Investigation into tenant organizations' willingness-to-pay for the intangible value-added benefits of sustainable buildings

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**AN INVESTIGATION INTO
TENANT ORGANIZATIONS' WILLINGNESS-TO-PAY FOR
THE INTANGIBLE VALUE-ADDED BENEFITS OF
SUSTAINABLE BUILDINGS**

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in partial fulfillment of the requirement for the degree of
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Abstract

Most of the past studies have focused on the cost reduction benefits of sustainable buildings as it is more tangible and easily quantifiable. However, it is widely believed that the benefits of sustainable building go beyond just reducing some costs. It produces a string of other benefits that bring value to the businesses of the building occupants which results in substantial economic impacts.

This research investigates tenant organizations' willingness-to-pay (WTP) for the intangible value-added benefits (VABs) of sustainable buildings. Tenant organizations refer to the organizations operating in office buildings on tenancy agreement. This research aims to understand how the demand stakeholders attach economic values to the intangible value-added benefits, i.e. what are the factors and how do they affect the demand stakeholders' valuation of the benefits.

The VABs experienced by the tenant organizations are firstly identified methodically by analyzing the aims and impacts of the sustainability criteria adopted in building sustainability rating systems. Five VABs are identified. They are (1) improved productivity (2) enhanced organizational image (3) improved ability to attract and retain staff (4) improved health of staff (5) improved comfort of staff.

The preferences of the tenant organizations and the satisfaction derived from the VABs are likely to show up in the form of a WTP for these VABs. The concept of economic valuation of which the notion of WTP falls under and past research works where economic valuation techniques have been applied to the field of sustainability are reviewed.

Based on the review, a conceptual model is developed with six groups of variables identified as possible factors of the tenant organizations' WTP for the VABs. They include three groups of exogenous factors, i.e. Organization Characteristics, Current Premises and Building Characteristics, and three groups of endogenous factors which are the tenant organizations' Satisfaction of the benefits experienced, their Perception and Knowledge of sustainability issues, building sustainability rating systems and building impacts.

Next, through interviews with ten experts from the fields of building sustainability and economic valuation, a questionnaire instrument is developed to capture the tenant organizations' WTP for the VABs. A survey in Singapore and a case study in Beijing were conducted using the questionnaire. Data collection was carried out in different countries to provide further investigation into the WTP behavior of tenant organizations located in different countries and operating in buildings which use different building sustainability rating systems. The hypothesized relationships between the six groups of factors and the WTP variables were then tested using the data obtained through a series of statistical techniques.

The survey and case study results reveal that although the tenant organizations' WTP for each VAB is significantly correlated to one another, their behavior toward each VAB is slightly different. Some other significant findings include:

- Older tenant organizations have lower WTP for the VABs, in particularly for improved health and comfort of staff
- An enhanced organizational image remains the main motivation of tenant organizations' demand for sustainable buildings
- Information needs of tenant organizations regarding sustainable buildings are diverse
- Information about air quality and thermal comfort of the indoor environment is important
- Current building sustainability rating systems are inadequate to communicate sustainability benefits to tenant organizations
- Current building sustainability rating systems are inadequate on its own to achieve building sustainability
- Use of sustainable technologies is not as crucial as how the building is being managed during its operational stage

These findings provide new insights into the barriers to the demand for sustainable buildings and towards enhancing the sustainability performance of buildings and help towards channeling the sustainability efforts to more effective areas.

Chapter One

1 Introduction

1.1 Research Background

The notion of sustainable buildings primarily originates from the increasing awareness of the significant impacts buildings have on resource depletion and environmental deterioration. It has been widely reported that buildings consume about 40% of the global energy and generate about 40% of all greenhouse emissions (Green Building Council of Australia., 2008; McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007; Sustainable Building and Construction Initiative., 2007). Therefore, the aim of sustainable buildings is to achieve efficient use of resources and minimum negative impacts on the environment.

However, environmental motivation is not the main driving force for the uptake of sustainable buildings. As pointed out by Chan et al (2009), Green Building Council of Australia (2008) and Lucuik et al (2005), the building and property industry is always economically motivated. To encourage uptake of sustainable buildings, the benefits of sustainable buildings must be translated into some kind of economic gains for the building stakeholders and could significantly affect their business decisions and operations.

Economic gains may be brought about by a reduction in the costs incurred or by an increase in the revenues received. Comparing with conventional buildings which do not have a sustainability focus, sustainable buildings aim to use less energy, water and materials. It is thus envisaged that reduction in consumption of these resources will result in some cost reduction benefits.

1.1.1 Cost Reduction Benefits of Sustainable Buildings

There are many discussions on how sustainable buildings will bring about cost reduction benefits to the building stakeholders (Environmental Building News., 2005; Lucuik et al., 2005; Seah, 2008). Energy and water savings are commonly believed to be the most possible cost reduction benefits of sustainable buildings as

minimizing energy and water consumption are often the priorities in sustainable buildings. Other cost reduction benefits include reduced cleaning and maintenance due to better design strategies and better choice of building materials; reduced churn costs through creating more flexibility in spaces and use of highly modularized systems; and reduced waste generation in building through providing building facilities to encourage recycling activities among the building occupants.

Although such cost reduction benefits are often claimed in the literature, the number of studies on the actual costs incurred by sustainable buildings remains few to date. This can be attributed to two reasons: the few numbers of appropriate case studies and the low availability of cost data. The concept of sustainable building is relatively new and the number of completed sustainable buildings, which are in operation for a time long enough so that sufficient data can be collected, is still not too many. As for costs data, it is not easily available due to the obvious reason of sensitivity and confidentiality.

Nonetheless, the cost studies on sustainable buildings to date have shown positive findings which support the claim that sustainable buildings produce cost reduction benefits for the building stakeholders.

These studies reveal that sustainable buildings indeed incurred lower operating costs, mainly because of savings in energy costs. In Kats (2003), a review of 60 Leadership in Energy and Environmental Design (LEED) certified buildings demonstrates that they save on an average of 20-30% energy. LEED is a building sustainability rating system, developed by the US Green Building Council, which evaluates buildings based on a set of sustainability criteria. The same magnitude of energy savings is also observed at a later study by Turner & Frankel (2008) which involved 121 LEED certified buildings. It shows that the energy use intensity of these LEED buildings is 24% less than the national average of all the commercial building stock reported in the Commercial Building Energy Consumption Survey. According to Kats (2003), a 30% reduced energy consumption would translate into an economic savings of US\$0.30/ft²/year at an electricity price of US\$0.08/kWh. Over a period of 20 years, this means a present value savings of US\$5.80/ft² at a 5% real discount rate.

Although sustainable buildings bring about reduction in operating costs, the perception of sustainable buildings entailing high initial costs is still discouraging some developers and building owners from adopting sustainability measures. It is commonly perceived that to achieve building sustainability will inevitably incur higher initial costs because of the more complex and expensive technologies required (Kibert, 2005a). However, recent studies seem to have refuted this commonly held conception. Table 1-1 summarizes the findings of some cost studies carried out in the United States, Australia and Singapore regarding whether a green premium exists.

Table 1-1: Green Premiums in United States, Australia and Singapore

Country	Certification System & Year Established	Green Premium Exists	No Green Premium
United States	Leadership in Energy and Environmental Design (LEED) - 1999	Initial costs of 33 LEED certified buildings are compared with conventional design and the average premium is found to be slightly less than 2% (Kats, 2003)	83 buildings with goal of achieving LEED certification are compared with 138 similar buildings but without such goal. It is found most projects are achieving LEED within their budgets and in the same cost range as non-LEED projects (Davis Langdon., 2007b)
Australia	Green Star - 2003	Based on 8 case studies, it is found that a slight cost premium exists for delivering a 6-Star Green Star rating building (Green Building Council of Australia., 2008)	Based on 9 Green Star certified buildings and 11 uncertified buildings, Davis Langdon in Australia finds that there is no correlation between Green Star and cost (Green Building Council of Australia., 2008)
Singapore	Green Mark - 2005	Initial costs of 15 Green Mark certified buildings are compared with code-compliant buildings and the premium is found to range from 0.3% to 8% depending on the rating level achieved (Building and Construction Authority Singapore., 2008)	-

As shown in the table, some studies report the existence of a green premium which varies from 0.3% to about 8%. In addition, it is found that buildings which have obtained a higher rating level are generally more costly than those with a lower

rating level. This seems to fit into the suggestion that building sustainability indeed does come at an extra cost and the higher level it is, the more costs it incurs.

However, in some other studies, particularly in the later studies, it is reported that there is no such green premium and no correlation is found between the sustainability rating obtained by a building and its initial cost.

The difference in the findings could be attributed to the building team's knowledge of and experience with sustainable building design. Kats (2003) attributes the majority of the higher initial costs incurred by sustainable buildings to the "increased architectural and engineering design time necessary to integrate sustainable building practices into projects". However, as knowledge and experience of sustainable building design grow with time, the design time and costs incurred can be reduced (Chan et al., 2009; Kats, 2006; McAuley, 2008; Nalewaik & Venters, 2009). In addition, advancements in sustainable technologies are lowering the manufactured costs and improving the product reliability (Nalewaik & Venters, 2009). These could be the reasons why the cost study carried out by Davis Langdon (2007b), about eight years after the establishment of the LEED rating system, shows that there is no significant difference in the initial costs of LEED-seeking buildings and non LEED-seeking buildings. Green Building Council of Australia (2008) also informs that by 2006, about three years after the establishment of the Green Star rating system, the construction of a 4-Star Green Star office building is within the normal budget and it is expected that a 5-Star Green Star office building should have no significant cost increase in 2008. Therefore, it is anticipated that the same observation would be made to Singapore's development of the Green Mark buildings.

Furthermore, Kibert (2005a) highlights a possibility that sustainable buildings may actually incur lower initial costs than conventional buildings which are without a sustainability focus. This is because achieving sustainable buildings necessitates the need for more integrated design which could keep the initial costs to the same cost range as that of conventional buildings, if not lesser.

Therefore, it is evident that cost reduction benefits are present in sustainable buildings. As the pool of sustainable building design experts grow, the initial costs of sustainable buildings can be kept low. Savings in resource consumption also reduces the operating costs of sustainable buildings substantially.

1.1.2 Value-Added Benefits of Sustainable Buildings

Besides cost reduction benefits, sustainable buildings can also bring about economic gains to building stakeholders by adding value to their businesses and operations and thus improving their revenue streams.

As sustainable buildings aim to reduce resource consumption and negative environmental impacts, it is anticipated that their indoor environment would be improved. By virtue of the use of environment-friendly materials, efficient HVAC system, natural ventilation, air-tight building envelope, admittance of daylight, etc, the air, acoustic, light and thermal quality of the indoor environment are expected to be enhanced. A high quality indoor environment is widely believed to improve the comfort and satisfaction of building occupants and in turn, improves their productivity (Carter, 2008; Green Building Council of Australia., 2008). Studies have shown that building occupants in LEED buildings are generally more satisfied with their indoor environment than building occupants in non-LEED buildings (Heerwagen & Zagreus, 2005; "Looking Back and Moving Forward," 2008).

A better quality indoor environment also helps tenant organizations in their business operations by attracting and retaining employees as more are aware of the importance of a good working environment and are desiring for a more comfortable and healthy environment. (Carter, 2008; Melbourne Business School., 2006; Zimmerman, 2008).

In addition, pursuing and operating in sustainable buildings gives an impression of a socially responsible corporation. In a survey carried out by McGraw-Hill Construction & Siemens Building Technologies Inc. (2007), the surveyed American corporations indicated that they see a value-added benefit of an enhanced organizational image and market differentiation brought about by operating in sustainable buildings.

Being sustainable also enhances the marketability of the buildings which result in higher lease rates and occupancy rate and more high quality tenants (Davis Langdon., 2007a; Environmental Building News., 2005; Madew, 2006; McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007; Seah, 2008). In Australia, about 50 property owners, valuers and developers indicated in a survey and in interviews that they would pay more for a Green Star building, mainly due to its better marketability which reduces vacancy times and hence income losses (Green Building Council of Australia., 2008).

It is also believed that being more energy and water efficient, sustainable buildings are able to cope better in the future against more stringent building regulations and higher energy prices (Davis Langdon., 2007a; Environmental Building News., 2005; Green Building Council of Australia., 2008; Seah, 2008).

Furthermore, improved marketability and greater ability of sustainable buildings to cope with future uncertainties in building occupants' demand, building regulations and energy prices attracts more institutional investors (Davis Langdon., 2007a; Madew, 2006; Seah, 2008).

Therefore, it can be seen that other than cost reduction benefits, sustainable buildings bring about many benefits which may not impact directly on the revenues but instead bring value to the businesses and operations of the organizations.

1.2 Problem Identification

According to Bevege (2007) and Melbourne Business School (2006), past strategies on promoting sustainable buildings have emphasized on the supply side of the industry such as developing sustainable building technologies and skills of the building professionals. However, focusing on supply stakeholders who develop and build is inadequate to transform the building market towards sustainability. Only strong demand from the demand stakeholders who own or occupy the buildings will shift the sustainable building market from the minority to the majority.

Therefore, it is important to highlight the full economic benefits of sustainable buildings which should include both the cost reduction benefits and the value-added benefits.

1.2.1 Need for Quantification of Value-Added Benefits in Monetary Terms

The need for quantifying the value-added benefits in monetary terms is often highlighted as an important area for promoting the uptake of sustainable buildings (Kwong, 2004; McAuley, 2008). By putting a value to the intangible value-added benefits, the demand for sustainable buildings may be stimulated in two ways.

Firstly, by putting a value on the intangible value-added benefits, its economic impacts are accentuated. As pointed out by Nalewaik & Venters (2009), unless the value-added benefits are quantified, there is no strong case for sustainable buildings on providing a considerable margin of economic benefit over the traditional buildings. This is further echoed by McAuley (2008) who adds that as demand stakeholders are interested in numbers and figures, measuring the intangible value-added benefits “may help to swing the balance in favour of more sustainable development”.

Secondly, quantifying the intangible value-added benefits would realign ‘cost-bearing’ stakeholders and ‘benefit-enjoying’ stakeholders. This helps to alleviate the problem of split incentives. As pointed out by Sustainable Building and Construction Initiative (2007), the actors who are responsible for the operational phase are usually not the ones involved in the building process and hence, a conflict of interests is usually resulted which hampers the implementation of building sustainability measures. By placing a value on the value-added benefits, it is envisaged that sustainable buildings would be properly valued and that stakeholders who bear the costs would be rewarded with appropriate returns through higher rents, higher property value and more accurate financial modeling or calculations. For example, quantifying the value-added benefits of sustainable buildings may improve the negotiation power of the building owners on structuring and review lease agreements (Madew, 2006).

However, none of the studies so far has successfully and conclusively quantified the value-added benefits in economic terms due to its intangible nature. As pointed out by McAuley (2008), measuring the exact financial impact of these intangible benefits is fraught with difficulties.

1.2.2 Intangible Nature of Value-Added Benefits

The intangible nature of value-added benefits of sustainable buildings may be best demonstrated by comparing it with cost reduction benefits. Table 1-2 summarizes the comparisons between the two types of benefits.

Table 1-2: Comparison between Cost Reduction Benefits and Value-Added Benefits

	Cost Reduction Benefits	Value-Added Benefits
Examples	<ul style="list-style-type: none">• Energy savings• Water savings	<ul style="list-style-type: none">• Improved productivity of building occupants• Improved health of building occupants• Enhanced comfort of building occupants
Economic Impact	<ul style="list-style-type: none">• Reduction in costs incurred	<ul style="list-style-type: none">• Adding value to business operations and management
Type of Data Required	<ul style="list-style-type: none">• Hard, i.e. measurable and documentable	<ul style="list-style-type: none">• Soft, i.e. not easily measurable and documentable
Data Availability	<ul style="list-style-type: none">• Available from periodic billing, measurement and documentation	<ul style="list-style-type: none">• Required data not easily defined and available
Predictability	<ul style="list-style-type: none">• Fairly predictable	<ul style="list-style-type: none">• Relatively uncertain• Harder to predict with accuracy• Assumptions must be made to their qualification

The intangibility of value-added benefits can be seen from its economic impacts which are less apparent and immediate than cost reduction benefits. Cost reduction benefits such as energy and water savings reduce the operating costs directly. On the other hand, the value-added savings such as improved productivity of building occupants may not be immediately and directly obvious on the revenues.

This has also made the documentation of value-added benefits difficult as the required data is not easily definable and available. On the other hand, the data required to measure cost reduction benefits is often easily documentable from periodic billing and measurements (Heerwagen, 2000; Kibert, 2005a; Yates, 2001).

Hence, cost reduction benefits are usually fairly predictable with the availability of hard data, whereas value-added benefits are more uncertain and difficult to predict with accuracy since it involves mainly soft data with many assumptions (Kats, 2003; Kibert, 2005a). Hence, the methods of measuring value-added benefits is more complex and less readily accepted as compared with the methods used to measure cost reduction benefits (Heerwagen, 2000).

Therefore, because of its intangibility, market acceptance of the value-added benefits is limited (Green Building Council of Australia., 2008) and they are also less studied compared with the cost reduction benefits. Nevertheless, the next section shall review the few studies that have attempted to capture the value-added benefits of sustainable buildings.

1.2.3 Past Studies on Capturing the Intangible Value-Added Benefits

Kats (2003) is so far the most cited work on quantifying the value-added benefits of productivity and health gains in monetary terms. After reviewing findings from a variety of previous works such as Fisk (2000), Carnegie Mellon University's Building Investment Decision Support program and National Energy Management Institute's study titled "Productivity and Indoor Environmental Quality", the author estimates a conservative 1% productivity and health gain for LEED buildings which have obtained the level of Certified and Silver and for Gold and Platinum level buildings, a 1.5% gain. Then based on the cost of a typical employee in the State of California, these productivity and health gains would translate to a monetary present value of US\$36.89 to \$55.33 per square feet over a 20-year period discounted at 5% rate.

Although the study provides an estimate of the economic value of the value-added benefits, its findings are not conclusive and useful mainly because of its generalization. Firstly, the productivity and health gains are merely estimations from secondary data sources. As compared to the calculation of costs reduction benefits which uses primary data from direct sources, the productivity and health gains estimates appear less reliable and accurate. Secondly, since the productivity and health gains are estimated for the whole nation, the calculated value-added benefits are not specific to the different groups of building stakeholders. Therefore,

it may not be useful for stimulating the demand for sustainable buildings since each stakeholder has no idea of the exact benefits that are accrued to them specifically.

Therefore, although quantifying the value-added benefits is important for stimulating the demand for sustainable buildings, its intangible nature poses great difficulties in quantifying them, particularly in monetary terms. Depending on the purpose, some studies have instead adopted qualitative approaches. The intangible value-added benefits are usually captured through the perception and satisfaction of the building occupants which are expressed using rating scales. For example, in Abbaszadeh et al (2006), a survey developed by the Centre for the Built Environment at the University of California, Berkeley, is conducted on the occupants of 215 buildings which consists of both LEED and non-LEED buildings. The occupants are asked to rate their satisfaction of the indoor environment and their productivity in the following categories: office layout, office furnishings, thermal comfort, air quality, lighting, acoustics, cleaning and maintenance, overall satisfaction with building and overall satisfaction with workspace. A 7-point semantic differential scale, from -3 to +3, with endpoints “Very dissatisfied” and “Very satisfied” is used. Value-added benefits such as improved occupant comfort and productivity gains are determined by comparing the responses from occupants in the LEED buildings and the non-LEED buildings.

Such qualitative approaches toward determining the intangible value-added benefits are usually applied to demonstrate that sustainable buildings perform better than conventional buildings (Abbaszadeh et al., 2006; Paul & Taylor, 2008) or to understand how sustainable design impact on the value-added benefits (Heerwagen & Zagreus, 2005; Ries et al., 2006). Such approach helps to encourage the demand for sustainable buildings by establishing the existence of value-added benefits in sustainable buildings but unlike the quantitative approach, it does not inform the building stakeholders about the magnitude of the benefits.

1.3 Research Aim, Significance and Scope

1.3.1 Research Aim and Objectives

Instead of attempting to quantify the intangible value-added benefits, this research aims to understand how the demand stakeholders attach economic values to these value-added benefits.

An investigation into the willingness to pay (WTP) of the demand stakeholders for the value-added benefits is thus proposed. Understanding the WTP behavior is an important element of establishing a business case for sustainable buildings (Melbourne Business School., 2006). In brief, WTP is the amount of resources that an individual is willing to give up in exchange for a good or service. It is deemed to be the truest measure of value (Chao et al., 1999). There will be more discussion on the concept of WTP in the later part of this research. At this point, it is sufficed to highlight that the WTP of the demand stakeholders for the value-added benefits reflect their economic valuation of the benefits. How they value the benefits would in turn reflect their preference and the sustainability performance of the buildings. When they prefer more of the benefits, it is likely to show up in a higher WTP for them. In addition, their WTP for the value-added benefits is likely to be high when the sustainability performance of the building is good.

Hence, by understanding the demand stakeholders' WTP behavior toward the intangible value-added benefits, the demand for sustainable buildings may be stimulated in two ways. Firstly, appropriate strategies and tools can be developed to promote sustainable buildings more effectively based on the preferences of the demand stakeholders. As reported in Building & Construction Interchange Asia (2008), McGraw-Hill Construction & Siemens Building Technologies Inc.(2007) and Yudelson (2009), the demand for sustainable buildings is hindered by a low awareness among the building occupants of the sustainability benefits. There is also a lack of appropriate tools for the demand stakeholders to make informed decisions. With an understanding of the preferences of the demand stakeholders, appropriate tools and strategies can be developed to increase their awareness and to improve the

tools available for their decision-making. In this way, their demand for sustainable building is likely to increase.

Secondly, the WTP of the demand stakeholders for the intangible value-added benefits reflect the sustainability performance of the buildings in a way. Better sustainability performance is likely to result in greater intangible value-added benefits which in turn increase the WTP of the demand stakeholders. By understanding the demand stakeholders, new insights into how the sustainability performance of the buildings may be improved are gained. Improving the sustainability performance of the buildings according to the WTP behavior of the demand stakeholders is likely to raise their demand for sustainable buildings.

Therefore, this research aims to investigate the demand stakeholders' WTP for the intangible value-added benefits.

1.3.2 Research Significance

An investigation into the building demand stakeholders' WTP for the intangible value-added benefits is significant in two ways.

Firstly, it provides evidence of the economic impacts of the intangible value-added benefits of sustainable buildings by demonstrating the willingness of demand stakeholders to give up some resources in exchange for enjoying them. This demonstration is important to signal to the supply stakeholders of the economic benefits of providing buildings that are sustainable. As illustrated by Myers (2004), a circle of blame exists among the supply and demand stakeholders for the low uptake of sustainable buildings. On the demand side, occupiers blame the supply stakeholders for the limited supply of sustainable buildings. On the other hand, the supply stakeholders blame the occupiers for not demanding for sustainable buildings. Therefore, to break this circle of blame, it is crucial to highlight to the supply stakeholders that there is a demand for sustainable buildings through the demand stakeholders' WTP.

Figure 1-1: Circle of Blame among Building Stakeholders (Myers, 2004)

Secondly, a qualitative investigation into the WTP of the demand stakeholders for the value-added benefits provides a foundation for further works on the application of economic valuation techniques for valuing the intangible value-added benefits. The investigation provides the key factors to be considered when developing economic valuation techniques for valuing the intangible benefits.

1.3.3 Research Scope

The kind of demand stakeholders varies depending on the building type. For example, in an office building, the demand stakeholders include the individual building occupants and the tenant organizations (i.e. organizations operating at the building on tenancy agreement). In a residential building, the demand stakeholders are the home owners and individual tenants.

Each type of demand stakeholders experiences different kinds of value-added benefits and affects their demand for sustainable buildings. For example, tenant organizations operating in a sustainable office building are likely to experience value-added benefits such as improved image. For home owners residing in a sustainable residential building, they may experience value-added benefits of improved health and comfort.

This research shall focus on the tenant organizations of office buildings for two main reasons. Firstly, office buildings have been the primary focus of the sustainable building development. From the development of the various building sustainability rating systems such as the LEED and Green Mark, office buildings are usually the first building type that is being focused on. Secondly, tenant organizations would make a greater impact on the demand for sustainable buildings than the individual building occupants who work in the building since they are the ones paying for the rental fees. They are also the one who pay the most for the use of a building over its whole life (Bartlett & Howard, 2000).

1.4 Research Questions and Methodologies

In this section, four research questions (RQ) are formulated to guide the research process towards the achievement of the research aim. They are:

- RQ1: What are the value-added benefits of sustainable buildings?
- RQ2: How can the WTP of the tenant organizations for the intangible value-added benefits be captured and analyzed?
- RQ3: What are the factors affecting the tenant organizations' WTP for the intangible value-added benefits?
- RQ4: What insights do investigating the WTP behavior of tenant organizations provide towards encouraging the demand for sustainable buildings?

Each RQ is further discussed as follows and the corresponding methodologies adopted are discussed.

1.4.1 RQ 1: What are the value-added benefits of sustainable buildings?

To examine the tenant organizations' WTP for the intangible value-added benefits, the first step is to understand what exactly these benefits are. Hence, the first research question is "What are the value-added benefits of sustainable buildings?"

From the literature review, it can be gathered that value-added benefits of sustainable buildings would include improved indoor environment, improved

image, future-proofed against more stringent building regulations, etc. These value-added benefits are normally presented through general discussions about the benefits of sustainable buildings in the literature.

This research adopts a methodical approach in identifying the value-added benefits with a specific focus on those experienced by tenant organizations operating in office buildings.

Definitions of sustainable buildings in the literature are firstly reviewed. The difficulty of a universally-agreed definition of sustainable building becomes apparent as the complexity surrounding the pursuit of sustainable buildings unfolds. The emerging building sustainability rating systems, such as LEED, BREEAM, Green Star and Green Mark, thus provide a convenient way of defining sustainable buildings in reality through the use of sustainability criteria. These sustainability criteria are comprehensively reviewed and analyzed to understand their motives and aims. Their impacts on the building and its occupants are then identified and the resultant value-added benefits of sustainable buildings are thus known.

1.4.2 RQ 2: How can the WTP of the tenant organizations for the intangible value-added benefits be captured and analyzed?

After the identification of the value-added benefits of sustainable buildings, the next step would be to investigate the tenant organizations' WTP for the value-added benefits. Therefore, the second RQ asks "How can the WTP of the tenant organizations for the intangible value-added benefits be captured and analyzed?"

