yes
10	male	18-30	Hong Kong	2/3 times per month	2	2	2	2	3	2	2	yes	yes	no	Good		no	yes
10	female	31-64	Hong Kong	2/3 times per week	4	3	3	4	4	4	4	no	yes	yes	Don't Know		yes	yes
10	female	18-30	Hong Kong	Everyday	3	4	2	2	3	3	3	yes	yes	no	Uncertified		yes	yes
10	female	18-30	Hong Kong	Once a month	3	3	3	3	3	3	3	Don't Know	no	no	Uncertified	Similar	no	no
10	female	18-30	Mainland	less often	1	1	1	1	1	1	1	yes	yes	no	Good	Better	no	yes
10	female	18-30	Hong Kong	2/3 times per month	4	4	3	4	4	3	3	Don't Know	no	no	Uncertified		no	yes
10	female	18-30	Hong Kong	Once a week	3	2	1	4	3	1	4	yes	no	no	Excellent	Better	yes	yes
10	male	18-30	Hong Kong	less often	3	3	3	4	3	3	4	yes	yes	yes	Good	Similar	no	no
10	female	18-30	Hong Kong	Once a month	2	2	2	3	3	3	3	yes	yes	no			yes	yes
10	female	31-64	Hong Kong	less often	3	3	3	3	3	3	4	yes	yes	no	Uncertified	Worse	no	no
10	female	18-30	Hong Kong	Once a month	4	4	3	3	2	3	4	Don't Know	yes	no	Uncertified		yes	yes
10	female	31-64	Mainland	less often	2	3	3	3	3	3	3	Don't Know	no	no	Don't Know	Similar	no	yes
10	female	31-64	Hong Kong	2/3 times per month	2	2	2	3	2	3	5	yes	yes	no	Uncertified	Similar	no	yes
10	female	18-30	Hong Kong	less often	5	4	4	4	4	4	4	no	yes	no	Uncertified	Worse	yes	yes
10	female	18-30	Mainland	less often	3	3	4	3	2	3	2	yes	no	no	Uncertified	Better	no	yes
10	male	31-64	Mainland	less often	3	3	3	3	2	3	2	Don't Know	yes	no	Don't Know	Similar	yes	yes
10	male	<18	Mainland	2/3 times per year	2	2	3	2	1	2	1	yes	yes	yes	Good	Similar	yes	yes
10	female	18-30	Mainland	less often	2	2	2	2	2	2	2	yes	yes	no	Don't Know	Similar	yes	yes
10	female	18-30	Mainland	Once a month	1	1	1	2	1	1	1	yes	no	no	Don't Know	Better	yes	yes
10	male	18-30	Hong Kong	Once a week	3	4	4	3	2	3	5	yes	yes	no	Don't Know		yes	yes
10	female	31-64	Mainland	less often	2	2	2	2	2	2	2	yes	no	no		Better	yes	yes
10	female	18-30	Mainland	2/3 times per year	3	2	3	1	2	3	2	yes	no	no	Good	Similar	yes	yes
10	female	18-30	Hong Kong	Once a week	3	2	2	2	2	3	4	yes	no	no		Similar	yes	yes
10	female	18-30	Mainland	less often	2	3	2	2	4	2	2	yes	no	no		Better	yes	yes
10	male	31-64	Mainland	2/3 times per year	2	2	2	3	2	2	2	yes	yes	no	Don't Know	Similar	yes	yes
10	male	18-30	Hong Kong	Once a month	4	4	3	3	3	4	4	yes	yes	yes	Don't Know		yes	yes
10	female	31-64	Mainland	less often	3	3	1	2	1	2	2	yes	no	yes	Don't Know	Better	yes	yes
10	male	<18	Hong Kong	less often	4	3	1	1	1	1	1	yes	no	no			no	no
10	female	18-30	Hong Kong	Once a month	2	2	2	3	3	4	3	no	yes	no	Don't Know		yes	yes
10	female	31-64	Hong Kong	Once a week	1	1	1	1	1	1	3	yes	yes	no	Good	Better	yes	yes
10	female	18-30	Hong Kong	2/3 times per week	4	4	4	3	3	4	4	no	yes	yes	Uncertified	Better	yes	yes
10	female	31-64	Hong Kong	2/3 times per week	4	3	2	3	4	3	2	yes	yes	no	Don't Know	Better	yes	yes
10	female	18-30	Mainland	2/3 times per year	3	3	1	3	4	3	2	no	no	yes	Don't Know	Similar	yes	yes
10	female	<18	Hong Kong	2/3 times per month	3	2	3	3	4	4	4	no	yes	yes	Don't Know		yes	yes
10	male	18-30	Mainland	2/3 times per year	4	4	3	2	2	3	5	no	no	yes	Don't Know	Similar	yes	yes
10	male	31-64	Taiwan	2/3 times per week	2	2	2	2	2	1	2	yes	no	no	Excellent	Better	no	yes
10	female	18-30	Hong Kong	Once a week	5	5	4	4	4	5	3	no	yes	no	Don't Know	Similar	yes	yes
10	male	18-30	Mainland	less often	2	3	2	3	3	3	4	Don't Know	yes	no	Good	Similar	yes	yes
10	female	<18	Hong Kong	2/3 times per month	2	2	3	3	3	3	4	no	yes	yes	Don't Know		yes	yes
10	female	18-30	Hong Kong	Once a month	4	3	3	2	2	3	4	yes	no	no	Don't Know	Similar	no	yes
10	female	18-30	Hong Kong	2/3 times per month	5	5	3	5	5	4	4	no	yes	yes	Uncertified	Worse	yes	yes
10	male	18-30	Mainland	less often	2	2	2	2	3	3	3	yes	yes	no	Good	Similar	yes	no
10	female	31-64	Switzerland	2/3 times per week	2	2	2	2	2	2	3	yes	yes	no	Good	Worse	no	no
10	female	31-64	Singapore	less often	3	3	3	3	3	3	3	yes	yes	no		Similar	yes	yes
10	male	<18	Mainland	2/3 times per year	2	3	3	3	4	2	1	yes	no	yes	Don't Know	Similar	yes	yes