WTP is a type of monetary measure in the economic valuation theory. Hence, the notion of economic valuation is explored. The type of monetary measures, the ways of obtaining the monetary measures, the applicability of each type of monetary measure and the factors affecting the monetary measure are reviewed.

Based on the principles of the economic valuation technique, a conceptual model is developed. Possible factors affecting the tenant organizations' WTP for the value-added benefits are identified from the literature and their relationships with the tenant organizations' WTP hypothesized.

Next, an instrument in the form of a questionnaire is developed based on the principles of an economic valuation technique and the conceptual model to obtain estimates for the tenant organizations' WTP and its factors. In order to ensure that the instrument is effective, expert opinions are sought on its content validity of before its implementation. This is achieved through interviews with ten experts from the fields of building sustainability and economic valuation.

After the development of the questionnaire, how the model variables may be analyzed is investigated. Based on the type of the model variables, appropriate statistical techniques are determined to test the hypothesized relationships between the model variables.

1.4.3 RQ 3: What are the factors affecting the tenant organizations' WTP for the intangible value-added benefits?

Factors affecting the tenant organizations' WTP for the intangible value-added benefits are next identified in the third research questionnaire. Estimates for the tenant organizations' WTP for the value-added benefits and the factors are firstly obtained. This is achieved by implementing the questionnaire through a survey conducted in Singapore and a case study conducted in Beijing.

The survey is carried out on the tenant organizations operating in the office buildings located in the Central Business District of Singapore. From the survey results, the relationships between the tenant organizations' WTP for the value-added benefits and its factors are analyzed using statistical techniques. Firstly, the hypothesized relationships are tested individually using Pearson r correlation, ANOVA and t-test. Next, the collective impacts of the factors on the tenant organizations' WTP for the value-added benefits are analyzed through regression analysis.

Lastly, a case study is carried out in an office building which is located in Beijing and is the first commercial building in China to obtain the LEED Gold award. The case study provides further investigation into the WTP behavior of tenant organizations that are located in a different country and are operating in a building

which uses a different building sustainability rating system from that of the buildings in the survey.

1.4.4 RQ 4: What insights do investigating the WTP of the tenant organizations provide towards encouraging the demand for sustainable buildings?

The investigation into the WTP of the tenant organizations for the value-added benefits is envisaged to shed light on two issues relating to the demand for sustainable buildings. They are how the current strategies and tools may be improved to enhance the tenant organizations' WTP for the value-added benefits and how the sustainability performance of buildings may be enhanced to bring greater value-added benefits. Hence, the last research question asks "What insights do investigating the WTP of the tenant organizations provide towards encouraging the demand for sustainable buildings?"

Barriers to the demand for sustainable buildings and towards the achievement of building sustainability are firstly identified. Findings from the survey and case study results are discussed in the light of these barriers. Then possible solutions are proposed.

1.5 Organization of Thesis

Figure 1-2 shows how the thesis is organized according to the research questions over the next seven chapters. In the next chapter, the value-added benefits shall be identified systematically from examining the impacts of sustainability criteria used in the common building sustainability rating systems and described to address the first research question.

Chapters 3 to 5 are in response to the second research question of how the tenant organizations' WTP for the value-added benefits may be captured and analyzed. The exploration of the notion of economic valuation and WTP are discussed in Chapter 3. Then in Chapter 4, a conceptual model is developed to capture the tenant organizations' WTP for the value-added benefits and its factors. Next in Chapter 5, a questionnaire is developed as an instrument to obtain estimates for the tenant

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organizations' WTP and its factors in reality and a statistical analysis plan is devised for analyzing the variables.

The questionnaire is applied to a survey and a case study. The process of implementation and the results obtained are reported in Chapter 6.

Barriers to the demand for sustainable buildings and towards enhancing sustainability performance of a building are identified. Findings from the survey and case study are presented and discussed in Chapter 7.

Lastly, in Chapter 8, answers to the four research questions are summarized. The contributions of this research and its limitations are discussed. Further works are also recommended.

Figure 1-2: Organization of Thesis

Chapter Two

2 Identifying the Intangible Value-Added Benefits of Sustainable Buildings

2.1 Chapter Introduction

This chapter seeks to answer the first research question, “What are the value-added benefits of sustainable buildings?”

Most discussions so far on the value-added benefits of sustainable buildings are mainly based on intuitions and reasoning (Environmental Building News., 2005; Green Building Council of Australia., 2008; Lucuik et al., 2005; Nalewaik & Venters, 2009; Paul von, 2003). The authors surmise that sustainable buildings are likely to produce value-added benefits mainly due to the enhanced indoor environment. This chapter shall investigate the value-added benefits in a systematic manner.

The investigation process is organized into three stages. The first stage looks into what defines a sustainable building by reviewing the current literature. There is no universally agreed definition for sustainable buildings so far but the emergent of building sustainability rating systems has introduced a convenient way of defining sustainable buildings in reality.

The second stage then moves on to examine the sustainability criteria used in the building sustainability rating systems with a view of how the pursuit of these sustainability criteria impacts on the buildings.

Lastly, with this understanding about the impact of sustainability criteria have on buildings, the resultant value-added benefits of sustainable buildings are identified, particularly those experienced by tenant organizations of office buildings.

2.2 Defining Sustainable Buildings

Sustainable buildings are often termed green buildings, high performance buildings, energy-efficient buildings, environmental buildings and eco-buildings (*The Guidelines for Sustainable Buildings*, 2002; Kibert, 2005a; Lucuik et al., 2005). Among these terms, green buildings are most often used interchangeably with sustainable buildings (McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007).

Although the terms “green” and “sustainable” are often used interchangeably in most circumstances, the distinction between their notions is important in the building environmental assessment community (Cole 1999). The term “green” is used if the aim of the building assessment tool is to result in buildings that are

superior to the current ones which use typical design practice and requirements. On the other hand, the term “sustainable” is used if the aim of the building assessment tool is to result in buildings which are designed and operated with an impact that is “within the assimilative capability of the local and global ecosystems” (Cole 1998). Hence, “green” building assessment tools are concerned with surpassing “typical” practices whereas “sustainability” building assessment tools are concerned with creating “sustainable” practices.

In this study, the term “sustainable buildings” shall be used as it is preferred over “green buildings” for two reasons. Firstly, it is generally believed that the concept of sustainability is broader than the term “green” (McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007). The concept of sustainability involves satisfying the three aims of economic, environmental and social. On the other hand, the concept of green is usually linked to the environmental impacts of a building (Cole 1998; Kaatz et al., 2006; McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007). Secondly, sustainable buildings give a better identification with the concept of sustainable development. Sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations., 1987). As mentioned, building consumes huge amount of resources and has significant impact on the environment and how the future generations meet their needs. Therefore, building plays a significant role in sustainable development. As described by Lutzkendorf & Lorenz (2005), sustainable buildings are simply buildings that contribute to sustainable development. Hence, the use of the term “sustainable buildings” gives a better description of its association with sustainable development.

Although there is no universally agreed definition for sustainable buildings, the definitions given in the current literature share similar ideas about what constitute a sustainable building.

2.2.1 Theoretical Definition of Sustainable Buildings

Most of the definitions of sustainable buildings are described by the goals that they aim to achieve. Table 2-1 summarizes the definitions of sustainable buildings found in the current literature.

Generally, sustainable buildings aim to minimize the negative impacts on the environment and occupants. For example, the Green Building Council of Australia describes sustainable buildings as buildings which aim to “reduce or eliminate the negative impact of development on the environment and occupants” through design, construction and operation practices (Madew, 2006). The Organization of Economic Co-operation and Development (1989) and ASTM International (2005) also suggest similar definitions of sustainable buildings. In addition, both emphasize the need to address environmental impacts, not only in the locality, but also regionally and globally. ASTM International (2005) further specifies a timeline for consideration which is to take into account the impacts during and after the construction and service life (See Part I of Table 2-1).

Other definitions of sustainable buildings attempt to give a more concrete idea of how sustainable buildings are to achieve their aim of minimizing negative impacts on the environment and its occupants. For example, Raman (2005) describes sustainable buildings as buildings that minimize the consumption of resources, i.e. water, energy and materials and maximize the health, safety and quality of life of the building occupants. At the Stanford University, similar definition of sustainable buildings is adopted where they are referred to as “buildings that use energy, water, and other natural resources efficiently and provide safe and productive environment” (*The Guidelines for Sustainable Buildings*, 2002). ASTM International (2005) also offer similar definition along the line of an efficient use of resources and a healthy indoor environment (See Part II of Table 2-1)

In addition, the Whole Building Design Guide (<http://www.wbdg.org/>), the Green Building Council of Australia and Lutzkendorf & Lorenz (2005) further identify the specific issues related to the efficient use of resources and provision of a healthy indoor environment (See Part III of Table 2-1)

Table 2-1: Definitions of Sustainable Buildings

Part (I)	Sustainable buildings minimize negative impact on the environment and occupants		
Green Building Council of Australia (2008)	Incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and occupants		
Organization of Economic Co-operation and Development (1989)	Have minimum adverse impacts on the built and natural environment, in terms of the buildings themselves, their immediate surroundings and the broader regional and global setting		
ASTM International (2005)	Provides the specified building performance requirements while minimizing disturbance to and improving the functioning of local, regional and global ecosystems both during and after its construction and specified service life		
Part (II)	Sustainable buildings:		
	Use resources efficiently	Provide a healthy indoor environment	
	Raman (2005)	Minimises the consumption of resources, i.e. water, energy and materials	Maximises the health, safety and quality of life of the building occupants.
	The Guidelines for Sustainable Buildings (2002)	Uses energy, water, and other natural resources efficiently	Provides safe and productive environment
	ASTM International (2005)	Optimises efficiencies in resource management and operational performance	Minimises risks to human health and the environment
Part (III)	Sustainable buildings address the following related issues:		
	Whole Building Design Guide (http://www.wbdg.org/)	<ul style="list-style-type: none">• Optimize Site Potential• Minimize Energy Consumption• Protect and Conserve Water• Use Environmentally Preferred Products• Optimize Operational and Maintenance Practices	<ul style="list-style-type: none">• Enhance Indoor Environmental Quality (IEQ)
	Madew (2006)	<ul style="list-style-type: none">• Energy efficiency• Greenhouse gas emission abatement• Water conservation• Waste avoidance, reuse and recycling• Pollution prevention - noise, water, air, soil and light• Enhanced biodiversity• Reduced natural resource consumption	<ul style="list-style-type: none">• Productive and healthier environment• Flexible and adaptable spaces
	Lutzkendorf & Lorenz (2005)	<ul style="list-style-type: none">• Minimize LCCs/cost effectiveness from a full financial cost-return perspective• Reduce land uses and use of hard surfaces• Reduce raw materials/ resource depletion• Closing of material flows• Reduce CO² emissions and other pollutants• Reduce impacts on the environment• Preserve of building's cultural value	<ul style="list-style-type: none">• Protection of health and comfort of building occupants/users as well as of neighbours• Maximization of the building's serviceability• Maximization of the building's functionality• Avoid or reduce hazardous substances

Although these issues pertaining to the aims of sustainable buildings help to further characterize them, such definitions may not be sufficient for identifying sustainable buildings in actuality.

There are two main reasons. Firstly, as shown in Table 2-1, there are many issues relating to the efficient use of resources and provision of a healthy indoor environment that a sustainable building has to tackle. The question that arises is then how many of these issues a building has to address in order to be classified as sustainable. Secondly, there are different degrees of achieving each aim and addressing each issue specified in the definitions. Hence, how much should an aim or an issue be met or addressed in order that a building is deemed sustainable?

Therefore, it is necessary to “operationalize” these definitions so that there is a common understanding and easier identification of sustainable buildings in practice. The building sustainability rating systems, which have sprung rapidly in many countries in the recent years, may be a solution.

2.2.2 Building Sustainability Rating Systems

The building sustainability rating systems promotes sustainable buildings by creating an awareness of sustainability issues among the building industry through labeling buildings with a “greenness” level (Kibert, 2005a; Lerario & Maiellaro, 2001; Macalusa, 2006). Some examples of such rating systems are the US’ Leadership in Energy and Environmental Design (LEED), UK’s Building Research Establishment Environmental Assessment (BREEAM), Australia’s Green Star and Singapore’s Green Mark. Table 2-2 summarizes some background information of these rating systems.

Table 2-2: Building Sustainability Rating Systems commonly used in the US, UK, Australia and Singapore

	LEED	BREEAM	Green Star	Green Mark
Country of Origin	US	UK	Australia	Singapore
Organization	US Green Building Council	BRE	Green Building Council Australia	Singapore Building and Construction Authority
Year Established	1999	1990	2003	2005
Rating Category Most Commonly Used for Office Buildings	New Construction Core & Shell	Office	Office Design	Non-Residential Building

In these rating systems, the definitions of sustainable buildings are “operationalized” into a set of criteria systematically. These criteria include energy efficiency, water efficiency and waste minimization. They correspond to the definition that sustainable buildings use resources efficiently. Other criteria such as ensuring indoor air quality, visual quality, thermal comfort and acoustic quality correspond to the definition that sustainable buildings provide a healthy indoor environment.

Some criteria are laid down as minimum requirements and have to be met. Others are optional. Each criterion entails a certain number of points and weightings. The sum of the points obtained will then determine the level of sustainability of the building and the label of “greenness” to be awarded.

Figure 2-1 shows how the definition of sustainable buildings is represented by a set of criteria in the four building sustainability rating systems: LEED, BREEAM, Green Star and Green Mark. The importance of each criterion to achieving sustainability in a building is represented by the weightings attached to it or the number of points allocated to it.

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¹ LEED 2009 for New Construction and Major Renovations

² BREEAM Offices 2008

³ Green Star Office Design v3

⁴ Green Mark for Non-Residential Building

Figure 2-1: Definition of Sustainable Buildings and Sustainability Criteria

As seen from the figure, the emphasis each building sustainability rating system places on the criteria varies from one another. This is due to cultural, social, climatic or geographical differences in different countries. For example, Singapore’s Green Mark rating system allocated about 62% of the total number of possible points to the criterion on energy efficiency. On the other hand, US’ LEED rating system allocated about 32%.

Therefore, the building sustainability rating system can provide a practical way of identifying sustainable buildings by “operationalising” the definition of sustainable buildings into a set of criteria and point system according to each region’s context

and unique sustainability problems and then deriving a sustainability label for each building.

2.2.3 Working Definition of Sustainable Buildings

The building sustainability rating systems provide a fairly easy and convenient way for identifying the sustainability performance of a building in the form of a label. The label may classify the sustainability performance of a building into “Platinum”, “Gold”, “Silver” or “Certified” as in the LEED system or into “6 Star”, “5 Star” or “4 Star” as in the Green Star system.

This labeling or classification is generally accepted now as an indication of the sustainability performance of a building in most countries. Hence, in practice, sustainable buildings are defined by the label or classification level. For example, sustainable buildings may be formally defined in building sustainability rating systems, such as in Australia where sustainable buildings are defined as buildings which have obtained “4 Star” or above in the Green Star rating system.

In other countries, there may not have such a formal definition of sustainable buildings. For example, in the US where the assessment of sustainability performance is voluntary, buildings which have obtained a LEED certification are commonly seen as sustainable regardless of the level of certification. On the other hand, those which have not obtained LEED certification are usually considered as unsustainable. This way of defining sustainable buildings is evident from many research studies such as Kats (2003), McAuley (2008), Nalewaik & Venters (2009) and Turner & Frankel (2008), where LEED certified or LEED-seeking buildings are defined by the researchers as sustainable and are then compared with non-sustainable buildings which are not LEED-certified or LEED-seeking. It is also evident from the reported increasing demand for LEED certified buildings from tenants because they see these LEED-certified buildings as sustainable (McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007).

In Singapore, where new buildings are mandatory to meet at least the Green Mark “Certified” level, it remains to be seen whether such buildings would be deemed less sustainable compared with buildings which surpass this basic requirement.

Currently, the public and building stakeholders generally perceive Green Mark buildings to be sustainable regardless of the label or classification obtained. However, with the mandate in place, it is unknown whether the building industry and public would raise their expectations of a sustainable building further.

2.3 Examining the Sustainability Criteria in Building Sustainability Rating Systems

Based on the working definition of sustainable buildings, the sustainability criteria specified in the building sustainability rating systems thus play an important role in the resultant benefits of sustainable buildings. Hence, in this section, the sustainability criteria are examined.

2.3.1 Overview of Sustainability Criteria used in Building Sustainability Rating Systems

The table on the left side of Figure 2-2 shows an overview of the main sustainability criteria adopted in the LEED, BREEAM, Green Star and Green Mark. As discussed previously in Section 2.2.2, these criteria are mainly organized around the definition of sustainable buildings. Hence, they are not exactly the same but share similar requirements which are centered around the two main aims, i.e. achieving towards efficient use of resources and a high quality indoor environment.

Eight common criteria can be derived from the four building sustainability rating systems as shown in the grey boxes on the right side of Figure 2-2. They are Water, Energy, Materials, Waste, Sustainable Sites, Management, Indoor Environmental Quality and Going Beyond Requirements. These sustainability criteria are expected to impact on how the buildings perform sustainably in three ways, i.e. environmentally, socially and economically.

¹ LEED 2009 for New Construction and Major Renovations

² BREEAM Offices 2008

³ Green Star Office Design v3

⁴ Green Mark for Non-Residential Building

Figure 2-2: Eight Common Sustainability Criteria

2.3.2 Impact of Sustainability Criteria on Buildings

As mentioned, one of the aims of the sustainability criteria in the building sustainability rating systems is to encourage efficient use of resources. Hence, the most obvious impact of these sustainability criteria is that it improves the environmental performance of the buildings. It is anticipated the buildings will encourage environmental protection of the air, water, land and ecosystems, and conservation of resources such as fossil fuels (ASTM International., 2005; Federal Energy Management Program., 2003).

The sustainability criteria also enhance the social performance of the buildings by promoting a high quality indoor environment which improves the quality of life of the building occupants (ASTM International., 2005; Federal Energy Management Program., 2003). The aim towards environmental protection also helps to improve the quality of life of the community and society as a whole.

In achieving towards the aims of sustainable buildings, the sustainability criteria also enhance the economic performance of the buildings through cost savings from the efficient use of resources and value-added to businesses and operations from the pursuit of a high quality indoor environment (ASTM International., 2005; Federal Energy Management Program., 2003).

In addition, the economic performance of the buildings is further enhanced by the environmental and social performance of the buildings. By supporting environmental causes, building stakeholders are often seen as corporate socially responsible and possible liability due to imposing negative impacts on the environment is reduced. An enhanced public image and reduced liability can lead to positive economic impacts (Federal Energy Management Program., 2003).

The social performance of buildings may also bring about further economic benefits. The improved quality of life for the building occupants may increase their productivity and lower the turnover rates and hence bring about further economic benefits (Federal Energy Management Program., 2003).

Figure 2-3 depicts the three types of impacts of sustainability criteria on buildings and how the environmental and social performances may contribute to economic performance of buildings.

On further examination, it can be seen that these three types of impacts result in basically two kinds of economic benefits, i.e. cost reduction benefits and value-added benefits.

Figure 2-3: Relationship between Economic, Environmental and Social Performance of Buildings (Adapted from Federal Energy Program (2003))

2.4 Identifying the Value-Added Benefits of Sustainable Buildings

The preceding section discusses briefly how cost reduction benefits and value-added benefits may result from the impact of the sustainability criteria on buildings. This section aims to identify the common resultant value-added benefits systematically from the sustainability criteria adopted in the building sustainability rating systems.

2.4.1 Definition of Value-Added Benefits

To identify the value-added benefits of sustainable buildings, it is pertinent to understand their characteristics. In the previous chapter, some examples of the value-added benefits of sustainable buildings were mentioned in Section 1.1.2. Its intangible nature was also described in Section 1.2.2.

Value-added benefits are mainly resulted from social and environmental performance of sustainable buildings (Kwong, 2004; Yates, 2001). They include improved organizational image, increased productivity and improved health of occupants. These benefits are due to the reduction of negative environmental impacts and a healthier indoor environment.

In addition, because of its intangible nature, value-added benefits are also often called the intangible benefits of sustainable buildings (Nalewaik & Venters, 2009). It is intangible because unlike the cost reduction benefits, its economic impact is indirect. As described by McAuley (2008), the value-added benefits of sustainable buildings are “indirect economic benefits of green buildings”. Kwong (2004) also refers them as “indirect gains which are benefits to the users of the building”.

Therefore, in summary, the value-added benefits of sustainable buildings have the following characteristics:

- 1) They result mainly from the environmental and social impacts of sustainability criteria
- 2) They do not have direct economic impact on the building and its occupants

2.4.2 Identification of Value-Added Benefits

Eight common sustainability criteria adopted in the LEED, BREEAM, Green Star and Green Mark rating systems have been identified in Section 2.3. They are Water, Energy, Materials, Wastes, Sustainable Site, Management, Indoor Environmental Quality and Going Beyond Requirements. Together with the characteristics of value-added benefits discussed in the preceding section, this section aims to identify the resultant value-added benefits from the eight sustainability criteria, experienced by the tenant organizations of sustainable office buildings, in a systematically fashion.

Figure 2-4 illustrates the framework for identifying the value-added benefits of sustainable buildings and the steps of investigation are as follows:

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The LEED, BREEAM, Green Star and Green Mark rating systems are firstly reviewed to find out how the sustainability criterion is being expressed and specified. This is to establish the aims and requirements of the sustainability criterion.

b) Step 2: Determine the Impact on Building

The aim and requirements are then analyzed to determine the specific economic, environmental and social impacts the sustainability criterion has on a building.

c) Step 3: Identify the Resultant Value-Added Benefits

The impacts of the sustainability criteria are further examined for any possible resultant value-added benefits. The value-added benefits are improved economic opportunities which result mainly from the environmental and social impacts.

The framework is applied on each of the eight criteria and discussed in the following sub-sections.

Figure 2-4: Framework for identifying the Value-Added Benefits of Sustainable Buildings

2.4.2.1 Examination of the Water Criterion and its Resultant Value-Added Benefits

In this section, the sustainability criterion, Water, is examined and its resultant value-added benefits are identified.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The water criterion makes up between 6 to 9% of the possible points in the four building sustainability rating systems (See Table 2-3). Examining the requirements in the rating systems, it is found that they can be broadly classified into three groups, i.e. reduction of potable water demand of building systems; monitoring of water consumption and detection of water leakage; and use of innovative wastewater technologies.

These requirements of the water criterion have a common aim, i.e. to minimize the consumption of potable water. This corresponds to one of the aims of sustainable buildings, which is to achieve efficient use of resources.

b) Step 2: Determine the Impact on Building

One of the most obvious impacts on building as a result of the water criterion is the costs savings from reduced water consumption and wastewater treatment costs. Another economic impact is the lower first costs from the implementation of certain water fixtures.

Besides the positive economic impacts, meeting the water criterion will also bring about positive impacts on the environment. These impacts include conservation of water due to reduced water consumption and protection of the aquatic ecosystem due to reduced water pollution through innovative wastewater treatment.

There are also positive social impacts as the reduction of water consumption cuts down the wastewater treatment plants and associated annoyances. Water resources are also preserved for future generations.

c) Step 3: Identify the Resultant Value-Added Benefits

From the above discussion, it can be seen that cost reduction benefits are most apparent, mainly due to the economic impacts. Nonetheless, there is a value-added benefit of an enhanced organizational image which results from the positive environmental and social impacts. These impacts give the perception that the building stakeholders who pursue this water criterion are socially responsible and thus enhancing their organizational image, which may lead to more business opportunities and bring value to business operations.

Table 2-3 summarizes the analysis of the aim and requirements of the water criterion found in LEED, BREEAM, Green Star and Green Mark, the impacts on building and the resultant value-added benefits.

Table 2-3: Analysis of Water Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Water

Aim	Requirements	LEED	BREEAM	Green Star	Green Mark	Economic	Environmental	Social
To minimize consumption of potable water	Reduction of Potable Water Demand of Building Systems/ Elements	✓	✓	✓	✓	• Lower first cost for some fixtures • Lower operating costs from reduced water consumption	• Conservation of water resources • Less strain on aquatic ecosystem	• Reduction of wastewater treatment plants and associated annoyances • Preservation of water resources for future generations
	Sanitary appliances	✓	✓	✓	✓			
	Landscape irrigation	✓		✓	✓			
	For cooling purposes			✓	✓			
	Fire systems			✓				
	Monitoring and Detection					• Lower operational costs from reduced water consumption	• Conservation of water resources	
	Monitor water consumption		✓	✓	✓			
	Detect water leakages		✓		✓			
	Use of Innovative Wastewater Technologies	✓				• Lower operational costs from reduced water consumption • Lower municipal costs for wastewater treatment	• Reduction of pollution discharge in waterways	
	Treat and use wastewater							
		Resultant Value-Added Benefits					➤ Enhanced organizational image	➤ Enhanced organizational image

2.4.2.2 Examination of the Energy Criterion and its Resultant Value-Added Benefits

Energy efficiency is one of the most, if not, the most important criterion in the building sustainability rating systems. Its impacts on buildings and the resultant value-added benefits are examined as follows and summarized in.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

Like the water criterion, the aim of the energy criterion corresponds to the sustainability aim of efficient use of resources, particularly the fossil fuels, through minimizing the energy consumption.

Table 2-4 lists the five main types of requirements specified in the four building sustainability rating systems. Some of these requirements seek to reduce energy consumption by decreasing the energy demand of the building. These requirements include commissioning of building energy systems, using passive and active means to reduce energy demand, monitoring and managing energy consumption and implementing energy efficient practices and features. Other requirement, i.e. use of alternative energy sources, focuses on increasing the supply of energy in a sustainable way.

b) Step 2: Determine the Impact on Building

Similar to the water criterion, cost reduction benefits are most apparent from the economic impacts of the energy criterion. Lower first costs are expected from system downsizing due to integrated energy solutions. The reduced electricity consumption and energy wastage also contribute to positive economic impacts by lowering the operating costs.

In addition, the energy criterion reduces the negative impacts on the environment by conserving the natural energy resources and reducing greenhouse gas emissions which are associated with fossil fuel use.

Since the energy criterion aims to reduce energy consumption, it is expected that fewer new power plants and transmission lines are needed and hence, lessening the associated annoyances. Lowering of energy demand through passive means is also

expected to improve the indoor thermal conditions and hence enhancing the comfort of the building occupants. Therefore, positive social impacts are expected from meeting this sustainability criterion on energy efficiency.

c) Step 3: Identify the Resultant Value-Added Benefits

An enhanced organizational image is the predominant resultant value-added benefit of this energy criterion. The positive environmental and social impacts help the building stakeholders to be perceived as an advocate for sustainable development and a socially responsible corporation.

Improved comfort of the building occupants is another value-added benefit. It results from improved thermal conditions due to the pursuing of integrated energy solutions of both passive and active means.

Table 2-4: Analysis of Energy Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Energy									
Aim	Requirements	LEED	BREEAM	Green Star	Green Mark	Economic	Environmental	Social	
To minimize energy consumption	Commissioning of Building Energy Systems	✓							
	Commission building energy systems								
	Reduction of Building Energy Demand/CO² emissions through Passive Means								
	Design of building envelope	✓	✓	✓	✓	• Lower first costs from system downsizing due to integrated energy solutions	• Conservation of natural energy resources	• Better occupant comfort due to improved thermal conditions	
	Design of building for natural ventilation	✓		✓	✓				
	Reduction of Building Energy Demand/CO² emissions through Active Means								
	Air-conditioning systems	✓	✓	✓	✓	• Lower operational costs from reduced fuel and electricity consumption	• Reduction of greenhouse gas emissions associated with fossil fuel use	• Fewer new power plants and transmission lines and associated annoyances	
	Artificial lightings	✓		✓	✓				
	Transportation systems, such as lifts, escalators, traveling walkways, etc	✓			✓				
	Peak demand on energy supply infrastructure								
	Use of Alternative Energy Sources				✓				
	On-site renewable energy	✓	✓		✓	• Lower operational costs associated with fuel energy consumption	• Reduction of greenhouse gas emissions associated with fossil fuel use		
	Green power sources	✓							
Monitoring and Management									
Monitor and manage energy consumption		✓	✓			• Lower operational costs from reduced energy wastage			
Energy Efficient Practices and Features									
Examples: Thermal storage system, heat recovery devices, light shelves, motion sensors, sun pipes, ductless fans, auto-condenser tube cleaning system, photo sensors		✓	✓		✓	• Lower operational costs from reduced fuel and electricity consumption	• Reduction of greenhouse gas emissions associated with fossil fuel use	• Fewer new power plants and transmission lines and associated annoyances	
Value-Added Benefits						Resultant		Value-Added Benefits	
						➤ Enhanced organizational image		➤ Enhanced organizational image	
								➤ Improved comfort of occupants	

2.4.2.3 Examination of the Material Criterion and its Resultant Value-Added Benefits

Besides consuming water and energy, building uses large amount of materials too, this section examines the sustainability criterion, Material and identifies its resultant value-added benefits.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The aim of this sustainability criterion on materials is to reduce the consumption of materials in buildings. As mentioned, buildings consume large amounts of materials for its construction. Excessive material consumption leads to resource depletion and environmental deterioration.

Therefore, the requirements of this criterion are organized around minimizing resource depletion and minimizing environmental deterioration. To minimize resource depletion, the choice of materials is important. Materials that are responsibly-sourced, rapidly renewable, with recycled content, etc are highly encouraged. Good practices such as reusing building materials and dematerialization are also requirements of the material criterion to minimize resource depletion. As for minimization of environmental deterioration, use of materials with low embodied impact, green certified materials and materials from nearby region are some associated requirements specified by the building sustainability rating systems.

b) Step 2: Determine the Impact on Building

As the aim of this sustainability criterion is to minimize resource depletion and environmental deterioration, the most direct and positive impacts are on the environment. It is expected that more natural resources will be conserved from the minimization of resource depletion and less associated greenhouse gas emissions through material production and transportation from the minimization of environmental deterioration.

Although its primary aim is to minimize resource depletion and environmental deterioration, the criterion also brings about positive economic impacts. The initial costs are reduced by the decrease in the amount of material consumption.

There are also positive social impacts. By reusing building materials and products, fewer landfills are required and the associated nuisances are reduced. Furthermore, using materials that are extracted and manufactured in the nearby region contributes to less traffic.

c) Step 3: Identify the Resultant Value-Added Benefits

Like the water and energy criteria, the most obvious impact on the businesses of the building stakeholders is the cost reduction benefits, resulted from lower first costs due to reduction in material consumption.

However, value-added benefits are also evident in the businesses of the building stakeholders by mainly enhancing the organizational image as a socially responsible corporation.

Table 2-5: Analysis of Material Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Materials									
Aim	Requirements	LEED	BREEAM	Green Star	Green Mark	Economic	Environmental	Social	
To minimize resource depletion and environmental deterioration due to material consumption	Minimization of Resource Depletion								
	Use responsibly sourced materials and products, particularly wood	✓	✓	✓				• Healthier forests	
	Use rapidly renewable materials	✓						• Conservation of natural resources	
	Reuse building materials and products to reduce demand for virgin materials	✓	✓	✓		• Lower first costs due to material reuse		• Conservation of natural resources	• Fewer landfills and associated nuisances
	Use materials with recycled content (e.g. steel, aggregates, etc) to reduce demand for virgin materials	✓	✓	✓	✓	• Lower first costs due to use of recycled materials		• Conservation of natural resources	
	Dematerialization, i.e. a net reduction in the total amount of material used			✓		• Lower first costs due to reduction in amount of material used		• Conservation of natural resources	
	Minimization of Environmental Deterioration								
	Use thermal insulation with low embodied impact relative to their thermal properties		✓					• Lower energy use and associated gas emissions resulting from material production	
	Use materials and products that are extracted and manufactured within the region	✓						• Lower energy use and associated gas emissions resulting from material transportation	• Decreased traffic
	Use green certified materials and products for building			✓				• Lower energy use and associated gas emissions resulting from material production	
Use green certified materials and products for hard landscaping and boundary protection			✓				• Lower energy use and associated gas emissions resulting from material production		
Minimize use of PVC				✓			• Lower negative impacts on environment due to disposal of non-degradable materials		
Resultant Value-Added Benefits						➤ Enhanced organizational image		➤ Enhanced organizational image	

2.4.2.4 Examination of the Waste Criterion and its Resultant Value-Added Benefits

In addition to consuming huge amount of resources, buildings generate much waste. The sustainability criterion on waste is examined in this section and its impacts on buildings and the resultant value-added benefits are summarized in Table 2-6.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The aim of this sustainability criterion is to minimize waste generation. Reviewing the LEED, BREEAM, Green Star and Green Mark rating systems shows that the requirements associated with this criterion can be broadly classify into two groups. The first group seeks to reduce the waste generated during the construction stage through recycling construction debris, reusing existing building elements, designing for disassembly and minimizing immediate tenant refits. The second group seeks to reduce the waste generated during the operation stage by provision of collection points for recyclable items and through robust designing to reduce the frequency of material replacement.

b) Step 2: Determine the Impact on Building

One obvious impact of the waste criterion is the lower operating costs from reduced waste disposal costs, municipal costs and required replacements. Reduction in waste generated also helps to reduce negative impacts on the environment by lessening the strain on landfills and conserving resources. There is also a positive social impact from reusing existing building elements which may help to retain cultural resources.

c) Step 3: Identify the Resultant Value-Added Benefits

Again, the value-added benefit, resulted from the positive environmental and social impacts, is likely to be an enhanced organizational image for the building stakeholders who pursue to meet this sustainability criterion on waste reduction.

Table 2-6: Analysis of Waste Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Waste

Aim	Requirements	LEED	BREEAM	Green Star	Green Mark	Economic	Environmental	Social
To minimize waste generation	Reduction of Waste Generated During Construction Stage	✓	✓	✓		<ul style="list-style-type: none">• Lower waste disposal costs• Lower municipal costs for new landfills	<ul style="list-style-type: none">• Conservation of resources• Reduced strain on landfills	<ul style="list-style-type: none">• Retain cultural resources
	Recycle and/or salvage nonhazardous construction and demolition debris	✓	✓	✓				
	Reuse existing structural and non-structural building elements				✓			
	Design for disassembly to reduce demolition waste				✓			
	Minimize immediate tenant refits to reduce fit-out waste				✓			
	Reduction of Waste Generated During Operation Stage	✓	✓	✓		<ul style="list-style-type: none">• Lower operating costs from reduced waste disposal• Lower operating costs from reduced replacements	<ul style="list-style-type: none">• Reduced strain on landfills	
	Provide storage and collection of recyclable items to reduce waste generated by building occupants							
	Reduce frequency of material replacement through robust design		✓					
Resultant Value-Added Benefits							<ul style="list-style-type: none">➤ Enhanced organizational image	<ul style="list-style-type: none">➤ Enhanced organizational image

2.4.2.5 Examination of the Sustainable Site Criterion and its Resultant Value-Added Benefits

The sustainable site criterion is another important criterion in most building sustainability rating systems. It makes up between 20% and 28% of the points obtainable in the LEED, BREEAM and Green Star rating systems (See Figure 2-1).

The criterion is examined as follows and its impacts on buildings and the resultant value-added benefits are summarized in Table 2-7.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

Besides consuming huge amounts of resources and generating substantial wastes, buildings impact significantly on the environment due to their site developments. Hence, the aim of this criterion on sustainable site is to minimize the negative impacts on the environment.

The aim is mainly achieved by the building sustainability rating systems through reducing the negative impacts of site developments on land use and ecology, atmosphere and hydrology system. Other associated requirements used in the rating systems include reducing environmental impacts from automobile use, minimizing light pollution to night sky, reducing heat island effect and reducing noise pollution.

b) Step 2: Determine the Impact on Building

One of the most obvious impacts of the sustainable site criterion is that on the environment. The environment is protected by the reduced greenhouse emissions associated with automobile use, reduced pollution of natural water flows and minimized negative impacts on microclimates and human and wildlife habitats.

There are also some positive social impacts such as increased commutation options for building occupants as a result of encouraging use of public transport and improved occupants' comfort as a result of reducing noise pollution.

Although environmental and social are the major impacts of the sustainable site criterion, there may be some positive economic impacts such as lower costs for site

preparation and clearance by reusing land that has been previously developed in order to minimize any negative impacts on the ecology.

c) Step 3: Identify the Resultant Value-Added Benefits

The positive environmental and social impacts of the sustainable site criterion are likely to bring about value to the businesses of the building stakeholders through enhancing their organizational image as responsible organizations who support environmental causes.

Table 2-7: Analysis of Sustainable Site Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Sustainable Site									
Aim	Requirements	LEED	BREAM	Green Star	Green Mark	Economic	Environmental	Social	
To minimize environmental impacts due to site development	Minimization of Environmental Impacts from Automobile Use								
	Encourage Alternative Commutation to Private Transportation								
	Locate building within good public transport networks	✓	✓	✓	✓		• Reduced gas emissions associated with automobile use	• Increased commutation options for occupants	
	Provide bicycle storage and changing rooms	✓	✓	✓	✓				
	Provide safe and secure pedestrian and cycle access routes within development		✓						
	Accommodate a range of travel options for the building users		✓						
	Limit car parking capacity	✓	✓	✓	✓				
	Reduce Traveling Needs								
	Locate building in proximity to local amenities		✓				• Reduced gas emissions associated with automobile use	• Convenience to occupants	
	Encourage Use of Low-Emitting and Fuel-Efficient Vehicles								
	Provide preferred parking and sharing program of such vehicles	✓		✓			• Reduced gas emissions associated with automobile use		
	Minimization of Environmental Impacts on Land Use and Ecology								
	Reuse land that has been previously developed	✓	✓	✓			• Lower costs for site preparation and clearance		
	Remediate and develop contaminated land	✓	✓	✓			• Protect greenfields and preserve habitat and natural resources		
	Locate development on land of low ecological value	✓	✓	✓					
	Maintain or enhance the site's ecological value		✓	✓					
	Promote long term biodiversity		✓						
	Protect or restore habitat	✓							
	Provide a high ratio of open space to development footprint	✓							
	Preserve ecological integrity of topsoil								
	Minimization of Environmental Impacts on Atmosphere								
	Minimization of Ozone Depletion								
	Do not use refrigerants or use refrigerants with ozone depleting potential of zero	✓		✓	✓		• Reduced contribution to global warming effects		
	Use no ozone-depleting substances in insulants								

Table 2-7: Analysis of Sustainable Site Criterion, its Impact on Buildings and the Resultant Value-Added Benefits (Cont'd)

Criterion: Sustainable Site (Cont'd)

Aim	Requirements	Economic				Environmental	Social
		LEED	BREEM	Green Star	Green Mark		
	Minimization of Contribution to Climate Change						
	Do not use refrigerants or use refrigerants with low global warming potential	✓	✓	✓	✓	• Reduced contribution to global warming effects	
	Others						
	Minimize refrigerants leakages by implementing refrigerant leak detection system, maintaining equipment, etc	✓	✓	✓		• Reduced contribution to global warming effects	
	Use supply of heat from a system that minimizes NOx emissions		✓				
	Minimization of Environmental Impacts on Hydrology						
	Reduce imperviousness of site	✓					
	Capture and treat stormwater runoff	✓	✓	✓		• Reduced pollution of natural water flows	
	Locate development in low flood risk areas or take measures to reduce flooding risks		✓				
	Reduce discharge to the municipal sewerage system			✓		• Reduced pollution of natural water flows	
	Minimization of Light Pollution to Night Sky						
	Minimize light trespass from building and site, reduce sky-glow, improve night-time visibility, reduce development impact from lighting on nocturnal environments, etc	✓	✓	✓			
	Minimization of Heat Island Effect						
	Reduce use of heat absorption material externally and use vegetation	✓			✓	• Minimization of impacts on microclimates and human and wildlife habitats	
	Noise Attenuation						
	Reduce the likelihood of noise affecting nearby noise-sensitive buildings		✓				• Increased occupant comfort
Resultant Value-Added Benefits						➢ Enhanced organizational image	➢ Enhanced organizational image

2.4.2.6 Examination of the Indoor Environmental Quality Criterion and its Resultant Value-Added Benefits

In this section, the sustainability criterion, indoor environmental quality, is examined and its resultant value-added benefits are identified and summarized in Table 2-8.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The requirements specified in the four building sustainability rating systems are largely organized around four areas of the indoor environment, i.e. the indoor air, visual performance, thermal comfort and acoustics. They generally aim to contribute to the comfort, well-being and productivity of the building occupants.

b) Step 2: Determine the Impact on Building

As shown in Table 2-8, social impact is the dominant impact of this sustainability criterion. Most of the requirements specified in the building sustainability rating systems are centered on two strategies, i.e. to adhere to commonly accepted standards and to provide for the building occupants a high level of personal control over the indoor environment conditions.

Adhering to the standards will help to ensure a healthy indoor environment. For example, meeting appropriate standards for air quality helps to ensure adequate fresh air and reduce spreading of germs through the specified minimum air change rates. And providing high levels of personal control over the indoor environment conditions have been found to increase the comfort and satisfaction of the building occupants (Abbaszadeh et al., 2006; Heerwagen & Zagreus, 2005). Hence, this sustainability criterion is likely to impact positively on the social performance of buildings by improving the health and comfort of the building occupants.

In addition, there is a positive influence on the environment through the specification of low-emitting materials to ensure good indoor air quality.

c) Step 3: Identify the Resultant Value-Added Benefits

This sustainability criterion is likely to add value through improving the health and comfort of the building occupants, which in turn enhance their productivity. By seeking a good quality indoor environment, the building stakeholders may also be perceived by employees as more caring and thus enhancing their ability to attract and retain employees. Together with positive environmental impacts, this perception also enhances their organizational image.

Table 2-8: Analysis of Indoor Environmental Quality Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Indoor Environmental Quality									
Aim	Requirements	LEED	BREAM	Green Star	Green Mark	Economic	Environmental	Social	
To contribute to the comfort, well-being and productivity of occupants	Ensuring Indoor Air Quality	✓	✓	✓					
	Adhere to or beyond specified standards		✓					• Improved occupants' health • Improved occupants' comfort	
	Achieve natural ventilation	✓					• Lower volatile organic emissions, carbon dioxide and other harmful gases		
	Control environmental tobacco smoke	✓							
	Monitor and control CO ² level	✓		✓					
	Reduce problems due to construction or renovation	✓							
	Use low-emitting materials and other nonhazardous materials	✓	✓						
	Control and isolate chemical and pollutant sources	✓							
	Minimize microbial contamination		✓						
	Provide tenant exhaust riser to remove indoor pollutants from printing and photocopy areas			✓					
	Ensuring Visual Quality								
	Adhere to best practices and avoid redesign of artificial lightings	✓	✓						• Improved occupants' health • Improved occupants' comfort
	Provide high level of lighting system control	✓	✓						
	Use high frequency ballasts in fluorescent luminaries		✓	✓					
	Introduce daylight into building interior	✓	✓						
Minimize glares		✓	✓						
Provide access to external views	✓	✓							
Ensuring Thermal Comfort									
Adhere to specified standards through design of HVAC systems, building envelope, etc	✓	✓	✓	✓				• Improved occupants' health • Improved occupants' comfort	
Provide high level of thermal comfort system control	✓	✓							
Implement a monitoring plan	✓								
Ensuring Acoustic Quality									
Adhere to the appropriate standards according to building's purpose			✓	✓	✓			• Improved occupants' comfort and health ➢ Enhanced organizational image ➢ Improved comfort of occupants ➢ Improved health of occupants	
		Resultant Value-Added Benefits							

2.4.2.7 Examination of the Management Criterion and its Resultant Value-Added Benefits

This sustainability criterion is different from the other criteria as discussed previously. It does not deal with the performance of the buildings directly but focuses on the management of the buildings instead.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The aim of the management criterion is to assist the fulfillment of the objectives of the other criteria. Table 2-9 lists its associated requirements collated from the LEED, BREEAM, Green Star and Green Mark rating systems. They can be broadly grouped into minimizing environmental impacts during construction, enhancing building performance during operation and supporting better integration of the different development stages.

b) Step 2: Determine the Impact on Building

The economic impacts of the management criterion mainly result from the requirements on enhancing building performance during operation. It is expected that conforming to these requirements would generally lower the operating costs.

Enhancing the building performance during operation is likely to improve the indoor environment and enhance the comfort of the building occupants too. Hence, there are also positive social impacts.

It is also expected that complying with the requirements on minimization of environmental impacts during construction would result in positive environmental impacts, such as conservation of resources and reduced pollution.

c) Step 3: Identify the Resultant Value-Added Benefits

The expected resultant value-added benefits of the management criterion is enhanced organizational image due to the positive environmental impacts and improved comfort of building occupants due to the positive social impacts.

Table 2-9: Analysis of Management Criterion, its Impact on Buildings and the Resultant Value-Added Benefits

Criterion: Management

Aim	Requirements	LEED	BREEAM	Green Star	Green Mark	Economic	Environmental	Social
To complement the other sustainability criteria through management	Minimization of Environmental Impacts during Construction							
	Adopt an environmental management system	✓	✓	✓	✓		• Conservation of resources • Reduced pollution	
	Minimize pollution due to construction activities	✓						
	Minimize resource and energy consumption due to construction activities		✓					
	Enhancement of Building Performance during Operation							
	Carry out building commissioning to ensure optimum building performance	✓	✓	✓	✓	• Lower operating costs • Lower costs due to reduced complaints • Preservation of life span of building systems	• Conservation of resources	• Improved comfort of occupants
	Provide building users with a user guide to ensure optimum building performance		✓	✓				
	Reduce opportunity for and fear of crime by effective design measures		✓					
	Conduct building tuning			✓				
	Better Integration of Different Development Stage							
	Engage accredited professional to provide sustainability advice from schematic design phase through to construction completion	✓		✓	✓			
	Appoint independent commissioning agent from project design through to handover				✓			
Resultant Value-Added Benefits							➤ Enhanced organizational image	➤ Enhanced organizational image ➤ Improved comfort of occupants

2.4.2.8 Examination of the “Going Beyond Requirements” Criterion and its Resultant Value-Added Benefits

This is the last sustainability criterion of the eight criteria identified from the LEED, BREEAM, Green Star and Green Mark rating systems. The purpose of it is to achieve the objectives of the other criteria but at the same time, allowing room for improvements on the means to achieve the objectives.

a) Step 1: Establish the Aims and Requirements of Sustainability Criterion

The last sustainability criterion focuses on going beyond what was required in the other criteria of the rating systems. It aims to encourage innovative ways to achieving sustainability in buildings through recognizing building design and features that are not specifically stated in the other criteria. Table 2-10 summarizes the requirements collated from the LEED, BREEAM, Green Star and Green Mark rating systems.

b) Step 2: Determine the Impact on Building

Although the requirements of this criterion are not specific, it is expected that the criterion should encourage more positive economic, environmental and social impacts since it aims to achieve the same objectives as the other criteria but through more innovative ways.

c) Step 3: Identify the Resultant Value-Added Benefits

Therefore, the expected resultant value-added benefits are enhanced organizational image due to positive environmental impacts. The positive social impacts are expected to result in value-added benefits of improved comfort, health, productivity of the building occupants and enhanced ability to attract and retain staff.

Table 2-10: Analysis of "Going Beyond Requirements" Criterion, its Impacts on Buildings and the Resultant Value-Added Benefits

Criterion: "Going Beyond Requirements"									
Aim	Requirements	LEED	BREEAM	Green Star	Green Mark	Economic	Environmental	Social	
To allow innovations for achieving building sustainability beyond what was stated in the criteria	Innovation in Design								
	Achieve significant, measurable environmental performance using strategy not addressed in the other criteria	✓		✓					
	Achieve exemplary performance	✓		✓					
	Regional Priority								
	Address geographically-specific environmental priorities	✓							
	Implementation of Other Green Features								
	Implement other green features not specified in the other criteria				✓				
	Value-Added Benefits						➤ Enhanced organizational image	➤ Enhanced organizational image ➤ Improved comfort of occupants ➤ Improved health of occupants	

2.4.3 The Five Identified Value-Added Benefits (VABs) Experienced by Tenant Organizations

From the examination of the eight common sustainability criteria found in the LEED, BREEAM, Green Star and Green Mark rating systems, five resultant value-added benefits (VABs) experienced by the tenant organizations are identified.

For tenant organizations operating in a sustainable building, the VABs include enhanced organizational image, improved health and comfort of building occupants. These benefits results in further gains to the tenant organizations. The improved health and comfort of staff increases the productivity of staff and the enhanced organizational image may improve the ability to attract and retain the staff (Kwong, 2004; Nalewaik & Venters, 2009; Paul & Taylor, 2008; Ries et al., 2006). Each of these benefits is further discussed as follows.

2.4.3.1 Improved Productivity

As mentioned, the overall productivity of staff may be improved due to their better health and comfort of their working environment. Improvements in productivity of staff may be shown in the form of a decrease in absenteeism rates; improved interactive behavior and communication of the staff which results in better information flow and collaborative work; improved product quality and timeliness of output; and increased innovation (Heerwagen, 2006; Heerwagen & Zagreus, 2005).

2.4.3.2 Enhanced Organizational Image

Positive environmental impacts such as conservation of natural resources and reduced greenhouse gas emissions help to improve the organizational image of the building stakeholders who are committed towards building sustainability. The improved organizational image may in turn bring about new or more business opportunities for the organizations.

2.4.3.3 Improved Ability to Attract and Retain Staff

The social impact of sustainable buildings include improved indoor or working environment. Hence, organization that pursues building sustainability may be seen as a caring employer who is concerned with the welfare of his staff and hence,

improving the ability to attract and retain staff. Turnover rates of staff may be reduced and the ease of attracting staff, particular high-calibre staff, may be enhanced.

2.4.3.4 Improved Physical and Psychological Health of Staff

One of the social impacts of the sustainability criteria is the improved indoor environment which brings about improvements in both the physical and psychological health of staff. As the indoor environment improves, 'Sick Building' related illness may be reduced. Psychological health of staff may also improve by a overall more positive workplace (Heerwagen & Zagreus, 2005).

2.4.3.5 Improved Comfort of Staff

The improved indoor environment also brings about improvements in the comfort of staff. A staff's comfort level is primarily affected by the thermal comfort, air quality, daylighting and acoustic conditions of their working environment (Abbaszadeh et al., 2006; Fisk, 2000; Paul & Taylor, 2008).

Figure 2-5 shows how the VABs "flow" from the basic aim of sustainable buildings through the sustainability criteria found in the building sustainability rating systems.

Figure 2-5: Overview of Sustainability Criteria and the Resultant Value-Added Benefits Experienced by Tenant Organizations

2.5 Chapter Summary

This chapter aims to answer the first research question of “What are the value-added benefits of sustainable buildings?” In order to identify the value-added benefits of sustainable buildings, sustainable buildings are firstly defined. From the literature review, it is found that although there is no universally agreed definition of sustainable buildings, sustainable buildings are generally perceived to be buildings which minimize negative impacts on the environment and occupants. Their aims are to achieve resource efficiency so as to reduce the negative impacts on the environment and to provide a healthy indoor environment in order to reduce the negative impacts on the building occupants.

The building sustainability rating systems, such as LEED, BRREAM, Green Star and Green Mark, achieve these sustainability aims through specifying the criteria for sustainability. Upon reviewing the rating systems, eight common sustainability criteria are identified. They are water, energy, materials, waste, sustainable site, management and “Going Beyond Requirements” which correspond to the aim of achieving efficient use of resources and indoor environmental quality which corresponds to the aim of achieving a healthy indoor environment. These criteria produce an array of positive economic, environmental and social impacts.

The positive economic impacts result in a series of cost reduction benefits, such as lower initial costs due to better integrated design solutions and lower operating costs due reduced energy and water consumption.

On the other hand, the positive environmental and social impacts of the sustainability criteria produce a variety of value-added benefits. Five VABs are identified specifically for tenant organizations. They are improvements in overall productivity, organizational image, ability to attract and retain staff and health and comfort of staff.

Chapter Three

3 Reviewing the Concept of Economic Valuation

3.1 Chapter Introduction

After identifying the value-added benefits of sustainable buildings, this chapter addresses the second research question of “How can the WTP of the tenant organizations for the intangible value-added benefits be captured and analyzed?”

This chapter is the first of the three chapters that seek to address the second research question. It mainly explores the concept of economic valuation in which the notion of WTP falls under. It discusses the rationale of economic valuation for valuing benefits and provides the framework for developing the conceptual model which aims to capture the WTP of the tenant organizations in the next chapter.

In this chapter, the concept of a benefit shall be reviewed to provide an understanding of how its value is determined fundamentally. Next, the concept of economic valuation and its various techniques are discussed. Ways of measuring and eliciting the monetary values attached to benefits and their applicability to the valuing the VABs of sustainable buildings are also reviewed. Lastly, the contingent valuation method which has become synonymous with eliciting WTP is discussed.