Appendix E: Demographics

Out of the 500 people we surveyed 277 of the participants were female, while the other 223 were male. While conducting our study, we noticed that females were more interested in participating in our study than the males.

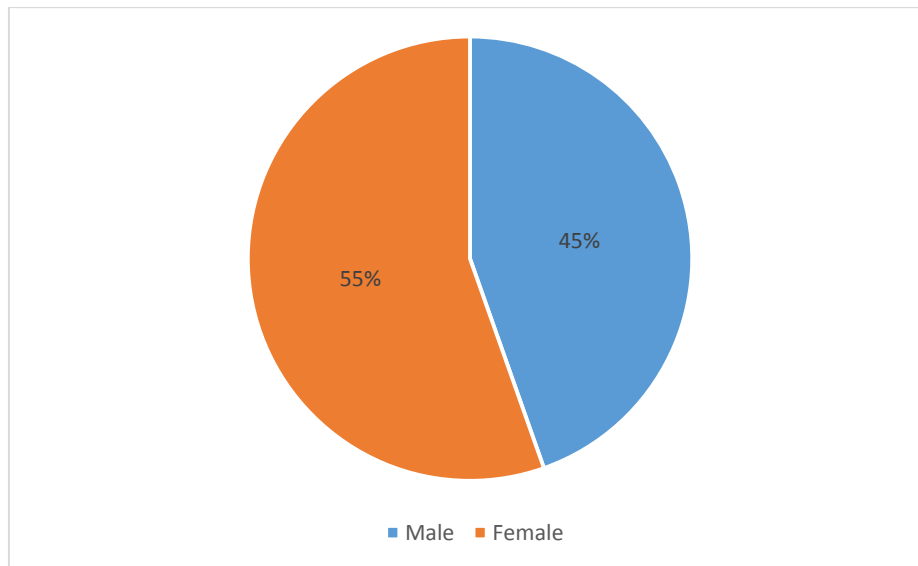Figure E-1 Gender distribution of survey respondents (n=500)

The age ranges of people we surveyed were broken up into four categories: <18 (adolescence), 18-30 (Young Adults), 31-64 (Middle Aged Adults), and >64 (Elders). From what we observed, most young adults were more willing to help us with our study as they took the time to understand what we were doing, while older people rejected our request to take our survey.
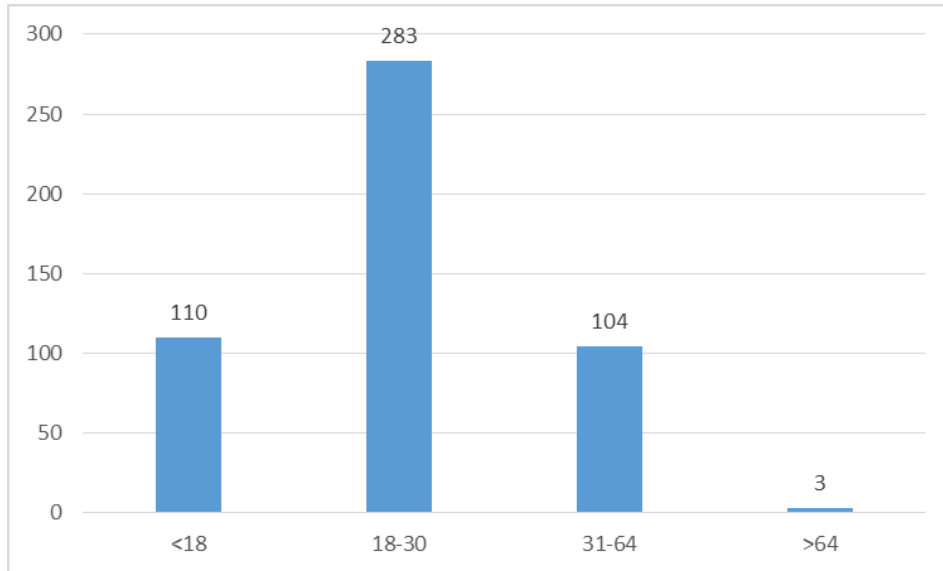
Figure E-2 Age distribution of survey respondents (n=500)