3.2 Reviewing the Concept of a Benefit

A benefit is a gain toward some objectives as defined by an individual, i.e. it contributes towards the objectives defined. Therefore, a benefit is a relative concept and not an absolute one. It differs for each individual depending on the objectives he has defined. The following sub-section describes the characteristics of a benefit.

3.2.1 Characteristics of a Benefits

3.2.1.1 Benefits are defined in terms of Costs

As resources are limited, in order to receive a benefit, something has to be given up. Therefore, a benefit may be measured by the costs incurred in order to obtain it. An individual gives up certain amount of the resources that he controls in exchange for a good which he values according to his objectives (Bateman et al., 2002; Mitchell & Carson, 1989). The amount of resources he gives up is the costs for him to secure the benefit, i.e. the good or service which he values.

3.2.1.2 Benefits are influenced by Individuals' Preferences

As described previously, the measure of a benefit is the costs incurred to secure it. How much this cost is depends on how much value an individual places on the benefit which in turn depends on the preference of each individual. An individual who values a benefit greatly will be willing to give up a larger amount of resources

that he has in order to enjoy the benefit. Hence, the value of a benefit reflects “what people want” (Organisation for Economic Co-operation and Development., 1989).

3.2.2 Requirements of a Benefit Measure

3.2.2.1 An Effective Substitute

As seen, the value of a benefit is defined in terms of the amount of resources an individual is willing to give up in order to obtain the benefit. Therefore, the value of a benefit is not defined in absolute measure. Instead, it exists in relation to other things.

Hence, to define the value of a benefit effectively, the choice of the benefit measure is important. The benefit measure has to be “a good that everyone prefers to have more of rather than less” (Bateman et al., 2002). This is so that it can be an effective potential substitute for the array of benefits to be measured.

3.2.2.2 Finely Divisible

In addition to being an effective substitute, the benefit measure should also be finely divisible (Bateman et al., 2002). As mentioned, the value of a benefit also reflects the preference of individuals and hence, its magnitude can be effectively represented if only the benefit measure is finely divisible.

3.2.3 A Monetary Benefit Measure

Money is a good benefit measure. Firstly, money is fungible (Bateman et al., 2002). It has the power to purchase a wide variety of goods and can be put to many uses. Therefore, it can be safely assumed that most people prefer to have more money than less of it. This makes it an effective substitute for most goods and services.

Secondly, money is finely divisible and can be expressed in discrete amounts. This characteristic of money allows the value of a benefit to be effectively and precisely measured. Thus, being fungible and finely divisible, money is a good measure of the value of a benefit, reflecting effectively the costs or the resources that an individual chooses to give up in order to receive the benefit.

3.3 Overview of Economic Valuation

3.3.1 Rationale of Economic Valuation

In the economic world, something has an economic value if it contributes positively to the human wellbeing (Bateman et al., 2002; Freeman, 2003). Human wellbeing in turn is affected by what individuals prefer. The economic value thus measures the change in human wellbeing due to the provision of a good or service which is preferred by the individuals and society.

The economic value of a good or service can be uncovered in the marketplace where sellers and buyers come to an agreement on the value of its contribution to the human wellbeing. Such goods and services are known as marketed goods and services. Buyers and sellers reveal their preferences, to a certain extent, about the marketed goods and services through acquiring and giving up their rights to the goods and services. Their preferences are translated into economic values which are revealed as either the price or the quantity as desired by them in the market place (Mitchell & Carson, 1989).

However, not all the economic values of goods and services can be uncovered in the market place. This happens when buyers and sellers are unable to reveal their preferences and valuation of the good or service simply through acquiring and giving up the rights to it. This is usually due to the non-rival and non-excludable nature of the goods and services (Bateman et al., 2002; Carson, 2000; Mitchell & Carson, 1989).

When a good or service is non-rival, i.e. one person's consumption of it does not reduce its amount available to others, there is no motivation for the sellers or buyers to state their preference for the good or service since it is always in a limitless amount. And when a good or service is non-excludable, the seller would not be able to express his preference for it by supplying it only to those who choose to pay for it. Similarly, the buyer finds no motivation to convey his preference for the good by choosing to pay for it since he would not be prevented from consuming the good or service anyway.

Such goods and services are therefore known as non-marketed for they have no market or have limited or “incomplete” market (Bateman et al., 2002). The non-rival and non-excludable characteristics make individual rights to the goods and services less explicit and identifiable, discouraging the determination of their economic values in the market place (Haab & McConnell, 2002; Mitchell & Carson, 1989). Hence, although the good or service may contribute positively to the human wellbeing, its economic value cannot be assessed by traditional economic techniques (Carson, 2000). Such non-marketed goods are usually associated with the environment. Examples include cleaner air, cleaner water and open spaces.

However, in some cases, it is necessary to uncover the economic value of these non-marketed goods and services as discussed in the next section. This results in the notion of economic valuation.

3.3.2 Purpose of Economic Valuation

Economic valuation is the assignment of monetary values to non-marketed goods and services (Bateman et al., 2002). Another related term found in the literature is benefit assessment (Organisation for Economic Co-operation and Development., 1989).

The purpose of assigning monetary values to non-marketed goods and services is to aid rational decision-making for the provision of such goods and services as the market does not provide for it (Bateman et al., 2002). The decision rule is usually to compare the benefits gained against the costs incurred for such provisions. Since costs are usually defined in monetary terms, benefits should be measured in monetary terms too so that comparison between them can be carried out.

Therefore, economic valuation allows the benefits of non-marketed goods and services to be entered into the decision rule. Without economic valuation technique, the benefits of the non-marketed goods and services would easily be downplayed (Organisation for Economic Co-operation and Development., 1989) and the goods and services may not be provided for adequately or even at all.

As mentioned in the previous section, non-marketed goods and services are usually associated with the environment. Therefore, economic valuation is usually applied in the environmental context as seen in Organization for Economic Co-operation and Development (1989) where it is described as “the widely accepted phrase for procedures which involve placing, as far as possible, a monetary value on the social advantages thought to accrue from improvements in natural and built environments”.

Therefore, economic valuation helps to measure and translate the value of environmental goods and services into economic terms and providing “a check on the economic rationality of investing in environmental improvement (Organisation for Economic Co-operation and Development., 1989). Hence, economic valuation is instrumental in ensuring the provision of non-marketed goods and services.

In the next two sections, the types of monetary measures and how they can be elicited under the concept of economic valuation shall be examined.

3.4 Ways of Measuring Monetary Values

There are two main groups of monetary measures used to quantify values attached to benefits in monetary terms (Haab & McConnell, 2002). The first group is Compensating Variation (CV) and Equivalent Variation (EV) and the other one is Willingness To Pay (WTP) and Willingness To Accept (WTA). Both groups of monetary measures have similar concept which is to measure the amount of money that makes a person indifferent, i.e. not better or worse off, under circumstances of a change in the goods or services.

According to Haab & McConnell (2002), these two groups of monetary measures are equally applicable for economic valuation purposes. However, WTP and WTA monetary measures are more commonly used in recent years. This is mainly due to their concept being more compatible with the language of the increasing popular stated preference technique. The stated preference technique shall be discussed in details in the later sections.

Therefore, the concept of WTP and WTA is further explored as follows.

3.4.1 Willingness to Pay (WTP)

WTP measures the maximum amount of money a person will pay in exchange for an improvement in circumstances or to secure a benefit. It also measures the maximum amount of money a person will pay to avoid a decline in circumstances (Bateman et al., 2002; Freeman, 2003; Haab & McConnell, 2002; Mitchell & Carson, 1989).

The amount would in turn depend on individual preference. Therefore, WTP is a measure of preference satisfaction which in turn is a measure of well-being (Bateman et al., 2002). Hence, being a measure of human well-being, WTP reflects the economic value of a good or service which brings about the change in circumstances.

3.4.2 Willingness to Accept (WTA)

WTA is a similar concept to WTP. Instead of measuring the willingness to pay, it measures the maximum amount of money one is willing to accept to endure a decline in circumstances. It also measures the maximum amount of money one will accept to give up an improvement in circumstances or to forgo a benefit (Bateman et al., 2002; Freeman, 2003; Haab & McConnell, 2002; Mitchell & Carson, 1989).

3.4.3 Which to Use - WTP or WTA?

Theoretically, under the same circumstances, WTP and WTA are the same, i.e. they derive the same economic value of a good or service. The WTP for an improvement in circumstances is equal to the WTA to forgo the same improvement or the WTP to avoid a decline in circumstances is equal to the WTA to endure the same decline.

WTP and WTA both work based on the economic concept of substitutability (Freeman, 2003). Money is used as the substitute for obtaining an improvement or accepting a decline in utility level due to a change in the good or service provided. Hence, the amount of money an individual is willing to pay or accept reveals about his preference and therefore his economic valuation of the good or service.

So which monetary measure should be used - WTP or WTA? This depends mainly on the right to a utility level of the good or service (Carson, 2000; Haab &

McConnell, 2002; Mitchell & Carson, 1989). If the right to a level of well-being belongs to someone else and one need to pay for it to maintain or obtain this level of well-being, a WTP measure should be used. On the other hand, if the right to a level of well-being belongs to an individual and he needs to receive compensation to maintain or give up this level of well-being, a WTA measure should be used.

Besides considering the right to a utility level, it should be noted that the WTP and WTA are likely to be of different magnitude in reality although theoretically they should be the same. It is found that WTA tends to derive at a larger estimate of the change in well-being than that by WTP for the same good or service under the same circumstances (Bateman et al., 2002; Haab & McConnell, 2002; Mitchell & Carson, 1989). In Whynes & Sach (2007), the author found that the mean WTA was approximately four times the mean WTP. Various researchers have suggested some possible reasons for it.

Firstly, from the psychological point of view, humans are more reluctant to give up their rights to a good or service that are in their possession in the first place and hence tend to place a higher value on it (Haab & McConnell, 2002; Organisation for Economic Co-operation and Development., 1989; Whynes & Sach, 2007). From the economic point of view, the assumption that people value gains and loss in the same way is incorrect (Organisation for Economic Co-operation and Development., 1989). They may actually attach more weight to a loss than to a gain as the former has a “compensation structure” and the latter a “purchase structure”. Therefore, the WTA measure tends to derive at a larger estimate of the well-being.

Another possible reason for the larger WTA estimates is that unlike WTP which is constrained by one’s income, there is no upper limit to the compensation amount one required for the loss of wellbeing (Haab & McConnell, 2002).

Between the two monetary measures, WTP is more preferred by most experts and are more widely used in practice (Haab & McConnell, 2002; Mitchell & Carson, 1989; Whynes & Sach, 2007). One of the reasons is that WTP gives a more conservative estimate than WTA. Another reason is that many believe WTA cannot be adopted by stated preference techniques which is one of the main two

approaches used in economic valuation (Haab & McConnell, 2002). Its concept is contradictory to the incentive-compatibility principle of stated preference techniques which seeks to encourage the individuals to state their true preference given incentives in some ways.

As such, the rest of the discussion on economic valuation shall focus mainly on WTP. In the next section, the different economic valuation techniques of eliciting monetary values are explored.

3.5 Ways of Eliciting Monetary Values

As discussed, monetary values placed on a good or service can be measured by WTP or WTA. The WTP or WTA of an individual is in turn affected of his preference for the good or service. Hence, to uncover the monetary value placed on a good or service is to find out the individual preference.

There are two ways in which the preferences of individuals can be known, i.e. as revealed indirectly through the behavior of the individuals or as stated directly by the individuals themselves (Bateman et al., 2002; Haab & McConnell, 2002).

3.5.1 Revealed Preference Technique

In the absence of a market, consumers' purchasing and selling behavior are not possible to be observed. Hence, their preferences and the monetary values that they place on non-marketed goods and services cannot be known directly.

However, if the consumption of the non-marketed good or service affects the consumption of some other related goods or services which are marketed, the individual preference for the non-marketed good or service may be revealed from the influence the good or service exerts on the actual markets of the associated goods or services and the monetary value may be inferred indirectly (Bateman et al., 2002; Carson, 2000; Haab & McConnell, 2002). This is possible if the relationship between the non-marketed good or service and its associated marketed goods or services is known (Mitchell & Carson, 1989).

This technique of economic valuation is called the revealed preference technique, as it infers the individual preference regarding a non-marketed good or service from observations made in the associated actual markets.

The revealed preference technique, as its name implies, obtains information about the preferences of individuals regarding a particular non-marketed good or service as revealed by their buying behavior in the actual markets of some other related goods (Bateman et al., 2002; Haab & McConnell, 2002). As the individual preference of the non-marketed good or service is obtained indirectly from other related markets, revealed preference technique is also known as the indirect behavioral approach (Bateman et al., 2002; Haab & McConnell, 2002).

An example of possible application of the revealed preference technique is the reduced traffic noise. Although no actual market exists for reduced traffic noise, its monetary value may be inferred from studying the prices of houses which are subjected to different levels of traffic noise.

Some examples of the revealed preference techniques include the hedonic pricing and household production function (Mitchell & Carson, 1989).

3.5.2 Stated Preference Technique

The stated preference technique, on the other hand, is the opposite of the revealed preference technique. It differs in two main ways.

Firstly, unlike the revealed preference technique which obtains information regarding the individual preference indirectly from the markets of related goods or services, the stated preference technique obtains the information directly from the individuals themselves by asking them to state the economic value they attach to the non-marketed goods or services (Bateman et al., 2002; Freeman, 2003).

Secondly, a hypothetical market is created in the stated revealed technique to provide a basis for the individual to state their preferences for the non-marketed good or service as compared to the revealed preference technique of observing individual's behavior in actual market of related goods and services (Freeman, 2003; Haab & McConnell, 2002).

Examples of the stated preference technique include contingent valuation, contingent choice and conjoint analysis (Haab & McConnell, 2002). Among these techniques, contingent valuation is the most prevalent and has become almost synonymous with the stated preference technique.

3.5.3 Which to Use - Revealed Preference or Stated Preference?

As seen from the above discussions, the main difference between the two methods of uncovering the monetary values lies in their data sources. The revealed preference technique obtains data from observations of real markets of related goods and services and the stated preference technique from the responses of individuals to hypothetical markets (Freeman, 2003).

It is, thus, no wonder that many perceive the revealed preference technique to be more reliable and even superior to the stated preference technique (Bateman et al., 2002; Haab & McConnell, 2002). The main reason is that responses to hypothetical markets are often seemed to be hypothetical whereas data obtained from actual markets are seemed to be more credible although they provide indirect information. Furthermore, economists are simply more comfortable with observing actual outcomes and behaviors in real markets (Bateman et al., 2002; Haab & McConnell, 2002). The idea of analyzing data from hypothetical markets is alien to most of them.

However, the advocates for stated preference technique contend that it is no less reliable than the revealed preference technique. Although the markets created are hypothetical, individuals can behave as it is in the real world by ensuring that the scenarios created mimic the relevant features of the market place. And if this is established, it introduces methods that are “unique in their simplicity, theoretical justification and ability to value the entire range of benefit categories” (Mitchell & Carson, 1989). In comparison, the revealed preference technique is a two-stage procedure, i.e. first to derive the monetary values of the related marketed good or service and then to infer the monetary value of the non-marketed good or service from the related marketed good or serve. This procedure can be complex, resulting in very uncertain estimates of the monetary values (Bateman et al., 2002).

Furthermore, stated preference technique provides greater flexibility in its application as compared with the revealed preference technique where it is confined to only non-marketed goods and services with associated markets (Bateman et al., 2002; Haab & McConnell, 2002). This is useful in cases where non-marketed goods or services “do not leave a behavioral trail” at all (Schläpfer, 2008).

In addition, stated preference technique allows the motives behind the preferences of individuals to be captured (Bateman et al., 2002; Freeman, 2003). It makes use of questionnaire-based technique which seeks to discover individuals’ preferences.

However, one practical drawback regarding stated preference techniques is that they are resource-intensive. Substantial collection of primary data is needed (Bateman et al., 2002).

Therefore, revealed preference and stated preference techniques have their own strengths and drawbacks and each has its own supporters. And which technique is to be used depends on the kind of data available. In Urama & Hodge (2006), the authors tried to compare between the monetary values derived by the stated preference technique and that by the revealed preference technique for mitigating soil and water pollution problems. It was found that they are significantly correlated. However, they are also significantly different at 5% level. This suggested that human preferences are context-dependent and that revealed preference and stated preference are conceptually different.

Therefore the choice of the economic valuation technique is not a question of superiority but rather the appropriateness of the technique depending on the kind of data available.

3.6 Applicability of Economic Valuation Techniques to Valuing the Intangible Value-Added Benefits of Sustainable Buildings

After the discussions on the concept and techniques of economic valuation, this section shall investigate the applicability of economic valuation to valuing the intangible benefits of sustainable buildings.

The investigation shall proceed by looking into three issues. The first issue is whether the intangible VABs of sustainable buildings are appropriate for economic valuation. This issue shall be examined by comparing the VABs of sustainable buildings and non-marketed goods.

The second and third issue is which monetary measure, WTP or WTA, and economic valuation technique, revealed preference or stated preference, is appropriate for valuing the VABs of sustainable buildings.

3.6.1 Comparison of the VABs of Sustainable Buildings and Non-marketed goods and services

The discussions on the economic valuation concept thus far have focused on non-marketed good or service, presuming taking into consideration all of its benefits. On the other hand, the research problem of this study is to value only some of all the benefits of sustainable buildings, i.e. the intangible VABs and not the cost reduction benefits. Would the concept of economic valuation be applicable to the VABs of sustainable buildings then?

As mentioned, economic valuation seeks to place a monetary value on non-marketed goods and services. How much this monetary value is will depend on the preference of individuals which in turn depends on the change in wellbeing level brought about by the good or service. When the change in wellbeing level contributes towards some objectives as defined by an individual, benefits are resulted and the individual's preference satisfaction is increased. Therefore, by valuing a good or service, one is essentially valuing its benefits.

Another point supporting the applicability of economic valuation concept on valuing the VABs of sustainable buildings is that valuing the VABs share two key similarities with valuing the non-marketed goods and services. Firstly, both have no actual markets. As mentioned in Section 3.3.1, because of its non-rival and non-excludable nature, the monetary value of non-marketed good and service cannot be determined by economic forces in the market place. Likewise, although there is a market for buildings in generally, no specific market exists yet for buildings that are

sustainable. Furthermore, because of the intangibility of VABs, its monetary value is not possible to be determined by market forces.

The second similarity between the VABs of sustainable buildings and non-marketed goods and services is that although they do not have a market, they both contribute positively to the human wellbeing and as mentioned, anything that contributes positively to the human wellbeing has economic values. The notion of economic valuation originates precisely from the aim to place a monetary value of such goods or services.

Therefore, economic valuation is applicable to the valuation of VABs of sustainable buildings. In the next two sections, how applicable is the economic valuation concept is further explored by examining the appropriateness of the monetary measures and economic valuation techniques for valuing the VABs of sustainable buildings.

3.6.2 Review of WTP and WTA for measuring monetary values of the VABs of Sustainable Buildings

As discussed in Section 3.4, there are two types of monetary measures used in economic valuation, i.e. WTP and WTA. They are conceptually similar but in practice, the WTA estimates are found to be higher than WTP most of the time. The conditions for their use also differ.

When an individual has to acquire the right to a certain utility level of the good or service, the WTP measure would be more appropriate. Conversely, when an individual has the right to a certain utility level of the good or service and is to give up this right, the appropriate monetary measure is WTA.

Therefore, in the case of the VABs of sustainable buildings, the appropriate monetary measure is WTP because the right to enjoy the benefits does not lie with the tenant organizations. The WTA measure would only work if the tenant organizations had possessed the VABs in the first place.

In addition, according to Bateman et al (2002), benefits are changes that are more preferred than the datum should be measured by WTP. On the other hand, changes

that are less preferred than the datum should be measured by WTA. Since the VABs are preferred by the tenant organizations, it is reasonable to assume that this preference will show up in the form of a WTP. Therefore, the WTP is the proper monetary measure for the VABs of sustainable buildings.

3.6.3 Review of Revealed Preference and Stated Preference techniques for Measuring VABs of Sustainable Buildings

As discussed in Section 3.5, the choice of revealed preference or stated preference technique lies in the type of data available.

Revealed preference technique would be appropriate if the consumption of the good or service exert some kind of influence in the market of another good or service. For the VABs of sustainable buildings which are improved productivity, enhanced organizational image, improved ability to attract and retain staff, improved health and comfort of staff, they are benefits that are attached to sustainable buildings. The demand for sustainable buildings may exert some influence on the markets of building sustainability professionals, sustainable building measures such as energy-saving bulbs, water efficient fittings, etc. However, the relationship between them and sustainable buildings is unknown and too complex, rendering the revealed preference technique useless.

Stated preference techniques emerge helpful in such situation. Its flexibility allows direct responses from the building tenants regarding their preference about the VABs to be sought directly and analyzed.

Therefore, stated preference technique is more appropriate for measuring VABs of sustainable buildings. In the next section, the contingent valuation method which has become almost synonymous with the stated preference technique is further explored.

3.7 Contingent Valuation (CV)

3.7.1 Principle of Contingent Valuation

The purpose of a CV study is to elicit individuals' preference for a good or service by uncovering their WTP for some changes in the quantity or quality of the good or service (Carson, 2000; Freeman, 2003; Haab & McConnell, 2002; Mitchell & Carson, 1989; Organisation for Economic Co-operation and Development., 1989).

This purpose is achieved by creating a hypothetical market in which the respondents can exercise their consumer sovereignty by stating how much they are WTP for the improvements in the good or service, contingent upon the conditions of the hypothetical market. It is assumed that each individual is able to do so because of the two key assumptions of the positive economic theory upon which the CV method is based, i.e. economic agents have different preferences for different bundles of goods and in all their actions, they always aim to maximize their overall level of satisfaction or utility (Mitchell & Carson, 1989). Therefore, the rationale underlying the CV method is that "individuals have, or can construct unique economic values for the goods by referring to their own well-constructed and known preferences ordering." (Chilton & Hutchinson, 2003)

The responses are usually elicited through the use of survey questions and then analyzed as though they were made by consumers in an existing market and monetary values placed upon the good or service are derived.

3.7.2 Components of a Contingent Valuation Study

There are three main components in a CV study (Mitchell & Carson, 1989). The first component is a detailed description of the good or service being valued and the hypothetical market which the good or service is made available to the respondents.

The second component is questions that elicit the WTP of the respondents for the good or service. There are a few ways of asking the questions such as open-ended, bidding game, payment cards and dichotomous or discrete choice (Freeman, 2003; Haab & McConnell, 2002). Open ended questions are usually in the form "How much would you be WTP for ...?" and a point estimate of the respondents' WTP is

obtained. In the bidding game, the respondents are provided with an amount and asked if they are WTP for the good or service at that amount. The process is repeated with a higher or lower amount depending on the respondents' answer till a point estimate of WTP is obtained. The payment card tries to condense the iterative process of the bidding game by asking the respondents to choose their WTP amount from a card which lists some predetermined values. In the dichotomous or discrete choice, the respondents simply need to answer yes or no to a provided WTP amount.

The last component is a set of questions that seek information which may explain the WTP and the preference of the respondents such as respondents' characteristics and their use of the good or service.

3.7.3 Implementation Issues of a Contingent Valuation Study

A CV study is carried through the use of survey and as with any survey, there are two main issues regarding the use and implementation of a CV study, i.e. its validity and reliability.

Validity is "the degree to which a study measured the intended quantity" (Bateman et al., 2002). Therefore, in a CV study, its results are valid when the elicited WTP values of the good or service are equal to the actual values if a real market existed.

However, in practice, the obtained WTP values may not be equal to the actual WTP values due to two main reasons. Firstly, respondents may exhibit strategic behavior due to how they perceive the payment obligation and their expectations about the provision of the good or service (Mitchell & Carson, 1989). They may answer the questions in a way to their own advantage and thus withhold their honest opinions. Another reason for the invalidity of the results is that respondents are not able to answer the questions in a meaningful way because of their unfamiliarity of the good or service (Bateman et al., 2002; Mitchell & Carson, 1989).

Another implementation issue of a CV study which is also a common issue with any survey is its reliability. Generally, reliability refers to "the degree of replicability of a measurement" (Bateman et al., 2002). In the context of a CV study, it refers to

“the extent which the variance of the WTP amounts given by respondents in a contingent valuation survey is due to random sources or noise” (Mitchell & Carson, 1989).

Mitchell & Carson (1989) gives three possible factors of the random sources. Firstly, the variance of the obtained WTP amounts is due to the actual variance in the WTP amounts of the whole population as it is inevitable that some of them will be WTP more than the others. The second factor of the noise is due to the administering of the survey instrument, such as the wording of the questions, the method of presentation, etc. The last factor of the noise could be due because only a sample of the whole population is surveyed.

3.8 Chapter Summary

This chapter explores the concept of economic valuation as part of a response to the second research question of “How can the WTP of the tenant organizations for the intangible value-added benefits of sustainable buildings be captured and analyzed?”

The concept of a benefit is firstly reviewed and it is found that money is an effective benefit measure. The rationale and purpose of economic valuation are then explained to provide a context for discussing the benefit measures available for reflecting the monetary value of a benefit and the ways available for eliciting the value.

WTP, which is one of the monetary benefit measures discussed, is found to be appropriate for capturing the monetary value the tenant organizations placed upon the intangible VABs. It is also concluded that eliciting the tenant organizations WTP for the VABs of sustainable buildings would require a stated preference technique and CV which has become almost synonymous with the stated preference technique is an appropriate method.

The discussions in this chapter provide a basis for the development of a conceptual model for the tenant organizations’ WTP for the VABs which is reported in the next chapter.

Chapter Four

4 Developing a Conceptual Model for Capturing the Tenant Organizations’ WTP for the Value-Added Benefits

4.1 Chapter Introduction

This chapter continues to address the second research question by developing a conceptual model to capture the tenant organizations’ WTP for the intangible value-added benefits.

According to Fellows & Liu (2008), a model “shows how the variables of a theory are hypothesized to interact in a particular situation”. It posits relationships between variables and hence allowing for generalizations (Burns & Burns, 2008).

Developing a conceptual model for measuring the VABs of sustainable buildings would thus entail identifying the pertinent variables of the values of VABs and making hypotheses about their relationships so that how tenant organizations value the VABs of sustainable buildings may be understood.

In this chapter, past works on the application of economic valuation techniques in the study of sustainable buildings are firstly reviewed. Possible factors affecting the WTP of tenant organizations for the VABs are then identified and their relationships are hypothesized.

4.2 Past Research Works

A review of the literature shows that there are not many works on the application of economic valuation techniques in the study of sustainable buildings. This may be due to the relatively new concept of sustainable buildings and hence, there are still many unexplored areas.

Nonetheless, there are some works which have attempted to understand the economic aspects of sustainable buildings through economic valuation techniques. For example, Leung et al (2005) examines the designers’ and developers’ WTP for improved environmental performance of the building envelope of office buildings in Hong Kong. It is found that the designers and developers are WTP for improvements in the thermal performance of building envelopes provided that there is already access to the external views through the building envelopes. In contrast, the amount of WTP for improved acoustic and daylighting performance is negligible.

Another application of the economic valuation in the study of sustainable buildings is carried out by Banfi et al (2008) where the WTP of home owners and tenants for energy-saving measures in residential buildings are elicited. The results reveal that in addition to the benefit of energy savings, other benefits such as thermal comfort,

air quality and noise protection are significantly valued by home owners and tenants.

The value of green energy is another common application of the economic valuation technique relating to sustainable buildings. The uses of the economic valuation techniques in these studies can be broadly grouped into two kinds. Most of them aim to obtain an estimate of consumers' WTP for green energy (Hite et al., 2008; Nomura & Akai, 2004; Roe et al., 2001; Yoo & Kwak, 2009; Zarnikau, 2003). Others went a step further to find out how the source of green energy (Borchers et al., 2007) or how the way green energy is being provided to the customers affects their WTP (Wiser, 2007).

Although these studies have applied the economic valuation techniques in different ways, they use the same monetary measure, i.e. WTP in their works. This is not surprising as in these cases, the right to the goods or benefits lie somewhere else. It has been reported that the WTP has more extensive use than WTA (Haab & McConnell, 2002; Mitchell & Carson, 1989; Whynes & Sach, 2007).

In these studies, the economic valuation technique used is the contingent valuation method and its variations which belong to the stated preference technique. The stated preference technique is adopted in these studies for the obvious reason that the revealed preference technique is not suitable. There is no apparent associated market with energy-savings building measures, improved environmental performance of building envelopers or green energy.

In summary, it can be seen that economic valuation technique is appropriate for valuing the VABs of sustainable buildings. WTP is also found to be the more appropriate monetary benefit measure than WTA since the right of utility lies somewhere else. Furthermore, it is found that WTP is often used in contingent valuation method because of their compatibility with each other. The contingent valuation method is a stated preference technique which is appropriate for valuing the VABs because revealed preference techniques are not suitable for there are no obvious associated markets for the VABs. Hence, it is found to be the main tool adopted in the study of sustainable buildings from the literature reviewed above.

4.3 Dependent Variable: Willingness to Pay (WTP)

As mentioned in Section 3.4.1, WTP measures the maximum amount of money a person will pay in exchange for an improvement in circumstances or to secure a benefit. Therefore, the tenant organizations' WTP for VABs of sustainable buildings is the maximum amount of money they will pay in order to enjoy the benefits. The amount of their WTP for the VABs will depend on their preferences for the VABs.

The preference of the organizations for each VAB is expected to be different as they bring about different kinds of contribution to the organizations. The VAB of improved productivity is expected to increase the output of the organization. Enhanced organizational image would help to improve the reputation of the organizational which have long-term impact. Improvements in the ability to attract and retain staff help to develop a talent pool and enhance the quality of human resource. As for the VAB of staffs' health being improved, it reduces the health costs. Lastly, improved comfort of staff is expected to enhance the quality of their work.

Although each VAB may contribute differently to the organization, they relate to one another in some ways. For example, improved health and comfort of staff is likely to increase their productivity. It also encourages the staff to remain in the organization and hence, adding on to the VAB of improved ability to attract and retain staff.

In order to gain a deeper understanding about each VAB, the tenant organizations' WTP for each VAB shall be elicited and studied in addition to their total WTP for all the VABs.

Examining the literature on WTP suggests a variety of factors that may affect an individual's preference and his WTP. Table 4-1 summarizes the studies on eliciting WTP for goods or services relating to sustainable buildings. The majority of the studies adopt the CV technique to elicit WTP amounts and then apply regression analysis to investigate the responses. A number of explanatory variables are

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included in the studies to help explain the responses. These variables can be broadly grouped into exogenous variables and endogenous variables.

Exogenous variables are external factors that respondents do not have a choice to make (Bateman et al., 2002). It explains the WTP of the respondents but is not being explained by it. Some examples of exogenous variables of WTP are as shown in the table. They include socio-demographic factors such as the age, income and education level of the respondents.

On the other hand, endogenous variables are internal factors where values are revealed through choices made by the respondents (Bateman et al., 2002). They help to explain the WTP amounts and the WTP amounts also reveal something about them. Examples in the literature reviewed include the respondents' attitude towards green issues, satisfaction level regarding the existing conditions and knowledge about sustainability issues as shown in Table 4-1.

In the following sections, the exogenous and endogenous factors of the tenant organizations' WTP for the VABs of sustainable buildings are identified and discussed.

Table 4-1: Past Studies on the application of WTP on Sustainable Buildings

Sources	Goods to valued	Technique used	Exogenous Factors	Endogenous Factors	Method of Analysis
Banfi et al (2008)	Energy saving measures in residential buildings	Choice experiment	<ul style="list-style-type: none">• Attributes of window, façade & ventilation system• Monthly rent or purchase price		Regression analysis
Leung et al (2005)	Environmental performance of building envelope	Averting expenditure	<ul style="list-style-type: none">• Thermal, daylighting, acoustic performance• Sensation of outdoor connection		Regression analysis
Begum et al (2007)	Improved construction waste management	Open-ended CV	<ul style="list-style-type: none">• Company Type• Experience• Contractor Category• Paid-up capital• Frequency rate of waste collection• Purchase of repairable, refillable and durable materials	<ul style="list-style-type: none">• WTP or not• Satisfaction level of existing waste collection and disposal service	Regression analysis
Nomura & Akai (2004)	Green electricity	Bidding game	<ul style="list-style-type: none">• Socio-demographic variables*• Monthly electricity bills	<ul style="list-style-type: none">• Possession of equipment related to energy use• Opinions about the Kyoto Protocol	Median values & probability
Borchers et al (2007)	Green electricity	Choice experiment	<ul style="list-style-type: none">• Socio-demographic variables*• Monthly electricity bill• Green energy sources	<ul style="list-style-type: none">• Concern about the environment impacts of electricity generation	Nested Logic Model
Hite et al (2008)	Biopower	Open-ended CV	<ul style="list-style-type: none">• Socio-demographic variables*• Current electricity provider	<ul style="list-style-type: none">• Attitudes on energy-related issues	Regression analysis
Zarnikau (2003)	Renewable energy	Open-ended	<ul style="list-style-type: none">• Socio-demographic variables*• Home owner or renter• Primary handler of electric bills		Regression analysis
Roe et al (2001)	Green electricity	Discrete choice	<ul style="list-style-type: none">• Socio-demographic variables*• Electricity service: monthly price, contract terms, fuel source mix, air emissions profile• Primary handler of household bills	<ul style="list-style-type: none">• Membership/donation to environmental organizations,	Median values and probability
Yoo & Kwak (2009)	Green electricity	Dichotomous Choice	<ul style="list-style-type: none">• Socio-demographic variables *• Household information: monthly recreational and environmental expenditure	<ul style="list-style-type: none">• Membership of environmental organizations• Whether respondents know about renewable energy• Whether respondents know about government's scheme of green electricity	Probability

*Socio-demographic variables: income, age, number of people in household, race, education level, gender, occupation

4.4 Exogenous Factors

Examining the exogenous factors in the studies summarized in Table 4-1, it can be seen that the factors may be further categorized into three groups. The first is about the characteristics of the respondents. These are usually the socio-demographic variables such as the age, income, educational level and gender.

The second group of exogenous factors concerns the existing conditions of the good. For example in eliciting the WTP for green electricity, information regarding the existing costs, contract terms and provider of electricity are also considered as explanatory factors in studies such as Borchers et al (2007), Hite et al (2008), Nomura & Akai (2004), Roe et al (2001) and Zarnikau (2003).

The last group of exogenous factors relates to the characteristics of the good being valued. For example, Borchers et al (2007) in eliciting the WTP for green electricity, also takes into consideration the source of the green electricity.

Following from these observations, the exogenous factors of the tenant organizations' WTP for the VABs may be identified as

- Characteristics of tenant organization
- Conditions of existing premises occupied
- Characteristics of building

4.4.1 Organization Characteristics

An organization may be characterized by its business type, company type, whether it is a MNC company, age, staff size and the amount of time the staff spend in office. *Business type* refers to the type of commercial activities that the organization is involved in. Examples include the construction, education, information technology and finance. Different industries may exhibit different responses to building sustainability issues. Some industries may be more forward-looking or more pro-environment. For example, the finance industry seems to be more informed about corporate social responsibility and has developed the Dow Jones Sustainability Index to track the financial performance of leading sustainability

driven companies (Lutzkendorf & Lorenz, 2005). Therefore, tenant organizations of different business types may exhibit different WTP behaviors.

Another organization characteristic is the *company type*, i.e. whether the ownership of the organization is private or public. It has been found in some studies that public companies prefer to operate in certified sustainable buildings (McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007). In some countries, it is even mandatory for government tenants to operate in buildings that have been certified sustainable (Davis Langdon., 2007a; Zimmerman, 2008). Therefore, the WTP behaviour of private tenant organizations may be different from that of public ones.

In addition, *multi-national companies* may also exhibit different WTP behavior from local companies. Multi-national companies are usually from countries where the awareness of sustainability issues is higher, such as the US, Europe, Australia and Japan. Many international firms such as Ernst and Young and PriceWaterCoopers are demanding for green tenancies (Bowen & Wills, 2008; Carter, 2008; Melbourne Business School., 2006). Hence, they may be more sustainability conscious and may have a higher WTP for sustainability benefits.

The *age* of the tenant organization is another organizational characteristic to be considered. Younger organizations may be more receptive towards new ideas and are more informed about sustainability issues. Older organizations may be slower to adapt or more resistant to changes. Therefore, younger organizations may have a higher WTP than that of the older organizations.

As discussed earlier, the WTP of an individual is constrained by his income. Similarly, the income of tenant organizations affects their WTP for the VABs. However, data about income is always sensitive and difficult to obtain. Hence, the *size* of the company may be considered for a rough indication about the income level. It is assumed a larger staff size indicate a higher income level. Hence, it is expected that a tenant organization with a larger staff size would have a higher WTP.

Another organization characteristic is *the amount of time the staff spend in the office*. The longer the time a staff spend working in the office, it is more likely for the tenant organization to place more emphasis on the working environment and hence, raising its WTP for the VABs.

Therefore, it is hypothesized that the above organization characteristics discussed affect the WTP of the tenant organizations for the VABs of sustainable buildings. The hypothesized relationships between the organization characteristics and the tenant organizations WTP for the VABs are summarized in Table 4-2.

Table 4-2: Hypothesized Relationships between Organization Characteristics and Tenant Organizations' WTP for the VABs

Organization Characteristics	Research Hypotheses
Business Type	The average WTP of tenant organizations of different business type is different
Company Type	The average WTP of public companies is different from that of private companies
MNC vs. Non-MNC	The average WTP of MNC companies is different from that of non-MNC companies
Age	The average WTP of tenant organizations is negatively related to their age
Staff Size	The average WTP of tenant organizations is positively related to their staff size
Amount of Time Staff Spend in Office	The average WTP of tenant organizations is positively related to the amount of time their staff spend in the office

4.4.2 Current Premises

The condition of the current premises which the tenant organization is operating from is another important factor as it may motivate or discourage their WTP for the VABs.

The conditions of the current premises include the leasing arrangements which allow the tenant organizations to operate. An example is the *rental fee* or *rental rates*. If the tenant organizations feel that they are already overpaying, it is likely to affect their valuation of the VABs and lower their WTP for them. The *type of lease* may also influence the WTP of the tenant organizations. For example, if the lease type is net, i.e. the tenant pays a fixed rent and a variable expenses such as utilities, he may be more cautious about indicating a high WTP for the VABs. Another leasing arrangement that may affect the tenant organizations' WTP for the VABs is

the *length of current lease*. A longer lease may indicate the overall satisfaction level of the tenant organizations regarding the premises and may affect their valuation of the VABs subconsciously. In addition, the *length of current lease remaining* may cause the tenant organizations to exhibit strategic behaviour. They may indicate a lower WTP than their actual one due to fear that their responses may be known to the building owner.

The *storey* which the tenant organizations are occupying may also influence their WTP. Higher floors are generally preferred by most tenants and hence, for the same VABs experienced, a tenant at higher floor may indicate a higher WTP than one located at a lower floor.

Other possible factors which may not have obvious impact on the tenant organizations' WTP but forms part of the conditions of the current premises include the *length of time they have been operating on the current premises* and the *area occupied*.

Therefore, the above conditions of the current premises are hypothesized to be factors of the tenant organizations' WTP for the VABs of sustainable buildings affecting it in ways as summarized in Table 4-3.

Table 4-3: Hypothesized Relationships between Conditions of Current Premises and Tenant Organizations' WTP for the VABs

Current Premises	Research Hypotheses
Years Operated at Current Premises	The average WTP of tenant organizations is related to the number of years operated at the current premises
Floor Area Occupied	The average WTP of tenant organizations is related to the size of floor area occupied
Storey Occupied	The average WTP of tenant organizations is positively related to the level of storey occupied
Length of Current Lease	The average WTP of tenant organizations is positively related to the length of current lease
Length of Lease Remaining	The average WTP of tenant organizations is negatively related to the length of current lease remaining
Monthly Rental Fee	The average WTP of tenant organizations is negatively related to the monthly rental fee
Rental Rates	The average WTP of tenant organizations is negatively related to the rental rates
Lease Type	The average WTP of tenant organizations of different lease types is different

4.4.3 Building Characteristics

The next group of exogenous factors affecting the tenant organizations' WTP for the VABs is the characteristics of the buildings which they are residing in.

The *size of the building* is an example of the building characteristics. Larger buildings are usually preferred by tenants because of a more majestic image projected and hence, their WTP may be influenced by the building size.

In addition, the performance of a building may decrease as it ages. Therefore, *the age of the building* may be an explanatory factor of a tenant organization's WTP for the VABs.

Another building characteristic to be taken into consideration is the *location* of the building. Some locations may be more attractive to certain tenants and hence affecting their valuation of the benefits.

Also, the *building sustainability rating level* obtained by the building may reflect the sustainability performance of the building and hence, it is expected that the higher the level obtained, the higher is the tenant organizations' WTP.

Another building characteristic factor to be considered is *how the building is managed during the occupancy*. Basically, it may be managed by the building owner himself, i.e. his in-house team or may be managed by engaging a facilities management company. How the building is being managed may affect the building performance and hence the VABs and eventually the WTP of the tenant organizations.

Lastly, building sustainability measures or features may affect the sustainability building performance and hence, it is necessary to examine how they influence the tenant organizations' WTP for the VABs. Common building sustainability features include sunshading devices at the façade, design for natural ventilation, use of water efficient fittings, roof gardens, provision of building user guide and adjustable air-conditioning systems.

In summary, the building characteristics above are hypothesized to be factors of the tenant organizations' WTP for the VABs, as summarized in Table 4-4.

Table 4-4: Hypothesized Relationships between Building Characteristics and Tenant Organizations' WTP for the VABs

Building Characteristics	Research Hypotheses
Gross Floor Area	The average WTP of tenant organizations is positively related to the GFA of building
Building Age	The average WTP of tenant organizations is negatively related to the building age
Building Location	The average WTP of tenant organizations in different locations is different
Building Sustainability Rating Level Obtained	The average WTP of tenant organizations is positively related to the building sustainability rating level obtained
Managed by Building Owners	The average WTP of tenant organizations operating in buildings managed by building owners is different from those that are not
Sunshading devices to Façade	The average WTP of tenant organizations operating in buildings with sunshading devices attached to the façade is different from those that do not have
Designed for Natural Ventilation	The average WTP of tenant organizations operating in buildings designed for natural ventilation is different from those that are not
Use of Water Efficient Products	The average WTP of tenant organizations operating in buildings that use water efficient products is different from those that do not
Roof Gardens	The average WTP of tenant organizations operating in buildings with roof gardens is different from those that do not have
Provision of User Guide	The average WTP of tenant organizations operating in buildings with provision of user guide is different from those that do not
Provision of Air Con Adjustment	The average WTP of tenant organizations operating in buildings with provision of air con adjustment is different from those that do not

4.5 Endogenous Factors

One of the endogenous factors listed in Table 4-1, affecting the respondents' WTP, is the satisfaction of the existing good or service. The satisfaction level in turn reflects the respondents' preferences.

The other endogenous factors are related to perception and knowledge of environmental issues and policies. The aim of these factors is to draw out the attitudes of the respondents regarding environmental issues. As explained by Luzar & Cosse (1998), attitudinal variables are significant explanatory factors which improve the estimation of WTP in CV studies. It is believed that the attitude of an individual is likely to lead to how he will act and his attitude is related to his values and beliefs.

Therefore, three groups of endogenous factors of WTP are identified. They are the tenant organizations’:

- Satisfaction of the value-added benefits experienced
- Perception of sustainable buildings, building sustainability rating systems and building impacts
- Knowledge of sustainability issues, building sustainability rating systems and building impacts

4.5.1 Satisfaction

As mentioned, the preference of an individual for a good or service will show up as his WTP for it. His preference for the good or service is affected by the satisfaction he derived from consuming it. Therefore, the tenant organizations’ WTP for the VABs is closely linked to their satisfaction of the VABs.

It is thus hypothesized that the tenant organizations’ WTP for the VABs is positively related to their satisfaction about them (See Table 4-5)

Table 4-5: Hypothesized Relationships between Tenant Organizations’ Satisfaction regarding the VABs and their WTP for them

Satisfaction regarding	Research Hypotheses
Overall productivity	The average WTP of tenant organizations is positively related to their satisfaction regarding overall productivity
Organizational image	The average WTP of tenant organizations is positively related to their satisfaction regarding organizational image
Ability to attract and retain staff	The average WTP of tenant organizations is positively related to their satisfaction regarding ability to attract and retain staff
Health of staff	The average WTP of tenant organizations is positively related to their satisfaction regarding health of staff
Comfort of staff	The average WTP of tenant organizations is positively related to their satisfaction regarding comfort of staff

4.5.2 Perception

Another endogenous factor of the tenant organizations’ WTP for the VABs is their *perception of sustainable buildings*. Their perception may be affected by how much they agree and believe that sustainable buildings bring about a range of cost reduction and value-added benefits. If they agree, it is likely to lead to a positive perception of sustainable buildings.

Since sustainable buildings are often identified by the building sustainability rating obtained, the perception of the tenant organizations of sustainable buildings is also affected by *how they perceive about the building sustainability rating systems*. If they perceive the rating systems as effective towards enhancing the building sustainability performance, it is likely to raise their WTP for the VABs.

Lastly, the tenant organizations' WTP is also affected by *how they perceive the impact that buildings have on their business operations*. If they perceive buildings as just shelters for their businesses and do not contribute actively towards their organizations, it is likely to decrease their WTP for the VABs.

Therefore, it can be seen a more positive perception is likely to lead to a higher valuation of the sustainable buildings' VABs and hence likely to show up in a higher WTP for the VABs. It is thus hypothesized that the WTP of the tenant organizations for the VABs is positively related to their perception of the sustainable buildings, building sustainability rating systems and building impacts.

Table 4-6: Hypothesized Relationships between Tenant Organizations' Perception regarding sustainable buildings, building sustainability rating systems and building impacts and their WTP for the VABs

Perception of	Research Hypotheses
Benefits produced by sustainable buildings	The average WTP of tenant organizations is positively related to their perception of the benefits produced by sustainable buildings
Effectiveness of building sustainability rating systems	The average WTP of tenant organizations is positively related to their perception of the effectiveness of building sustainability rating systems
Impact of buildings have on occupants and their activities	The average WTP of tenant organizations is positively related to their perception of the impact of buildings have on occupants and their activities

4.5.3 Knowledge

The last endogenous factor of the tenant organizations' WTP is their knowledge about sustainability issues, building sustainability rating systems and the building impacts. It is expected that the more knowledgeable they are, they are more likely to understand the benefits of sustainable buildings and hence would raise their WTP for the VABs.

Therefore, the WTP of the tenant organizations for the VABs is hypothesized to be positively related to their knowledge of sustainability issues, building sustainability rating systems and knowledge of building impacts.

Table 4-7: Hypothesized Relationships between Tenant Organizations' Knowledge regarding sustainability issues, building sustainability rating systems and building impacts and their WTP for the VABs

Knowledge of	Research Hypotheses
Sustainability issues	The average WTP of tenant organizations is positively related to their knowledge of sustainability issues
Building sustainability rating systems	The average WTP of tenant organizations is positively related to their knowledge of building sustainability rating systems
Building impacts	The average WTP of tenant organizations is positively related to their knowledge of building impacts

4.6 Chapter Summary

From the review of the literature on the application of economic valuation concept in the field of building sustainability, three groups of exogenous factors and three groups of endogenous factors are identified as variables of the tenant organizations' WTP for the intangible VABs. The exogenous factors are the Organizations Characteristics, Current Premises and Building Characteristics. The endogenous factors include the tenant organizations' satisfaction regarding the VABs experienced, their perception and knowledge of the building impacts, sustainability issues and the building sustainability rating systems.

Table 4-8 summarizes the factors and their hypothesized relationships with the tenant organizations' WTP for the VABs of sustainable buildings. The hypothesized relationships are of two types. The first type is where the relationship between the factors and the tenant organizations' WTP is hypothesized to have a positive or negative correlation. The second type is where such correlation is absent and instead it is hypothesized that there is a difference in the mean WTP of the tenant organizations which are grouped according to the values of the variable.

Table 4-8: Summary of Factors of Tenant Organizations' WTP and the Expected Relationship between Them

Identified Variables		Expected Relationship with WTP
Exogenous Factors	Organization Characteristics	
	Business Type	Group Difference
	Company Type	Group Difference
	MNC or Non-MNC	Group Difference
	Organization Age	+ / -
	Staff Size	+
	Amount of Time Staff Spend in Office	+ / -
	Current Premises	
	Number of Years operated at the current premises	+ / -
	Floor Area Occupied	+ / -
	Storey Occupied	+
	Length of Current Lease	+
	Monthly Rental Fee	-
	Rental Rates	-
	Lease Type	Group Difference
	Building Characteristics	
	Gross Floor Area	+
	Building Age	-
	Location	Group Difference
	Building Sustainability Rating Obtained	+
	Managed by Building Owner	Group Difference
	Sunshading Devices at Façade	Group Difference
	Designed for Natural Ventilation	Group Difference
	Use of Water Efficient Products	Group Difference
	Roof Gardens	Group Difference
	Provision of User Guide	Group Difference
	Provision of Air Con Adjustments	Group Difference
Endogenous Factors	Satisfaction	
	Satisfaction of overall productivity	+
	Satisfaction of organizational image	+
	Satisfaction of ability to attract and retain staff	+
	Satisfaction of health of staff	+
	Satisfaction of comfort of staff	+
	Perception	
	Perception of benefits produced by sustainable buildings	+
	Perception of effectiveness of building sustainability rating systems	+
	Perception of building impacts	+
	Knowledge	
	Knowledge of sustainable issues	+
	Knowledge of building sustainability rating systems	+
	Knowledge of building impacts	+

Chapter Five

5 Applying the Conceptual Model to Capture and Analyze the Tenant Organizations’ WTP for the Value-Added Benefits

5.1 Chapter Introduction

This chapter presents a research methodology for applying the conceptual model to capture and analyze the tenant organizations’ WTP for the VABs.

The conceptual model may be applied by measuring the model variables and analyzing them. Hence, the research methodology is developed around measuring the model variables and how to analyze them. This chapter is organized into two main parts. The first part reports the development of an instrument to measure the variables. The second part discusses the appropriate statistical strategies for analyzing the model variables.

5.2 Development of a Questionnaire Instrument to Capture the Model Variables

In the contingent valuation method, a survey questionnaire is used to capture the WTP of the respondents. As discussed, a questionnaire not only allows the elicitation of the respondents' WTP, it also captures the explanatory factors of their WTP. Therefore, in this research, an instrument in the form of a questionnaire is developed for capturing the model variables.

The development of the questionnaire is reported as follows. Firstly, the design of the questionnaire is described. Next, to ensure the content validity of the questionnaire, i.e. appropriate information is elicited for capturing the tenant organizations' WTP for the VABs and its factors, ten experts from the fields of building sustainability and contingent valuation were interviewed. Lastly, the expert opinions on the adequacy of the questionnaire for the research purpose are reported.

5.2.1 Designing the Questionnaire

The aim of the questionnaire is to provide an instrument for capturing the tenant organizations' WTP for the VABs and its factors in reality. Some considerations when designing the questionnaire include the:

- 1) Organization of the Questionnaire
- 2) Formulation of Questions

5.2.1.1 Organization of the Questionnaire

Corresponding to the six groups of factors identified in the previous chapter, the questions targeted at the tenant organizations, are organized into four sections as follows:

- Section A: Organization characteristics
- Section B: Current premises
- Section C: Tenant Organizations' WTP and their satisfaction of the VABs experienced
- Section D: Tenant organizations' perception and knowledge of sustainability issues, building sustainability rating system and building impacts

The survey questionnaire can be found in Appendix A. The group of factors associated with building characteristics is not included in this questionnaire as it is best obtained from the building managers or owners. Hence, a separate questionnaire targeted at the building managers or owners is developed to capture the information regarding the building characteristics group of factors (See Appendix C for the questionnaire on capturing the building characteristics).

5.2.1.2 Formulation of Questions

In Section A, the questions ask about the Organization Characteristics which include the business type, company type, whether it is a MNC or non-MNC, organization, age, staff size and amount of time staff spend in office. These questions are close-ended with options given.

Section B focuses on obtaining information regarding the current premises that the tenant organizations are operating on. It includes a mixture of close-ended questions such as the number of years the organization has been operating at the current premise and their lease type and open-ended questions such as the floor area occupied, current monthly rental fee, the length of current lease and the year when the current lease expires.

The questions in Section C are about the tenant organizations' satisfaction regarding the benefits experienced at the current premises and their WTP for them. Firstly, a description of the VABs is given and the respondents are asked to rate their

satisfaction regarding a VAB on a scale of 1 to 5, where 1 indicates “Somewhat Satisfied” and 5 indicates “Extremely Satisfied”. Where no such benefit is experienced, the respondents may indicate a zero. Next, a WTP elicitation question with a hypothetical scenario is posed “Assume that your current rental fee has not taken into consideration of the benefits stated in the previous question, how much more are you willing to pay on top of your current monthly rental fee in order to continue enjoying the same benefits at the same level of satisfaction?”