We broke up the residency of respondents into three areas: Hong Kong, Mainland (China), and Other. A lot of Mainlanders come to do their shopping in Hong Kong, so putting them a separate home location category seemed important, and it helped us draw conclusions about people's perceptions of IAQ.
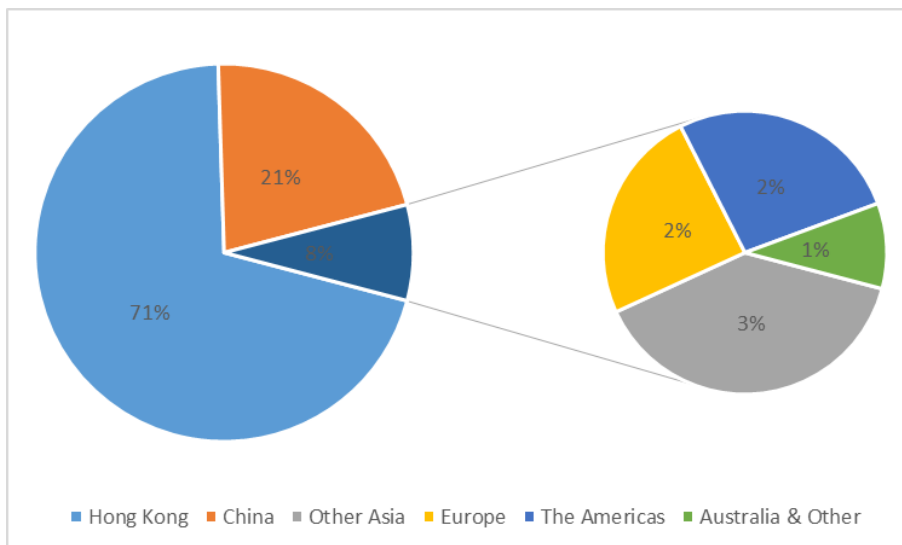

Figure E-3 Place of origin of survey respondents (n=500)

Appendix F: Satisfaction/Complaint Response Survey

Indoor Air Quality Survey

1. How does the air quality in this shopping mall affect you?

   Positively ☐1 ☐2 ☐3 ☐4 ☐5 Negatively

2. How is the air flow in this shopping mall?

   Perfect ☐1 ☐2 ☐3 ☐4 ☐5 Too strong/weak

3. How are the odours in the air of this shopping mall

   Clean Air ☐1 ☐2 ☐3 ☐4 ☐5 Smells

4. How is the humidity in this shopping mall?

   Perfect ☐1 ☐2 ☐3 ☐4 ☐5 Too Humid/Dry

5. How is the temperature in this shopping mall?

   Perfect ☐1 ☐2 ☐3 ☐4 ☐5 Too Hot/Cold

6. How do you think the air quality is inside today?

   Great ☐1 ☐2 ☐3 ☐4 ☐5 Bad

7. According to your personal standards, is the air in this shopping mall satisfactory?

   ☐ Yes ☐ No

Additional Comments

Submit

Figure F-1 Satisfaction/Complaint Response Survey Example

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Appendix G: Digital Display

Figure G-1 Digital Display Example

Appendix H: Table 2-4 Legend

Legends:

a. In some cases, it may not be practicable to take 8-hour continuous measurement. In these circumstances, surrogate measurement (i.e. an intermittent measurement strategy based on the average of half-an-hour measurements conducted at four time-slots) is also accepted.
b. EMSD (1998), Guidelines on Energy Efficiency of Air Conditioning Installations
c. IAQ guideline value for Japan (Law of Maintenance of Sanitation in Building) and South Korea (Public Sanitary Law).
d. US EPA (1996), *Facilities Manual: Architecture, Engineering, and Planning Guidelines.* Maximum Indoor Air Concentration Standards.
e. IAQ guideline value for Australia (Interim National IAQ Goals), Canada (IAQ in Buildings: A Technical Guide), Japan (Law of Maintenance of Sanitation in Building), South Korea (Public Sanitary Law), Singapore (Guidelines for Good IAQ in Office Premises/building), Sweden (Ventilation Code of Practice) and Norway (Recommended Guidelines for IAQ).
f. Finnish Society of IAQ and Climate (2001), *Classification of Indoor Climate 2000: Target Values, Design Guidance and Product Requirements.*
g. WHO (2000), *Guidelines for Air Quality*
h. EPD (1987), Hong Kong Air Quality Objectives under the Air Pollution Control Ordinance (Cap. 311)
i. US EPA(1987): US EPA Guideline for Radon in Homes due to Natural Radiation Sources (Note: 4 pCi/L or 150 Bq/m^3 is EPA Action Level)
j. ACGIH (1986), ACGIH committee activities and reports "*Bioaerosols: Airborne viable microorganisms in office environments: sampling protocol and analytical procedures*", Applied Industrial Hygiene.
k. The exceedance of bacterial count does not necessarily imply health risk but serve as an indicator for further investigation.