Lastly, in Section D, the questions focus on the tenant organizations’ perception and knowledge of sustainability issues, a building sustainability rating system that is applicable to the country and building impacts. Firstly, a 5-point scale is adopted for eliciting their perceptions. On a scale where 1 indicates “Unimportant At All” and 5 indicates “Very Important”, the tenant organizations are asked to rate the importance of buildings towards the achievement of their organizational mission and for producing benefits for their organization. They are also asked to rate the importance of the building sustainability rating system and its labeling to their organizations when selecting a place for operation of their businesses. On their perception of sustainable buildings, they are asked to rate how much they agree on the kind of benefits claimed to be produced by sustainable buildings on a 5-point scale where 1 indicates “Strongly Disagree” and 5 indicates “Strongly Agree”.

Next, 10 questions with “True”, “False” and “Don’t Know” options are posed to test the tenant organizations on their knowledge regarding sustainability issues, the building sustainability rating system and the impacts of building on its occupants. Following are the ten statements which the tenant organizations are to answer:

- 1) Sustainable development meets the needs of the present generations without compromising the ability of future generations to meet their own needs
- 2) Sustainability is achieved as long as its negative impacts on the environment are addressed
- 3) A building has 3 types of impacts, i.e. environmental, economic and social
- 4) An energy-efficient building is a sustainable building
- 5) The Green Mark assessment initiated by the Building and Construction Authority, is a green building rating system

- 6) The Green Mark assessment system is applicable to new buildings only
- 7) One of the criteria of the Green Mark assessment system aims to improve the indoor environment quality of a building
- 8) Natural lighting and access to external views are distractions to the building occupants
- 9) The ability to have personal control over temperature, noise, air movement and lighting is likely to improve the productivity of a worker
- 10) The floor layout affects remodeling costs

5.2.2 Interviewing the Experts

5.2.2.1 *Rationale for Seeking Expert Opinions*

The purpose of the questionnaire is to obtain the tenant organizations' WTP estimates for the VABs of sustainable buildings and identify the factors that lead to their estimations. Hence, the central question of the survey is the WTP elicitation question. How the tenant organizations are being led in the survey to make an estimation of their WTP for the VABs is of utmost importance.

There are two issues regarding the elicitation of WTP estimates from respondents (Mitchell & Carson, 1989). Firstly, there is a possibility of strategic behavior by the respondents. Therefore, it is unsure if respondents will answer honestly.

Although respondents may exhibit strategic behavior by deliberately giving untruthful WTP values, this threat is likely to be much less serious than the second issue that they may give meaningless values (Mitchell & Carson, 1989). The hypothetical nature of the scenario and unfamiliarity of the good or service to be valued may cause the respondents not being able to make a true estimation of their WTP for the good or service.

In addition to the crucial elicitation question, key factors that affect the tenant organizations' WTP for the VABs are also imperative in understanding their WTP behavior towards sustainable buildings. From the literature review, it is found that the tenant organizations' WTP are likely to be influenced by a variety of exogenous and endogenous factors as discussed in the previous chapter. Therefore, the questionnaire seeks to capture these explanatory variables too.

Therefore, the purpose of seeking expert opinions is two-fold. Firstly, it is to establish the content validity of the questionnaire. Content validity involves the “issue of whether the measure adequately covers the construct’s domain” (Mitchell & Carson, 1989). It assesses the validity of the results obtained by examining whether right questions have been asked and the way that they are being asked. According to Mitchell & Carson (1989), the content validity of a survey can only be evaluated by a subjective judgment. Therefore, the opinions of experts in the field of building sustainability and/or CV study are sought.

Secondly, seeking expert opinions also help to achieve the aims of a pilot study such as whether the questions are clearly worded, whether the respondents are able to answer the questions and whether the obtained responses achieved the intention of the questions.

5.2.2.2 Conducting the Interviews

To seek the opinions of the expert on the questionnaire, interviews were carried out. In order to facilitate the interviewing process, a questionnaire is drafted to focus on three main issues:

- 1) *Does the questionnaire encourage the respondents to answer honestly?*
i.e. whether the design of questionnaire encourages respondents to reveal their true WTP for the benefits enjoyed
- 2) *Does the questionnaire allow the respondents to answer meaningfully?*
i.e. whether the information provided in the questionnaire is sufficient and reasonable for respondents to make informed decisions on their WTP for the benefits enjoyed
- 3) *Does the questionnaire ask appropriate and adequate explanatory variables to explain the attitude and behavior of the respondents on their stated WTP?*

Appendix B contains the questions that were asked to the experts. For local experts, face-to-face interviews were conducted which took between one to two hours. As for overseas experts, interviews were conducted via the questionnaire sent through email. The whole interviewing process took place from April 2008 to June 2008.

5.2.2.3 Profile of Experts

In total, ten experts from both the academia and industry with knowledge in either building sustainability, CV study or both were interviewed. Table 5-1 summarizes the designation of the experts, their institution and the mode of interview.

Table 5-1: Profile of Experts

Expert	Designation	Institution	Mode of Interview
A	Associate Professor in Civil Engineering	Tertiary Institution	Face-to-face
B	Senior Research Scientist	Research Institution	Email
C	Senior Interior Design Project Manager	Design Consultant	Face-to-face
D	Research Scholar in Construction Management	Tertiary Institution	Face-to-face
E	Manager, Properties and Facilities Management	Government Statutory Board	Face-to-face
F	Assistant Professor in Construction Management	Tertiary Institution	Face-to-face
G	Quantity Surveyor	Quantity Surveying Co.	Face-to-face
H	Research Scholar in Sustainable Buildings	Tertiary Institution	Face-to-face
I	Development Manager	Real Estate Developer	Face-to-face
J	Professor in Economics	Tertiary Institution	Email

Before the commencement of the interview, the experts were asked to self-evaluate their knowledge about CV studies and building sustainability issues on a rating of 0 to 3, with 0 indicating Unfamiliar and 3 Very Familiar. Figure 5-1 summarizes the self-evaluation results of the experts. Most of the experts are more familiar with building sustainability issues, except for four experts who rated themselves from fairly familiar to very familiar with CV studies.

Figure 5-1: Experts' Self-Evaluated Familiarity with CV studies and Building Sustainability Issues

5.2.3 Examining the Expert Opinions

Next, the responses of the experts on the three issues identified in Section 5.2.2.2 are discussed as follows.

5.2.3.1 Does the questionnaire encourage the respondents to answer honestly?

The first issue discussed is whether the survey is designed in such a way as to allow the respondents to answer honestly, i.e. they will not exhibit strategic behavior to hide their true responses. The questionnaire is designed with some features to encourage the tenant organizations to answer honestly. Firstly, on the cover page, the respondents are assured of the confidentiality of their responses. In addition, the completed questionnaire shall be returned directly to the researcher. Lastly, the final affirmation that the survey is for the sole purpose of research is explained on the cover page.

The experts were asked to rate their agreement of how these features of the questionnaire have helped to encourage the respondents to answer honestly on a scale of 1 to 5, from Strongly Disagree to Strongly Agree. Table 5-2 summarizes the opinions of the experts.

Table 5-2: Expert opinions regarding whether the questionnaire encourages respondents to answer honestly

S/N	Does the questionnaire encourage the respondents to answer honestly?	Expert										Average Score
		A	B	C	D	E	F	G	H	I	J	
1	The <i>assurance on the confidentiality</i> of the respondents' participation encourages the respondents to reveal their WTP for the benefits enjoyed	4	4	5	4	4	4	4	5	4	4	4.2
2	By <i>returning the completed questionnaire directly to the researcher</i> encourages the respondents to reveal their WTP for the benefits enjoyed	4	2	3	4	2	4	4	5	4	4	3.6
3	The questionnaire is carried out for <i>research purposes</i> . Hence, there will be minimum strategic behavior of the respondents, i.e. behavior of not revealing their true intended WTP for the benefits enjoyed	4	4	4	3	4	4	5	4	4	2	3.8

Rating Scale: 1-Strongly Disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly Agree

On average, the experts agreed that these features of the questionnaire would encourage the respondents to answer honestly, particularly the assurance on the confidentiality of their responses. One expert commented that a further elaboration of how the answers of the respondents would be used may be helpful to elicit true and thoughtful responses. Hence, the obtained information would be useful for the research purpose towards “achieving the goals of building sustainability” is further explained on the cover page of the questionnaire to the tenant organizations.

5.2.3.2 Does the questionnaire encourage the respondents to answer meaningfully?

The next issue concerns whether the respondents will answer meaningfully. The opinions of the experts are sought in two main areas - one pertaining to the manner of eliciting the tenant organizations' WTP and another regarding the notion of WTP as a reflection of the monetary value of the VABs. The opinions of the experts are summarized in Table 5-3.

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Table 5-3: Expert opinions regarding whether the questionnaire encourages respondents to answer meaningfully

S/N	Does the questionnaire encourage the respondents to answer meaningfully?	Expert										Average Score
		A	B	C	D	E	F	G	H	I	J	
(i)	Regarding the Manner in which the WTP is elicited											
1	The <i>description of the VABs is clear</i> to the respondents such that they are able to identify whether such benefits have been experienced	5	2	5	5	3	5	5	4	3	5	4.2
2	The <i>assumptions are clear</i> to respondents such that they are able to answer the elicitation question seriously and thoughtfully	3	5	5	5	2	4	5	4	4	4	4.1
3	The <i>assumptions are plausible and reasonable</i> to respondents such that they are able to answer the elicitation question seriously and thoughtfully	3	4	4	5	2	4	5	4	4	3	3.8
4	The <i>consequence of non-payment for the benefits</i> , i.e. being not able to enjoy the same benefits at the same level, is clear to respondents such that they are able to answer the elicitation question seriously and thoughtfully	3	2	4	5	2	4	5	4	4	5	3.8
5	The <i>elicitation question is clear</i> to respondents such that they are able to answer it seriously and thoughtfully	3	3	4	4	2	4	5	3	4	2	3.4
6	<i>Expressing the amount of WTP as a percentage</i> of the organizations' current rental fee is <i>reasonable</i>	3	4	5	4	5	4	5	5	3	4	4.2
7	<i>Expressing the amount of WTP as a percentage</i> of the organizations' current rental fee is more likely to yield a <i>valid</i> estimate of their WTP as compared to expressing the WTP amount in absolute numbers	3	3	5	5	5	4	5	4	4	3	4.1
8	The reminder " <i>Do remember you have a budget to stick to</i> " is helpful to respondents to state a realistic WTP	3	3	3	2	3	2	5	4	2	5	3.2
9	The <i>summation of the stated percentages is helpful</i> to respondents to state a realistic WTP	3	4	5	4	4	3	5	5	4	2	3.9
(ii)	Regarding the Notion of WTP as a Reflection of the Monetary Value of VABs											
1	The stated WTP in the questionnaire reflects the <i>usefulness</i> of the benefits enjoyed by organizations from operating their current premises	4	4	5	4	4	4	5	4	4	5	4.3
2	The stated WTP in the questionnaire reflects the <i>preferences</i> of the organizations on the sustainability benefits	.	.	.	4	4	4	5	4	4	5	4.3
3	The stated WTP in the questionnaire reflects the <i>performance</i> of the buildings	4	2	2	4	4	4	5	4	3	4	3.6
4	The stated WTP in the questionnaire reflects the <i>monetary value</i> of the benefits of the buildings	4	3	4	4	4	4	4	4	4	4	3.9

Rating Scale: 1-Strongly Disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly Agree

Firstly, the manner of eliciting the tenant organizations' WTP for the VABs is investigated. To enable the tenant organizations' to answer meaningfully, it is of primary importance that the tenant organizations understand what they are being asked to value. Hence, a *description of the VABs* is given prior to the WTP elicitation question. The experts were asked how much they agree with the clarity of the description. There were some comments regarding the format of the description which requires considerable reading effort. Hence, the amended questionnaire to the tenant organizations incorporated a short description of the VABs. Nevertheless, the experts indicated a high agreement on the clarity of the contents in the description based on their average score of 4.2 out of 5.

A hypothetical scenario is created for the tenant organizations as a basis for their valuation of the VABs. The experts were asked what they thought of the *clarity* and *plausibility of the assumptions* made in the scenario and they rated an average score of 4.1 and 3.8 respectively. In addition, they also agreed that the *consequence of non-payment* for the VABs mentioned in the hypothetical scenario is clear to the respondents.

Next, the WTP elicitation question "How much more are you willing to pay on top of your current monthly rental fee in order to continue enjoying the same benefits at the same level at the new premises?" is asked. The experts generally agreed that *the elicitation question is clear* to the respondents such that they are able to answer it seriously and thoughtfully. Several experts pointed out that this WTP elicitation question may not be answered by someone who is not familiar with the property requirements of the organization. Hence, they suggested that this problem to be resolved by selecting the appropriate personnel of the organization to answer the questionnaire. Therefore, the personnel of the organization who is suitable to answer the questionnaire is specified on the cover page.

Furthermore, the experts agreed that *expressing WTP as a percentage* of the respondents' current rental fee is reasonable and is more likely to yield a valid WTP estimates compared with expressing the WTP amount in absolute numbers. The *summation of the WTP of each VAB* would also help the respondents to state a realistic WTP. However, the experts deemed that the *reminder* that "Do remember

you have a budget to stick to” as less helpful in eliciting a realistic WTP. One of the experts commented that in his opinion, most of the respondents do not need such a reminder. On the other hand, another expert remarked that such a reminder is helpful to remind the respondents of the income constraint to their WTP for the VABs. Nonetheless, this reminder is included in the questionnaire since it is agreed that it does not discourage the respondents from answering meaningfully anyway.

In addition to the manner of eliciting the WTPs of the tenant organizations, expert opinions on the notion of WTP as a reflection of the monetary value of the VABs are sought. The experts were asked how much they agreed that the WTPs of the tenant organizations reflect the *usefulness* of the VABs to the respondents, the respondents’ *preferences*, the *performance* of the buildings and the *monetary value* of the VABs. Among these four issues, the experts most agreed that the WTP elicited would reflect the usefulness of the VABs and the preferences of the tenant organizations. On the other hand, they were least agreeable that the elicited WTP would reflect the performance of the buildings.

5.2.3.3 *Does the questionnaire ask appropriate and adequate explanatory variables to explain the attitude and behavior of the respondents on their stated WTP?*

The last issue explored with the experts is whether appropriate and adequate explanatory variables are captured in the questionnaire. Table 5-4 summarizes the responses of the experts.

Generally, the experts agreed that the questions asked in the survey have captured the organizations’ characteristics, the conditions of the current premises, the perception and knowledge of the organizations regarding the building impacts, Green Mark and sustainable buildings. They gave an average score of 3.7 to 4.4. One expert suggested that multi-national companies may have a higher WTP than local ones because of the countries which they are based in, such as the US and Japan, have a greater awareness of sustainable buildings. Therefore, this suggestion is accepted and added to the questionnaire to the tenant organizations.

In addition, the experts agreed that these groups of variables are sufficient and appropriate for analyzing the attitude and behavior of the tenant organizations

toward their WTP for the VABs enjoyed based on their high average score of 3.9 to 4.3.

Table 5-4: Expert opinions regarding whether the explanatory variables are appropriate and adequate

S/N	Does the questionnaire ask appropriate and sufficient explanatory variables to explain the attitude and behavior of the respondents on their stated WTP?	Expert										Average Score
		A	B	C	D	E	F	G	H	I	J	
(i)	Regarding the Organization Characteristics											
1	The <i>questions in Section A</i> are <i>appropriate</i> for capturing the characteristics of organizations	4	4	5	5	4	5	5	4	4	4	4.4
2	The <i>characteristics of organizations</i> is an <i>appropriate factor</i> for analyzing the attitude and behavior of organizations towards their WTP for the benefits enjoyed	4	4	5	3	4	4	4	5	4	4	4.1
(ii)	Regarding the Current Premises											
1	The <i>questions in Section B</i> are <i>appropriate</i> for capturing the conditions of the current premises	4	3	5	4	4	4	5	5	4	4	4.2
2	The <i>current premises which the organizations are operating from</i> is an <i>appropriate factor</i> for analyzing their attitude and behavior towards their WTP for the benefits enjoyed	4	5	5	4	5	3	5	4	4	4	4.3
(iii)	Regarding the Perception of Building Impacts, Building Sustainability Issues & Green Mark Rating System											
1	Question 1 and 2(i) are appropriate for capturing the organizations' perception of <i>the impact of building on its occupants</i>	4	3	5	4	2	4	2	4	5	4	3.7
2	Question 2(ii) and 2(iii) are appropriate for capturing the organizations' perception of the effectiveness of <i>Green Mark</i> towards contributing to the indoor environment quality	4	3	5	4	4	4	5	5	4	4	4.2
3	Question 4 is appropriate for capturing the organizations' perception of <i>sustainable buildings</i>	4	3	5	4	4	4	5	4	5	4	4.2
4	The perception of organizations on <i>sustainable buildings</i> is an <i>appropriate factor</i> for analyzing their attitudes and behavior towards their WTP for the benefit enjoyed	4	4	2	4	4	4	5	5	4	4	4.0

Table 5-4: Expert opinions regarding whether the explanatory variables are appropriate and adequate (Cont'd)

S/N	Does the questionnaire ask appropriate and sufficient explanatory variables to explain the attitude and behavior of the respondents on their stated WTP?	Expert										Average Score
		A	B	C	D	E	F	G	H	I	J	
(iii)	Regarding the Perception of Building Impacts, Building Sustainability Issues & Green Mark Rating System (Cont'd)											
5	The perception of organizations on <i>Green Mark is an appropriate factor</i> for analyzing their attitudes behavior towards their WTP for the benefits enjoyed	4	4	5	4	4	4	5	4	3	4	4.1
6	The perception of organizations on <i>the impact of building on building occupants is an appropriate factor</i> for analyzing their attitudes and behavior towards their WTP for the benefits enjoyed	4	3	5	4	4	4	5	5	4	4	4.2
(iv)	Regarding the Knowledge of Building Impacts, Building Sustainability Issues & Green Mark Rating System											
1	Question 5 are appropriate for capturing the organizations' knowledge of <i>sustainable buildings</i>	4	4	4	4	4	4	5	4	4	4	4.1
2	Question 6 are appropriate for capturing the organizations' knowledge of <i>Green Mark</i>	4	3	4	4	4	4	5	4	2	4	3.8
3	Question 7 are appropriate for capturing the organizations' knowledge of <i>the impact of building on its occupants</i>	4	4	4	4	3	4	3	4	4	4	3.8
4	The knowledge of organizations on <i>sustainable buildings is an appropriate factor</i> for analyzing their attitudes and behavior towards their WTP for the benefit enjoyed	4	3	5	4	4	4	5	5	4	4	4.2
5	The knowledge of organizations on <i>Green Mark is an appropriate factor</i> for analyzing their attitudes and behaviours towards their WTP for the benefit enjoyed	4	3	5	4	4	4	5	4	2	4	3.9
6	The knowledge of organizations on <i>the impact of building on building occupants is an appropriate factor</i> for analyzing their attitudes and behaviors towards their WTP for the benefit enjoyed	4	3	5	5	4	4	3	5	4	4	4.1
(v)	Overall											
1	The variables explored in the CV questionnaire are sufficient for analyzing the attitude and behavior of the organizations towards their WTP for the benefits enjoyed	4	3	5	4	3	4	5	4	3	5	4.0

Rating Scale: 1-Strongly Disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly Agree

Other comments given by the experts include how to improve the questionnaire such as the wording of the questions. Some concerns were also raised regarding the participation rate of the questionnaire as it requires a considerable effort to understand the questions being asked.

In conclusion, the experts had no major issues with the content of the questionnaire. They generally agreed that the design of the questionnaire encourages the tenant organizations to answer the questions honestly and meaningfully and that the questionnaire has captured the appropriate explanatory variables of the tenant organizations' WTP for the VABs adequately.

5.3 Development of a Statistical Analysis Plan to Analyze the Model Variables

In this section, how the model variables captured by the questionnaire may be analyzed is discussed.

5.3.1 Determining the Dependent and Independent Variables

Before any analysis, it is crucial to identify the dependent variables and independent variables. Dependent variable is "the variable that the researchers observe to see whether it changes as a result of changes in the independent variable" (Thorne & Giesen, 2003). In other words, it is the variable that is being caused or explained (Sirkin, 2006). On the other hand, the independent variable is the variable that is doing the causing or explaining. It is controlled or manipulated in some ways by the researcher to examine its impact on the dependent variable.

In this research, the object of interest is the tenant organizations' WTP for the VABs. Hence, the tenant organizations' WTP for the VABs are defined as the dependent variables:

- WTP_Total: WTP for all the five VABs
- WTP_Productivity: WTP for improved productivity
- WTP_Image: WTP for improved enhanced image
- WTP_Staff: WTP for improved ability to attract and retain staff

- WTP_Health: WTP for improved health of staff
- WTP_Comfort: WTP for improved comfort of staff

As for the independent variables, they are the six groups of exogenous and endogenous factors identified which may impact on how the tenant organizations are WTP for the VABs. They are the organization characteristics, current premises, building characteristics, satisfaction, perception and knowledge.

5.3.2 Identifying the Variable Types

In addition, it is important to identify the nature of the variables in order to determine the appropriate statistical techniques. There are three main types of variables, depending on whether it is qualitative or quantitative in nature and the way its value is obtained (Howell, 2004; Sirkin, 2006; Thorne & Giesen, 2003).

The first type of variable is the categorical variable. As its name suggests, it serves to categorize or classify objects or events. It is meaningless to manipulate it mathematically as it is qualitative in nature. Examples of categorical variables in this research include the Business Type, Company Type and Lease Type. When the possible number of values a categorical variable can have is only two, usually a “Yes” or “No”, it is called a dummy variable. Examples include Whether the organization is a MNC company and Whether Roof Gardens exist in the Building.

On contrary to the categorical variable is the numerical variable which is quantitative in nature. They are not used for classification purpose. Instead, they inform about the quantity or which object or event is greater than another. Examples include the Floor Area Occupied, Rental Fee and the dependent variable, i.e. the tenant organizations’ WTP for the VABs.

The last type of variable is the ordinal variable. They may be thought of as a “hybrid” of the categorical variable and numerical variable in a way. As they are qualitative in nature, putting a value to it helps to categorize the objects or events. However, they also help to inform about the ranking or order of the object or events and hence, reflect which object or event is greater. Essentially, they give

quantitative data although in a crude way. Examples in this research include the satisfaction of the tenant organizations regarding the VABs experienced.

5.3.3 Determining the Appropriate Statistical Techniques

As discussed in the previous section, the independent variables may be categorical, dummy, numerical or ordinal, and the dependent variable is a numerical variable. Therefore, the appropriate statistical techniques to test for any relation between the dependent variables and independent variables include the t-test, ANOVA and Pearson r correlation test. These tests are appropriate to analyze the relation between each independent variable and the dependent variable individually. On the other hand, to understand the relation between the independent variables and the dependent variable collectively, regression analysis is appropriate. These four statistical techniques are further described as follows.

5.3.3.1 Independent samples t-test

The independent samples t-test is used to test a difference between the two independent groups on the means of a variable. Two groups are independent when the behavior of the members of one sample is not related to the behavior of the members of the other (Thorne & Giesen, 2003). The definitional formula is as follows:

$$t_{\bar{X}_1 - \bar{X}_2} = \frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}}$$

Where t = t-statistic
($\bar{X}_1 - \bar{X}_2$) = difference between the sample means
S = estimated standard error of the mean differences

Equation 5-1: Definitional formula of One-sample t-test for independent samples

In this research, the test is applied to determine if a dummy independent variable is a significant factor of the WTP dependent variable. The test helps by generalizing any significant difference in the mean WTP between two groups of tenant organizations such as MNC organizations vs. Non-MNC organizations, Green Mark

building occupants vs. Non- Green Mark building organizations and Tenant organizations operating in buildings which have roof gardens vs. Tenant organizations operating in buildings which do not have roof gardens.

However, when the number of independent groups is more than two, t-test is no longer appropriate and the ANOVA test has to be used instead.

5.3.3.2 *One -Way ANOVA*

The one-way analysis of variance test (ANOVA) is a technique for testing a difference among three or more independent groups on the means of a variable (Sirkin, 2006; Thorne & Giesen, 2003). The definitional formula is as follows:

$$F = \frac{MS_b}{MS_w}$$

Where F = F ratio
 MS_b = between-groups mean square
 MS_w = within-groups mean square

Equation 5-2: Definitional formula of ANOVA

In this research, ANOVA test is applied to determine if a categorical independent variable is a significant factor of the WTP dependent variable. It checks if there is a significant difference in the mean WTP of independent groups of tenant organizations with, for example, different lease types and different business types.

5.3.3.3 *Pearson r correlation test*

When the independent variable is not a dummy or categorical variable, it is impractical to establish independent groups of tenant organizations to test if there is a significant difference in their mean WTP. Therefore, it is more useful to determine if a significant correlation exists between the dependent variable and independent variables. In this research, the Pearson r correlation test is used to test for significant relationships between the tenant organizations' WTP for the VABs and the independent variables such as the satisfaction of the tenant organizations regarding the VABs and the area of floor area occupied.

The dependent variable and independent variable may be positively correlated, negatively correlated or have no correlation at all (Thorne & Giesen, 2003). The Pearson r is the mean of the z-score products for X and Y pairs, where X stands for one variable and Y stands for the other. Z-score is the number of standard deviations above or below the mean.

$$r = \frac{\sum ZxZy}{N}$$

Where Zx = z-score for X variable
 Zy = z-score for Y variable
 N = number of pairs of scores.

Equation 5-3: Definitional Formula of Pearson r

The r reflects the strength of correlation and ranges from -1 to 1 where -1 indicates a strong negative correlation, 1 indicates a strong positive correlation and 0 shows no correlation. Although the Pearson r correlation test is applied to test the relationship between the dependent and independent variables in this research, it should be noted that it does not indicate a causal relationship.

5.3.3.4 Regression Analysis

Regression analysis is useful for analyzing the dependent variable and its independent variables collectively. The general equation for a linear regression equation is

$$Y = a + b_1X_1 + b_2X_2 + \dots + b_nX_n$$

Where Y = Y variable
 X = X variable
 a = y-intercept
 b = slope of the line or the regression coefficient

Equation 5-4: General Regression Equation

It is the equation for the straight line that best describes the relationship between the variables.

5.3.4 Conducting Hypothesis Testing

To identify the significant factors of the tenant organizations' WTP for the VABs, their hypothesized relationships are tested. The steps of hypothesis testing are carried out as follows:

1) State the Null hypothesis (H_0) and Alternative hypothesis (H_1)

The null hypothesis, H_0 , may be defined as no difference in the group means or no correlation between two variables. The hypothesis testing always begins with the assumption that H_0 is true.

The alternative hypothesis, H_1 , which is accepted when H_0 is rejected, is the research hypothesis. Therefore, it is always aimed to reject H_0 so that H_1 or the research hypothesis is accepted. The research hypotheses derived in Chapter Four are summarized in the table as shown on the next page. It either assumes a difference in the group means or a correlation between two variables.

2) Specify the level of significance (α)

After stating the H_0 and H_1 , the level of significance is specified. It is the acceptable probability of H_0 being rejected when in fact it is true. In other words, it is the acceptable error rate or the risk of concluding incorrectly. In this research, a level of significance at 5% and 1% is adopted.

3) Calculate the p-value

After specifying the level of significance, the p-value is calculated. p-value is probability of getting a result that leads to rejection of H_0 when in fact H_0 is true.

4) Reject or Accept the H_0

If the p-value is less than the significance level of 5%, H_0 will be rejected since the probability of getting the result, which leads to rejection of H_0 when in fact H_0 is true, is within the specified risk. Hence, H_1 is accepted.

In other words, if the probability of getting the result, which leads to rejection of H_0 when H_0 is true, is low, it is likely that the result is not mere coincidence. When the p-value is below the specified significance level, it implies that the probability of getting the result, which leads to rejection of H_0 when H_0 is true, is significantly low enough to reject H_0 and accept H_1 .

Identified Variables		Expected Relationship with WTP
Exogenous Factors	Organization Characteristics	
	Business Type (OC_Business)	Group Difference
	Company Type (OC_Company)	Group Difference
	MNC or Non-MNC (OC_MNC)	Group Difference
	Organization Age (OC_Age)	+ / -
	Staff Size (OC_StaffSize)	+
	Amount of Time Staff Spend in Office (OC_StaffTime)	+ / -
	Current Premises	
	Number of Years operated at the current premises (CP_YrsOp)	+ / -
	Floor Area Occupied (CP_FloorArea)	+ / -
	Storey Occupied (CP_Storey)	+
	Length of Current Lease (CP_CurrentLease)	+
	Monthly Rental Fee (CP_RentFee)	-
	Rental Rates (CP_RentRate)	-
	Lease Type (CP_LeaseType)	Group Difference
	Building Characteristics	
	Gross Floor Area (BC_GFA)	+
	Building Age (BC_Age)	-
	Location (BC_Loc)	Group Difference
	Building Sustainability Rating Obtained (BC_RatingSys)	+
	Managed by Building Owner (BC_OwnMge)	Group Difference
	Sunshading Devices at Façade (BC_Sunshade)	Group Difference
	Designed for Natural Ventilation (BC_NatVent)	Group Difference
	Use of Water Efficient Products (BC_WaterPdt)	Group Difference
	Roof Gardens (BC_RoofGar)	Group Difference
	Provision of User Guide (BC_UserGuide)	Group Difference
	Provision of Air Con Adjustments (BC_AirConAdj)	Group Difference
Endogenous Factors	Satisfaction	
	Satisfaction of overall productivity (S_Productivity)	+
	Satisfaction of organizational image (S_Image)	+
	Satisfaction of ability to attract and retain staff (S_Staff)	+
	Satisfaction of health of staff (S_Health)	+
	Satisfaction of comfort of staff (S_Comfort)	+
	Perception	
	Perception of benefits produced by sustainable buildings (P_SusBldg)	+
	Perception of effectiveness of building sustainability rating systems (P_SusRating)	+
	Perception of building impacts (P_BldgImpact)	+
	Knowledge	
	Knowledge of sustainable issues (K_Sus)	+
	Knowledge of building sustainability rating systems (K_SusRating)	+
	Knowledge of building impacts (K_BldgImpact)	+

5.3.5 Overview of Statistical Analysis Plan

Figure 5-2 shows an overview of the model variables, the hypothesized relationships and the statistical techniques employed.

5.4 Chapter Summary

This chapter is a concluding section to the second research question of how the tenant organizations' WTP for the VABs may be captured and analyzed. Based on the discussion on the CV studies and the conceptual model developed in the preceding two chapters, a questionnaire instrument is developed to capture the tenant organizations' WTP and its factor in practice.

Expert opinions are sought during the development of the instrument regarding the three issues, i.e. whether the respondents are able to answer honestly, whether they are able to answer meaningfully and whether the explanatory variables are appropriate and adequate.

Ten experts from the field of building sustainability and CV were interviewed. Generally, they agreed that the questions asked are effective for the purpose of the research. Most of the suggestions given were to the wording of the questions. Some concerns were also raised regarding the considerable efforts to understand and answer the questions and who would be the most suitable person in an organization to fill in the questionnaire.

Next, how these model variables may be analyzed is discussed. Based on the variable types and the hypothesized relationships between the model variables, appropriate statistical techniques are identified and discussed. They include the one-sample independent t-test, ANOVA, Pearson r correlation and regression analysis.

The next chapter shall commence the investigation of the tenant organizations' WTP behavior to answer the third research question "What are the factors affecting the tenant organizations' WTP for the VABs?"

Figure 5-2: Overview of Statistical Analysis Plan

Chapter Six

6 Investigating the Tenant Organizations' WTP for the Intangible Value-Added Benefits

6.1 Chapter Introduction

This chapter seeks to implement the questionnaire developed in the preceding chapter to answer the third research question “What are the factors affecting the tenant organizations' WTP for the value-added benefits?”

The investigation is carried out using the developed questionnaire via a survey and a case study. Hence, this chapter is organized into two sections. The first section shall describe the survey and report on the survey results and the second section on the case study.

6.2 Survey

Firstly, the implementation of the survey is described. As this research focuses on the tenant organizations of office buildings and is executed in Singapore, the survey hence targets at the tenant organizations of office buildings in Singapore. Issues such as sampling and the mode of survey are discussed. Secondly, the descriptive results of the survey are reported, including the profile of the respondents and the descriptive statistics of major variables. Next the survey results are analyzed using various statistical techniques to identify the significant factors affecting the tenant organizations' WTP for the VABs. Lastly, the issues of reliability and validity are discussed.

6.2.1 Implementation of Survey

6.2.1.1 Target Population, Sampling Frame and Sample

Before the implementation of the survey, the target population of the respondents has to be established. According to Czaja & Blair (2005), the target population may be defined in terms of a combination of demographic characteristics and geographic boundaries.

For this research, the target population is defined as the tenant organizations of the office buildings located in the central business district (CBD) of Singapore. There are two main reasons for the specification of a geographic delineation to only the CBD. Firstly, the office buildings in the CBD are representative of the building trends in the country. The CBD is the heart of the country and most of the office buildings are located here. Secondly, the tenant organizations of office buildings in the CBD are likely to be similar in terms of activities and wealth. Therefore, their WTPs for the VABs experienced are less likely to be influenced by the differences in activities and the income factor.

Besides the geographical considerations, since the respondent unit of the survey is a group of people, the most suitable person to represent the group should be identified. The respondent should be knowledgeable about the issues in the questionnaire and can provide accurate information (Czaja & Blair, 2005). For this research, it is likely to be the property manager or office manager who understands the operations and space requirements of the company.

After defining the target population, the sampling frame is next defined. The sampling frame is the “source or sources that include the population of eligible people or groups” (Czaja & Blair, 2005). Therefore, for this research, the eligible tenant organizations are those residing in office buildings located in the CBD area of Singapore.

A search on the Wikimedia produces a list of 62 office buildings in Singapore of which 26 are located in the CBD area. Another search by district on the Emporis shows a list of 60 buildings of various functions in the CBD area. Out of these 60 buildings, 3 of them are not office buildings, 10 of them are actually the same buildings but of different towers and the construction of 1 of them has not been completed. Hence, there are actually 51 office buildings in the CBD area according to Emporis. The shortlisted office buildings on both websites are further examined to see if they are largely owner-occupied. In the end, 32 office buildings are selected and the tenant organizations in these 32 office buildings are the sampling frame.

Next, a sample is drawn from the tenant organizations of the 32 office buildings by selecting 10 of them from each building. This is achieved mainly either by seeking the help of the building managers to provide contacts to their tenants or by selecting any 10 of the tenant organizations from the tenant directory located at the buildings.

How the survey is conducted on the 320 tenant organizations is further discussed as follows.

6.2.1.2 Mode of Survey

According to Czaja & Blair (2005), there are four main modes of survey. They are mail surveys, internet surveys, telephone surveys and face-to-face surveys. Each mode of survey has its advantages and weaknesses.

Face-to-face surveys are useful for ensuring the quality of the data obtained. The response rate is usually good and the recording of the responses is of high quality. It allows the use of visual aids and open-ended questions favorably. However, face-to-face surveys are time-consuming and costly. For this research, the onus of interviewing the tenant organizations lies solely on the researcher and hence, to carry out face-to-face interviews on 320 tenant organizations would be too time-consuming.

Telephone surveys may reduce the time for interviewing the respondents and also less costly to carry out than face-to-face surveys while maintaining a relatively good response rate and high-quality recording of responses. However, the amount of time needed to contact and interview the appropriate personnel of 320 tenant organizations by phone could still be too time-consuming to be carried out by the researcher alone.

Internet survey is another possible mode of survey. It is fast and the questionnaire could be sent out at one time to all the 320 tenant organizations. However, it is likely that the response rate could be low, especially for this research where the respondents sought is the property manager or office manager who may have a hectic work schedule. An internet survey questionnaire could easily be regarded as spam emails and would be deleted or ignored. In addition, not all the email addresses or contact details of the representative of the tenant organization are obtainable.

Therefore, the mode of survey selected for this research is the mail surveys for the following reasons. Firstly, mail surveys can overcome the time-consuming problem present in the face-to-face and telephone surveys. It can be sent out to the 320 tenant organizations at the same time. Secondly, it is possible to obtain the addresses of all the 320 tenant organizations and where the names of the appropriate

personnel could not be obtained, it could be sent for the attention of the general manager who may forward the questionnaire to the appropriate personnel. A formal questionnaire in a hardcopy form is also less likely to be overlooked or ignored. This ensures a higher possibility than the internet survey that the questionnaire reaches the appropriate personnel in all the 320 tenant organizations.

In addition, mail survey has the advantage of a lower cost than a telephone or face-to-face survey. According to Czaja & Blair (2005), mail survey also gives a greater response accuracy as “respondents may consult household or personal records”. This is very apt for the survey questionnaire of this research where the questions vary from about the organizations in terms of staff size to about the current premises in terms of floor area occupied. Hence, the property or office manager may require assistance from other departments.

However, mail survey may receive low response rate (Czaja & Blair, 2005). In this research, this problem is being minimized by follow-up calls after the questionnaires are sent and reminders after the first due-date of response. Furthermore, the survey is carried out as a collaboration project with the Building and Construction Authority of Singapore which is a government agency, to boost the response rate.

6.2.2 Descriptive Results of Survey

6.2.2.1 Profile of Respondents

The survey was conducted from July 2008 to September 2008. The questionnaire was sent to the 320 tenant organizations via mails. In total, 37 completed questionnaires are received. However, 3 of them are discarded because of missing pertinent information. Hence, 34 completed questions are used for data analysis and discussions. According to Czaja & Blair (2005), the response rate is “the number of eligible sample members who complete a questionnaire divided by the total number of eligible sample members”. Hence, the response rate of this questionnaire survey is about 10.6%.

The reason for the rather low response rate is what the experts had conjectured during the development of the questionnaire. A considerable amount of effort is

needed to understand and answer the questions. In addition, some quantitative data such as the floor area occupied may require the respondents to refer to their documents and records and hence, adding some inconvenience to the respondents. Nevertheless, a sample size greater than 30 is sufficient for carrying out the statistical analysis to understand the tenant organizations' WTP for the VABs.

Table 6-1 summarizes the profile of the tenant organizations who responded to the survey. The majority of the tenant organizations are private multi-national companies in the finance industry. A typical respondent is established between one to five years with a staff size of more than 50 employees. In addition, almost two-thirds of the respondents operate in Green Mark awarded buildings.

Table 6-1: Profile of Respondents

1. Business Type	2. Company Type	3. MNC vs. Non-MNC	4. Company Age	5. Staff Size	6. Green Mark vs. Non-Green Mark
Finance (56%)	Private (88%)	MNC (65%)	Less than 1 year (3%)	Less than 10 (18%)	Green Mark Occupant (62%)
IT (12%)			More than 1 but less than 5 years (59%)	More than 10 but less than 30 (24%)	
Construction (6%)			More than 5 but less than 10 years (18%)	More than 30 but less than 50 (9%)	
Education (3%)	Public (12%)	Non-MNC (35%)	More than 10 but less than 15 years (15%)	More than 50 (50%)	Non-Green Mark Occupant (38%)
Legal (3%)			More than 15 years (6%)		
Others (21%)					

These 34 respondents are tenant organizations from 21 buildings. Based on their year of completion or the year of their last major renovation, these 21 buildings are between 2 to 15 years old with a GFA between 10,212 m² and 148,000 m². Figure 6-1 shows the breakdown of the respondents according to the sustainability features available at the buildings which they are operating in. More than half of the respondents are operating in buildings with water efficient products and air con adjustment features. About half of them are operating in buildings with roof gardens and provision of user guide and a third in buildings that are designed for natural

ventilation. Lastly, only 12% of the respondents are operating in buildings that have sunshading devices at the façade.

Figure 6-1: Percentage of Respondents Operating in Buildings with the Sustainability Features

6.2.2.2 Descriptive Results of Major Variables

In the survey, the tenant were asked how much more they are WTP on top of their current monthly rent to continue enjoying the VABs at the same level at their current premises. As discussed, it is expected that their WTP for the VABs would be affected by their satisfaction about the VABs, how they perceive and know about the building sustainability issues, the Green Mark rating system and the building impacts. The survey results for these major variables are presented as follows.

6.2.2.2.1 Tenant Organizations' WTP for the VABs

The average WTP of the 34 respondents for the VABs is 19.21% of their current monthly rent. Figure 6-2 illustrates the average WTP of the 34 respondents for each of the five intangible benefits. The survey results show that among the five benefits examined, the respondents are most willing to pay for the benefit of an enhanced image, which is 4.12% of their current rental fee and their lowest WTP is for the benefit of improved productivity which is 3.56% of their current rental fee on average.

Figure 6-2: Average WTP Values

6.2.2.2.2 Tenant Organizations' Satisfaction of the VABs Experienced

Figure 6-3 shows the average satisfaction score of the respondents regarding the VABs experienced at their current premises. They were asked to rate on a scale of 1 (Somewhat Satisfied) to 5 (Very Satisfied) about their satisfaction regarding a VAB experienced. If no such VAB was experienced, they may indicate a zero. The results show that the respondents are most satisfied with their enhanced organizational image and least satisfied with the comfort experienced by the staff. Although they may have different satisfaction levels regarding the VABs experienced, the respondents indicated that they have experienced all the five VABs.

Figure 6-3: Average Satisfaction Level of the VABs

6.2.2.2.3 Tenant Organizations' Perception of Building Impacts, Green Mark and Sustainable Buildings

Figure 6-4 summarizes the average score given by the tenant organizations regarding their perception of the building impacts on their organizations, Green Mark rating system and sustainable buildings. On a scale of 1 (Unimportant At All) to 5 (Very Important), the respondents indicated an average score of 3.41 and 3.71 for the importance of the building towards achieving their organizational mission

and producing benefits for their organization respectively. This is between “Undecided” and “Important”. On the other hand, they gave an average score of 2.62 and 2.56 regarding the importance of Green Mark award and its level of certification respectively, which is between “Unimportant” and “Undecided” on the scale.

The respondents were also asked to rate on a scale of 1 to 5, from Strongly Disagree to Strongly Agree, about their agreement with the claims of the benefits produced by sustainable buildings. Among the benefits listed which consisted of four cost reduction benefits and five value-added benefits, the respondents indicated they most agreed that sustainable buildings help to reduce operational costs. Improved comfort of staff is the next benefit they perceive to be associated greatly with sustainable buildings.

Rating Scale for Perception of building impacts and Green Mark rating system:
1-Unimportant at all, 2-Important, 3-Undecided, 4-Important, 5-Very Important
Rating Scale for Perception of benefits produced by sustainable buildings:
1-Strongly Disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly Agree

Figure 6-4: Average Score of Tenant Organizations' Perception Regarding Building Impact, Green Mark rating system and Sustainable Buildings

6.2.2.2.4 Tenant Organizations' Knowledge of Building Impacts, Green Mark and Sustainability Issues

Three questions about the impact of building on its occupants were posed to the tenant organizations. About two thirds of the respondents answered all three questions correctly. On average, the respondents scored 2 out of 3 questions correctly or 66.7%.

Another three statements regarding the Green Mark rating system were presented to the respondents. About one third of them got none of the three questions correctly. On average, the respondents scored 1.33 out of 3 questions correctly, i.e. 44.3%. This is relatively low as compared to their score about the impacts of building on its occupants.

As for the tenant organizations' knowledge about sustainability issues, about two thirds of them got 3 out of 4 questions correctly. On average, the respondents scored 2.53 out of 4 questions correctly, i.e. 63.3%. None of them got all the four questions correctly.

Figure 6-5: Average Score for Knowledge of Tenant Organizations

Therefore, based on the number of questions answered correctly, the respondents' knowledge about the Green Mark rating system is the lowest among the three issues

investigated. On the other hand, they are most aware of the impacts of buildings. Generally, they have an average score of 5.85 out of the 10 for the ten questions posed.

In the next section, the survey results shall be analyzed to identify the factors that affect the tenant organizations' WTP for the VABs experienced.

6.2.3 Statistical Analysis of Survey Results

SPSS 17.0 is used to carry out the statistical analyses. The relation between the tenant organizations' WTP for the VABs and the factors are firstly analyzed individually using the t-test, ANOVA and Pearson r correlation and are reported in Section 6.2.3.1. Next, their relations are tested collectively using regression analysis and are reported in Section 6.2.3.2.

6.2.3.1 t-test, ANOVA and Pearson r Correlation Test

In the following sections, the hypothesis testing results using t-test, ANOVA and Pearson r correlation test are reported according to the six groups of independent variables, beginning with the Organization Characteristics. Detailed statistical results can be found in Appendix E.

6.2.3.1.1 Organization Characteristics

The first group of independent variables to be investigated is the organization characteristics. They include:

- OC_Business : Business Type
- OC_Company : Company Type
- OC_MNC : Whether it is a MNC company
- OC_Age : Age of Company
- OC_StaffSize : Staff Size
- OC_StaffTime : Amount of time staff spend in office

The mean WTP of tenant organizations for each VAB is tested, using either ANOVA or t-test on OC_Business, OC_Company and OC_MNC, for any significant difference. As for the variables, OC_Age, OC_StaffSize and OC_StaffTime, Pearson r correlation test is applied to test the hypothesis that they

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are significantly correlated with the tenant organizations' WTP for each VAB. The hypotheses formulated, the statistical techniques used and the hypothesis testing results are summarized in Table 6-2.

All the null hypotheses are rejected, except the one that hypothesizes WTP_Total is not correlated with OC_Age. In other words, all the organization characteristics are not factors of the tenant organizations' WTP for the VABs, except the organization age.

Table 6-2: Hypothesis Testing Results of Organization Characteristics

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypothesis		Results
				H ₀	H ₁	
OC_Business	Categorical	ANOVA	Group Difference	Tenant organizations of different business types have the same mean WTP	Tenant organizations of different business types have different mean WTP	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ OC_Business is not a significant factor of tenant organizations' WTP
OC_Company	Dummy	t-test	Group Difference	Private tenant organizations' mean WTP is the same as that of public tenant organizations	Private tenant organizations' mean WTP is different from that of public tenant organizations	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ OC_Company is not a significant factor of tenant organizations' WTP
OC_MNC	Dummy	t-test	Group Difference	MNC tenant organizations' mean WTP is the same as that of non-MNC tenant organizations	MNC tenant organizations' mean WTP is different from that of non-MNC tenant organizations	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ OC_MNC is not a significant factor of tenant organizations' WTP
OC_Age	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their age	Tenant organizations' WTP is negatively related to their age	p-value obtained for WTP_Total, WTP_Health and WTP_Comfort are <0.05. Hence, H ₀ is rejected for these WTP variables ➤ OC_Age is a significant factor of WTP_Total, WTP_Health & WTP_Comfort
OC_StaffSize	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their staff size	Tenant organizations' WTP is positively related to their staff size	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ OC_StaffSize is not a significant factor of tenant organizations' WTP
OC_StaffTime	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to the amount of time their staff spend in the office	Tenant organizations' WTP is positively related to the amount of time their staff spend in the office	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ OC_StaffTime is not a significant factor of tenant organizations' WTP

The relationship between OC_Age and WTP_Total is tested with a Pearson r Correlation Test. Table 6-3 summarizes the test results. The r coefficient between OC_Age and WTP_Total is -0.346 with p-value <0.05. Therefore, H₀ which assumes that there is no correlation between them is rejected, i.e. a negative relationship exists between OC_Age and WTP_Total at a significant level of 0.05. Further examining the tenant organizations' WTP for each VAB with OC_Age, it is found that a correlation actually exists between OC_Age and their WTP for two of the VABs, i.e. WTP_Health and WTP_Comfort. The Pearson r coefficient obtained for OC_Age and WTP_Health is -0.347 and it is significant with a p-value <0.05. A stronger correlation is found between OC_Age and WTP_Comfort with a Pearson r coefficient of -0.408 at the same level of significance.

Table 6-3: Results of Pearson r correlation test between Organization Age and WTP variables

	WTP_ Total	WTP_ Productivity	WTP_ Image	WTP_ Staff	WTP_ Health	WTP_ Comfort
OC_Age	r = -.346* p = 0.045	r = -.281 p = 0.107	r = -.319 p = 0.066	r = -.292 p = 0.093	r = -.347* p = 0.045	r = -.408* p = 0.017

*. Correlation is significant at the 0.05 level (2-tailed).

Therefore, from the statistical tests carried out on the Organization Characteristics variables and the WTP variables, it is found that only the organization age is a significant factor of the tenant organizations' WTP for the VABs. More specifically, it is a significant factor of the tenant organizations' WTP for the benefits of improved health and comfort. The negative relationship between them reveals that the WTP of older tenant organizations for improved health and comfort of staff is lower. Figure 6-6 shows the tenant organizations' mean WTP according to their age. When the tenant organizations have been established for more than 10 years, their WTP for improved health and comfort of staff is substantially lower. Hence, older tenant organizations tend to place less emphasis on the health and comfort of their staff compared with their younger counterparts.

Figure 6-6: Tenant Organizations' mean WTP according to their Age Group

6.2.3.1.2 Current Premises

The second group of independent variables to be investigated is the conditions of the current premises which the organizations are operating in. They include:

- CP_YrsOp : Years Operated at Current Premises
- CP_FloorArea : Floor Area Occupied
- CP_Storey : Storey Occupied
- CP_CurrentLease : Length of Current Lease
- CP_RemainingLease : Length of Lease Remaining
- CP_RentalFee : Monthly Rental Fee
- CP_RentalRate : Rental Rates
- CP_LeaseType : Lease Type

Table 6-4 lists the hypotheses, the statistical tests used and the corresponding results. The results show that none of the null hypotheses is rejected, except the one that the WTP_Total is not correlated with CP_YrsOp.

Table 6-4: Hypothesis Testing Results of Current Premises

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
CP_YrsOp	Ordinal	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the number of years they have been operated at their current premises	Tenant organizations' WTP is related to the number of years they have been operated at their current premises	p-value obtained for WTP_Total, WTP_Staff, WTP_Health and WTP_Comfort are <0.05. Hence, H ₀ is not rejected for these WTP variables ➢ CP_YrsOp is related to Age is a significant factor of WTP_Total, WTP_Staff, WTP_Health and WTP_Comfort
CP_FloorArea	Numerical	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the size of floor area occupied	Tenant organizations' WTP is related to the size of floor area occupied	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➢ CP_FloorArea is not a significant factor of tenant organizations' WTP
CP_Storey	Numerical	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the level of storey occupied	Tenant organizations' WTP is positively related to the level of storey occupied	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➢ CP_Storey is not a significant factor of tenant organizations' WTP
CP_CurrentLease	Numerical	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the length of current lease	Tenant organizations' WTP is positively related to the length of current lease	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➢ CP_CurrentLease is not a significant factor of tenant organizations' WTP
CP_RemainingLease	Numerical	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the length of current lease remaining	Tenant organizations' WTP is negatively related to the length of current lease remaining	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➢ CP_RemainingLease is not a significant factor of tenant organizations' WTP
CP_RentalFee	Numerical	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the monthly rental fee	Tenant organizations' WTP is negatively related to the monthly rental fee	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➢ CP_RentalFee is not a significant factor of tenant organizations' WTP

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Table 6-4: Hypothesis Testing Results of Current Premises (Cont'd)

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
CP_Rental Rates	Numerical	Pearson r	Relation-ship	Tenant organizations' WTP is not related to the rental rates	Tenant organizations' WTP is negatively related to the rental rates	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➤ CP_RentalRates is not a significant factor of tenant organizations' WTP
CP_LeaseType	Categori-cal	ANOVA	Group Difference	Tenant organizations of different lease type have same mean WTP	Tenant organizations of different lease type have different mean WTP	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➤ CP_LeaseType is not a significant factor of tenant organizations' WTP

The Pearson r correlation test shows that WTP_Total is negatively correlated at the 0.05 significance level with CP_YrsOp (See Table 6-5). Further examination reveals that CP_YrsOp is also negatively correlated with WTP_Staff, WTP_Health and WTP_Comfort at a 0.05 significant level. Therefore, the longer the tenant organizations have been operating at their current premises, the lower is their WTP for the three benefits.

Table 6-5: Results of Pearson r correlation test between Years Operated at Current Premises and WTP variables

	WTP_Total	WTP_Productivity	WTP_Image	WTP_Staff	WTP_Health	WTP_Comfort
CP_YrsOp	r = -.393* p = 0.022	r = -.335 p = 0.052	r = -.335 p = 0.052	r = -.364* p = 0.034	r = -.410* p = 0.016	r = -.422* p = 0.013

*. Correlation is significant at the 0.05 level (2-tailed).

There are two possible reasons for the negative correlation between CP_YrsOp and the WTP variables. One of the reasons could be the decreasing satisfaction with the current premises as the years go by and resulting in lower WTP. Another reason for the correlation could be associated with the organization age. As found in the previous section, the tenant organizations' WTP for the VABs is correlated with their age. Hence, their WTP may be correlated to the length of time they have been operating at the current premises if they have been operating at the same premises since their establishment.

Further Pearson r correlation tests are carried out between CP_YrsOp and the tenant satisfaction about the benefits experienced and also between CP_YrsOp and OC_Age. The results show that there is no significant correlation between CP_YrsOp and the tenant organizations' satisfaction. Instead, a significant positive relationship is found between CP_YrsOp and OC_Age at 0.01 significant level. Therefore, the correlation between CP_YrsOp and the tenant organizations' WTP is attributed to the organizations' age and CP_YrsOp cannot be considered as a significant factor of the tenant organizations' WTP for the VABs.

Table 6-6: Pearson *r* Correlation test between CP_YrsOp and Tenant Organizations' Satisfaction

	Satisfaction of				
	Productivity	Image	Ability to Attract & Retain Staff	Staff Health	Staff Comfort
CP_YrsOp	$r = -0.107$ $p = 0.545$	$r = -0.058$ $p = 0.745$	$r = -0.265$ $p = 0.129$	$r = -0.139$ $p = 0.434$	$r = -0.274$ $p = 0.117$

Table 6-7: Pearson *r* Correlation test between CP_YrsOp and OC_Age

	OC_Age
CP_YrsOp	$r = 0.465^{**}$ $p = 0.006$

******. Correlation is significant at the 0.01 level (2-tailed).

In addition, the lack of a significant relationship between the variables, CP_RemainingLease, CP_RentalFee, CP_RentalRates and CP_LeaseType, and the WTP variables points to the absence of strategic behavior by the tenant organizations. Therefore, the tenant organizations' decision on their WTP for the VABs is not affected by whether their lease is ending soon or the rental fee or rates that they are already paying, but it is simply a valuation of the VABs.

6.2.3.1.3 Building Characteristics

The third group of independent variables is the building characteristics. They are:

- BC_GFA : Gross Floor Area
- BC_Age : Building Age
- BC_Loc : Building Location
- BC_GM : Whether Building has obtained Green Mark award
- BC_GMLevel : Green Mark level obtained by Building
- BC_OwnMge : Whether Building is managed by Building Owner
- BC_Sunshade : Whether sunshading devices are attached to the Façade

- BC_NatVent : Whether the building is designed for natural ventilation
- BC_WaterPdt : Whether water efficient products are used in the building
- BC_RoofGar : Whether roof gardens are incorporated in the building
- BC_UserGuide : Whether user guide is provided
- BC_AirConAdj : Whether building has air-con adjustment features

Again, t-test or ANOVA tests are conducted on the above building characteristics variables, except BC_GFA and BC_Age, for any significant difference in the mean WTP of the tenant organizations for each of the VABs. As for BC_GFA and BC_Age, they are tested for any significant correlation with the WTP variables using the Pearson r correlation test. The hypotheses, statistical tests and results are as shown in Table 6-8.

Table 6-8: Hypothesis Testing Results of Building Characteristics

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
BC_GFA	Numerical	Pearson r	Relationship	Tenant organizations' WTP is not related to the GFA of building	Tenant organizations' WTP is positively related to the GFA of building	p-value obtained for all the WTP variables, except WTP_Image, are > 0.05. Hence, H ₀ is not rejected ➤ BC_GFA is a significant factor of WTP_Image
BC_Age	Numerical	Pearson r	Relationship	Tenant organizations' WTP is not related to the building age	Tenant organizations' WTP is negatively related to the building age	p-value obtained for all the WTP variables are >0.05. Hence, H ₀ is not rejected ➤ BC_Age is not a significant factor of tenant organizations' WTP
BC_Loc	Categorical	ANOVA	Group Difference	Tenant organizations sited in different locations have the same mean WTP	Tenant organizations sited in different locations have different mean WTP	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_Age is not a significant factor of tenant organizations' WTP
BC_GM	Dummy	t-test	Group Difference	Tenant organizations operating in Green Mark buildings have the same mean WTP as those in non-Green Mark buildings	Tenant organizations operating in Green Mark buildings have higher mean WTP as those in non-Green Mark buildings	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_GM is not a significant factor of tenant organizations' WTP
BC_GMLlevel	Categorical	ANOVA	Group Difference	Tenant organizations' WTP is not related to the Green Mark level obtained	Tenant organizations' WTP is positively related to the Green Mark level obtained	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_GMLlevel is not a significant factor of tenant organizations' WTP

Table 6-8: Hypothesis Testing Results of Building Characteristics (Cont'd)

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
BC_OwnMge	Dummy	t-test	Group Difference	Tenant organizations operating in buildings managed by building owners have the same mean WTP as those not managed by the building owners	Tenant organizations operating in buildings managed by building owners have the different mean WTP from those not managed by the building owners	p-value obtained for all the WTP variables are <0.05. Hence, H ₀ is rejected ➤ BC_OwnMge is a significant factor of tenant organizations' WTP
BC_Sunshading	Dummy	t-test	Group Difference	Tenant organization operating in buildings with sunshading device attached to the façade have the same mean WTP as those operating in buildings without such devices	Tenant organization operating in buildings with sunshading device attached to the façade have higher mean WTP than those operating in buildings without such devices	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_Sunshading is not a significant factor of tenant organizations' WTP
BC_NatVent	Dummy	t-test	Group Difference	Tenant organizations operating in buildings that are designed for natural ventilation have the same mean WTP as those operating in buildings without such design	Tenant organizations operating in buildings that are designed for natural ventilation have higher mean WTP as those operating in buildings without such design	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_NatVent is not a significant factor of tenant organizations' WTP
BC_WaterPdts	Dummy	t-test	Group Difference	Tenant organizations operating in buildings that use water efficient products have the same mean WTP as those operating in buildings without such products	Tenant organizations operating in buildings that use water efficient products have higher mean WTP as those operating in buildings without such products	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_WaterPdts is not a significant factor of tenant organizations' WTP
BC_RoofGardens	Dummy	t-test	Group Difference	Tenant organizations operating in buildings with roof gardens have the same mean WTP as those operating in buildings without roof gardens	Tenant organizations operating in buildings with roof gardens have higher mean WTP as those operating in buildings without roof gardens	p-value obtained for all the WTP variables, except WTP_Image, are > 0.05. Hence, H ₀ is not rejected ➤ BC_RoofGardens is a significant factor of WTP_Image

Table 6-8: Hypothesis Testing Results of Building Characteristics (Cont'd)

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
BC_UserGuide	Dummy	t-test	Group Difference	Tenant organizations operating in buildings with provision of user guide have the same mean WTP as those operating in buildings without such provision	Tenant organizations operating in buildings with provision of user guide have higher mean WTP as those operating in buildings without such provision	p-value obtained for all the WTP variables are > 0.05. Hence, H ₀ is not rejected ➤ BC_UserGuide is a not significant factor of tenant organizations' WTP
BC_AirConAdj	Dummy	t-test	Group Difference	Tenant organizations operating in buildings with air con adjustment have the same mean WTP as those operating in buildings without such provision	Tenant organizations operating in buildings with air con adjustment have higher mean WTP as those operating in buildings without such provision	p-value obtained for all the WTP variables, except WTP_Image, are > 0.05. Hence, H ₀ is not rejected ➤ BC_AirConAdj is a significant factor of WTP_Image

One significant result is that the tenant organizations operating in buildings that are managed by the building owners have a higher mean WTP than those operating in buildings that are not. The average total WTP of tenant organizations which are operating in buildings that are managed by building owners is 29.6% of their current rent, whereas that of tenant organizations operating in buildings that are not managed by building owners is only 14.3% of their current rent. The t-test shows that this difference is significant at 0.01 level.

Furthermore, the WTP of the tenant organizations operating in buildings that are managed by building owners are consistently higher than those operating in buildings that are not managed by the building owners for each VAB (See Figure 6-7). For those operating in buildings managed by the building owners, their WTP for the VABs ranges from 5.5% to 6.4% whereas those that are not managed by building owners ranges from 2.6% to 3.1%. Again, the t-test results reveal that these differences in the mean WTP for each of the VAB is significant at 5% level.

Figure 6-7: Average WTP of tenant organizations operating in buildings managed by building owners vs. those that are not

In contrast, the Green Mark award is found to have no correlation with the tenant organizations' WTP for the VABs. t-test is applied to determine if there is any significant difference between the mean WTP of the tenant organizations operating in Green Mark buildings and that of those operating in non-Green Mark buildings. At 0.05 significant level, the null hypothesis that tenant organizations in Green Mark buildings have the same mean WTP as those in non-Green Mark buildings is not rejected. A similar result is obtained from an ANOVA test on comparing the mean WTP of the tenant organizations in buildings with no Green Mark award, with Green Mark Certified award, Gold award, Gold Plus award and Platinum award. It is found that the mean WTP of the tenant organizations in these five groups of buildings are not significantly different.

In addition, the hypothesis testing results also show that the tenant organizations' WTP for enhanced organizational image is related to the BC_GFA, BC_RoofGarden and BC_AirConAdj. Table 6-9 summarizes the results of Pearson r correlation test and t-test on these variables.

Table 6-9: Pearson r Correlation and t-test Between WTP_Image and Building GFA, Roof Garden and Air Con Adjustment

	BC_GFA	BC_RoofGarden	BC_AirConAdj
WTP_Image	Pearson r correlation r = 0.391 p = 0.036	t-test t = -2.143 p = 0.043 Mean difference = -2.834	t-test t = -3.506 p = 0.002 Mean difference = -3.192

At 0.05 significant level, WTP_Image is positively correlated with BC_GFA, i.e. the larger is the building; the higher is the tenant organizations' WTP for enhanced organizational image. This correlation may be explained by a more prestigious image projected by a larger building compared with a smaller one.

In addition, tenant organizations operating in buildings with roof gardens or with provision of air-con adjustment have a higher mean WTP for enhanced organizational image than those operating in buildings without these features (See Figure 6-8 and Figure 6-9). The difference in the mean WTP_Image is found to be significant at a level of 0.05 and 0.01 respectively.

Figure 6-8: Average WTP of tenant organizations for improved organizational image in buildings with Roof Garden vs. Without Roof Garden

Figure 6-9: Average WTP of tenant organizations for improved organizational image in buildings with Provision of Air Con adjustment vs. Without Air Con adjustments

Therefore, except for the BC_RoofGarden and BC_AirConAdj, the building sustainability features such as façade sunshading device, natural ventilation design, use of water efficient products and provision of user guide are found to have no relationship with the tenant organizations' WTP for the VABs. The t-test shows that the mean WTP of tenant organizations in the two groups of buildings with and without such features are no different at 0.05 level of significance.

6.2.3.1.4 *Satisfaction regarding the Value-Added Benefits Experienced*

In this section, the tenant organizations' satisfaction about the benefits experienced is examined for their relation with their WTP. The variables include:

- S_Productivity : Satisfaction about productivity
- S_Image : Satisfaction about organizational image
- S_Staff : Satisfaction about ability to attract and retain staff
- S_Health : Satisfaction about the health of staff
- S_Comfort : Satisfaction about the comfort of staff

It is hypothesized that there is a positive correlation between the satisfaction of the tenant organizations and their WTP for the VABs. Pearson r correlation test is conducted to test the hypotheses and Table 6-10 summarizes the results. Although the Pearson r correlation test does not establish a causal relationship, based on economic theory, a higher satisfaction is likely to show up in a form of WTP. Therefore, it is assumed that the causal direction is from the tenant organizations' satisfaction to their WTP.

Table 6-10: Hypothesis Testing Results of Tenant Organizations' Satisfaction regarding the benefits

Variables	Variable Type	Statistical Test	Type of Hypothesis	Hypothesis Testing		Results
				H ₀	H ₁	
S_Productivity	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their satisfaction about the overall productivity	Tenant organizations' WTP is positively related to their satisfaction about the overall productivity	Only the p-value for WTP_Productivity and WTP_Image are <0.05. Hence, H ₀ for these variables are rejected ➤ S_Productivity is a significant factor of WTP_Productivity and WTP_Image
S_Image	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their satisfaction about the organizational image	Tenant organizations' WTP is positively related to their satisfaction about the organizational image	Only the p-value for WTP_Productivity is <0.05. Hence, H ₀ for this variable is rejected ➤ S_Image is a significant factor of WTP_Productivity
S_Staff	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their satisfaction about the ability to attract and retain staff	Tenant organizations' WTP is positively related to their satisfaction about the ability to attract and retain staff	p-value for all WTP variables are <0.05. Hence, H ₀ for these variables is rejected ➤ S_Staff is a significant factor of tenant organizations' WTP
S_Health	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their satisfaction about the health of staff	Tenant organizations' WTP is positively related to their satisfaction about the health of staff	Only the p-value for WTP_Total and WTP_Productivity are <0.05. Hence, H ₀ for these variables is rejected ➤ S_Health is a significant factor of WTP_Total and WTP_Productivity
S_Comfort	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their satisfaction about the comfort of staff	Tenant organizations' WTP is positively related to their satisfaction about the comfort of staff	p-value for all the WTP variables are <0.05. Hence, H ₀ for these variables is rejected ➤ S_Comfort is a significant factor of tenant organizations' WTP

At 0.05 significant level, S_Productivity is positively correlated with WTP_Productivity and WTP_Image. It is quite obvious that the higher the satisfaction about productivity, the higher is the tenant organizations' WTP for improved productivity. However, a positive relationship between S_Productivity and WTP_Image seems less obvious. Hence, further Pearson r correlation tests are conducted to probe how S_Productivity could be significantly correlated with WTP_Image. Four aspects about productivity is examined, i.e. (1) Staff absenteeism rate (2) Communication and interaction among the staff (3) Product quality and timeliness of output (4) Innovation. The Pearson r correlation test results show that a positive relationship exists between the tenant organizations' WTP for enhanced image and their satisfaction with the product quality and timeliness of output. Although the Pearson r correlation test does not prove a causal relationship, it is likely that the tenant organization see a high quality and timely output as an advantage to their organizational image.

Table 6-11: Further Pearson r Correlation test between Tenant Organizations' WTP for Enhanced Organizational Image and their Satisfaction about Productivity

	Absenteeism rate	Communication & Interaction	Quality and Timeliness	Innovation
WTP_Image	r = 0.000 p = 0.998	r = 0.152 p = 0.390	r = 0.379* p = 0.027	r = 0.240 p = 0.171

*. Correlation is significant at the 0.05 level (2-tailed).

Next, the relationship between the tenant organizations' satisfaction about their organizational image and their WTP for the VABs is examined. The Pearson r correlation test shows that a significant relationship exists only between S_Image and WTP_Productivity. Further Pearson r correlation tests are carried out to understand the possible reasons (See Table 6-12). It can be seen that at a significant level of 0.01 and 0.05 respectively, WTP_Productivity is positively related to the tenant organizations' satisfaction about their image as a socially responsible organization and about an enhanced image that leads to more business opportunities. Hence, it is likely that a socially responsible image and an enhanced image that leads to more business opportunities are seen as contributors by the tenant organizations to their productivity.

Table 6-12: Further Pearson *r* Correlation Test Results between Tenant Organizations' WTP for Improved Productivity and their Satisfaction about their Organizational Image

	Image of a Socially Responsible Organization	Enhanced Image leading to More Business Opportunities
WTP_Productivity	$r = 0.478^{**}$ $p = 0.004$	$r = 0.431^{*}$ $p = 0.011$

******. Correlation is significant at the 0.01 level (2-tailed).
*****. Correlation is significant at the 0.05 level (2-tailed).

The next satisfaction factor, S_Staff, to be investigated is found to have a significant positive correlation with all the WTP variables, i.e. the more satisfied the tenant organizations are about their ability to attract and retain staff, the higher is their overall WTP for the VABs and for each VAB. Further Pearson *r* correlation tests are thus conducted to investigate how S_Staff impact positively on the WTP variables. It is found that WTP_Total, WTP_Productivity and WTP_Staff are affected by both the staff turnover rates and the easiness of attracting high-calibre staff at a significance of 0.05. On the other hand, at a significance of 0.05, WTP_Image and WTP_Health are only affected by the easiness of attracting high-calibre staff.

Table 6-13: Further Pearson *r* Correlation Test Results between Tenant Organizations' WTP and their Satisfaction about their Ability to Attract and Retain Staff

	Staff Turnover Rates	Attracting High-Calibre Staff
WTP_Total	$r = 0.345^{*}$ $p = 0.046$	$r = 0.388^{*}$ $p = 0.023$
WTP_Productivity	$r = 0.402^{*}$ $p = 0.019$	$r = 0.419^{*}$ $p = 0.014$
WTP_Image	$r = 0.318$ $p = 0.067$	$r = 0.391^{*}$ $p = 0.022$
WTP_Staff	$r = 0.345^{*}$ $p = 0.046$	$r = 0.360^{*}$ $p = 0.036$
WTP_Health	$r = 0.302$ $p = 0.082$	$r = 0.340^{*}$ $p = 0.049$
WTP_Comfort	$r = 0.263$ $p = 0.134$	$r = 0.322$ $p = 0.64$

******. Correlation is significant at the 0.01 level (2-tailed).
*****. Correlation is significant at the 0.05 level (2-tailed).

The next set of variables to be tested is the tenant organizations' satisfaction with the improvements in their staffs' health. The correlation test reveals a positive relationship between S_Staff and WTP_Overall and between S_Staff and WTP_Productivity at 0.05 significant level. Further Pearson r correlation tests are carried out to investigate which aspects about the health of the staff impacts positively on the WTP_Overall and WTP_Productivity. It is found that the overall WTP of the tenant organizations is mainly affected by the satisfaction about the staff's physical health. As for the tenant organizations' WTP for productivity, both the physical and psychological health of staff are significant factors.

Table 6-14: Further Pearson r Correlation Test Results between Tenant Organizations' WTP_Total and WTP_Productivity and their Satisfaction about the Health of Staff

	Physical Health of Staff	Psychological Health of Staff
WTP_Total	r = 0.383* p = 0.025	r = 0.337 p = 0.051
WTP_Productivity	r = 0.454** p = 0.007	r = 0.390* p = 0.023

** . Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed).

Lastly, the satisfaction of the tenant organizations regarding their staff comfort is found to be a significant factor of their WTP for all the VABs. A positive relationship is found between S_Comfort and WTP_Total at a significance level of 0.01. Further examining the WTP variables, all, except WTP_Image, are positively correlated with S_Comfort at 0.05 significant level. WTP_Image is positively correlated with S_Comfort at 0.01 significant level. Therefore, the more satisfied are the tenant organizations with the comfort experienced by their staff, the higher are their WTP for the VABs. Four aspects regarding the staff comfort are further tested for relationship with the WTP variables. The four aspects are thermal comfort, lighting quality, acoustic quality and air quality. Satisfaction about the thermal comfort and air quality are the only two factors found to have positive impacts on all the WTP variables. On the other hand, the satisfaction about lighting quality impacts on the least number of WTP variables (See Table 6-15).

Table 6-15: Further Pearson *r* Correlation Test Results between Tenant Organizations' WTP and their Satisfaction about the Comfort of Staff

	Thermal	Lighting	Acoustic	Air
WTP_Total	$r = 0.436^{**}$ $p = 0.010$	$r = 0.343^{*}$ $p = 0.047$	$r = 0.410^{*}$ $p = 0.016$	$r = 0.471^{**}$ $p = 0.005$
WTP_Productivity	$r = 0.454^{**}$ $p = 0.007$	$r = 0.352^{*}$ $p = 0.041$	$r = 0.419^{*}$ $p = 0.014$	$r = 0.475^{**}$ $p = 0.005$
WTP_Image	$r = 0.457^{**}$ $p = 0.007$	$r = 0.372^{*}$ $p = 0.030$	$r = 0.480^{**}$ $p = 0.004$	$r = 0.489^{**}$ $p = 0.003$
WTP_Staff	$r = 0.345^{*}$ $p = 0.045$	$r = 0.310$ $p = 0.074$	$r = 0.373^{*}$ $p = 0.030$	$r = 0.446^{**}$ $p = 0.008$
WTP_Health	$r = 0.396^{*}$ $p = 0.020$	$r = 0.291$ $p = 0.095$	$r = 0.315$ $p = 0.070$	$r = 0.423^{*}$ $p = 0.013$
WTP_Comfort	$r = 0.409^{*}$ $p = 0.016$	$r = 0.287$ $p = 0.100$	$r = 0.332$ $p = 0.055$	$r = 0.386^{*}$ $p = 0.024$

******. Correlation is significant at the 0.01 level (2-tailed).

*****. Correlation is significant at the 0.05 level (2-tailed).

6.2.3.1.5 Perception of Building Impact, Green Mark rating system and Sustainable Buildings

The perception of the tenant organizations regarding the impact of buildings, the Green Mark Rating System and the benefits of sustainable buildings are another set of independent variables to be examined:

- P_SusBldg : Perception of benefits produced by sustainable buildings
- P_GM : Perception of effectiveness of Green Mark rating systems
- P_BldgImpact : Perception of building impacts

Pearson *r* correlation tests are carried out to test the hypotheses that the tenant organizations' WTP for the VABs is positively correlated with their perception regarding the three issues above.

Table 6-16 summarizes the results. The results show that the alternative hypotheses are not accepted and that there is no relationship between the perception of the tenant organizations regarding the building impacts, Green Mark Rating System and benefits of sustainable buildings and their WTP for the VABs.

Table 6-16: Hypothesis Testing Results of Tenant Organizations' Perception of Building Impacts, Green Mark and Sustainable Buildings

Variables	Variable Type	Statistical Test	Types of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
Perception of the Benefits produced by sustainable buildings	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their perception of the benefits produced by sustainable buildings	Tenant organizations' WTP is positively related to their perception of the benefits produced by sustainable buildings	p-value for all the WTP variables are >0.05. Hence, H ₀ for these variables is not rejected ➤ P_BldgImpact is not a significant factor of tenant organizations' WTP
Perception of the Green Mark rating system	Ordinal	Pearson r	Relationship	Tenant organization' WTP is not related to their perception of the effectiveness of building sustainability rating systems	Tenant organization' WTP is positively related to their perception of the effectiveness of building sustainability rating systems	p-value for all the WTP variables are >0.05. Hence, H ₀ for these variables is not rejected ➤ P_GM is not a significant factor of tenant organizations' WTP
Perception regarding the Impact of buildings have on occupants and their activities	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their perception of the impact of buildings have on occupants and their activities	Tenant organizations' WTP is positively related to their perception of the impact of buildings have on occupants and their activities	p-value for all the WTP variables are >0.05. Hence, H ₀ for these variables is not rejected ➤ P_SusBldg is not a significant factor of tenant organizations' WTP

Tenant Organizations' WTP for the VABs of Sustainable Buildings

Although the perception of the tenant organizations may not have a direct relationship with the tenant organizations' WTP for the VABs, further statistical tests are carried out to investigate into how the perception of the tenant organizations may affect their WTP for the VABs in some other ways.

Pearson r correlation tests are thus conducted to test for any significant relationships between P_SusBldg, P_GM and PM_BldgImpact and the tenant organizations' satisfaction about the benefits experienced. Table 6-17 summarizes the significant results. Only the tenant organizations' perception of the benefits produced by building is found to have a positive significant relationship with their satisfaction about their image, health and comfort of staff.

Table 6-17: Pearson r correlation test between Satisfaction variables and Perception variables

	S_Image	S_Health	S_Comfort
Perception of the benefits produced by building	r = 0.451** p = 0.007	r = 0.461** p = 0.006	r = 0.343* p = 0.047

** . Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed).

Therefore, there are some interactions between the tenant organizations' perception of the benefits produced by the buildings that they are located in and their satisfaction about the organizational image, health and comfort of staff. These interactions are further investigated by using Pearson r correlation to test for any relationship between them and the tenant organizations' WTP for the VABs. Table 6-18 summarizes the significant results. Together with S_Image, S_Health and S_Comfort, the tenant organizations' perception of the benefits produced by the buildings they are located in has a positive relationship with WTP_Productivity at a significance level of 0.05. In addition, their perception regarding the benefits produced by the buildings and S_Comfort have a positive relationship with WTP_Total and WTP_Image at 0.05 significant level. Therefore, the perception of the tenant organizations' regarding the benefits produced by the buildings they are located in have some indirect impacts on their WTP for the VABs, in particular for productivity and image.

Table 6-18: Pearson *r* correlation test between WTP variables and the Interaction between Perception and Satisfaction variables

	WTP_Total	WTP_Productivity	WTP_Image
Interaction between Perception of benefits produced by building & S_Image	-	$r = 0.373^*$ $p = 0.030$	-
Interaction between Perception of benefits produced by building & S_Health	-	$r = 0.370^*$ $p = 0.031$	-
Interaction between Perception of benefits produced by building & S_Comfort	$r = 0.364^*$ $p = 0.034$	$r = 0.369^*$ $p = 0.032$	$r = 0.384^*$ $p = 0.025$

**, Correlation is significant at the 0.01 level (2-tailed).

*, Correlation is significant at the 0.05 level (2-tailed).

6.2.3.1.6 Knowledge of Building Impact, Green Mark rating system and Sustainability Issues

The last group of independent variables to be investigated is the knowledge of the tenant organizations regarding sustainability issues, the impact of buildings on occupants and the Green Mark Rating System:

- K_Sus : Knowledge about sustainability issues
- K_GM : Knowledge about Green Mark rating system
- K_BldgImpact : Knowledge about impacts of building

The p-value obtained from the Pearson *r* correlation tests are >0.05 for the *r* coefficient between the knowledge of the tenant organizations and their WTP for the VABs. Therefore, the null hypotheses that they are not related are not rejected.

This result is similar to that reported in Brown & Cole (2009) where the influence of occupant knowledge on their comfort was explored. The occupant knowledge refers to “the occupants’ awareness and understanding of building environmental features and control systems, gained through their immediate experience in the building while tempered by a broad range of influences such as tacit knowledge, contextual and cultural influences”. It was found that there is no significant correlation between the occupant knowledge and comfort.

Chapter 6
Investigating Tenant Organizations' WTP Behavior

Similarly, in this research, the knowledge of the tenant organizations regarding sustainability issues, the Green Mark rating systems and building impacts was found to have no correlation with their WTP for the VABs experienced.

Table 6-19: Hypothesis Testing Results of Tenant Organizations' Knowledge about Sustainability Issues, Green Mark and Building Impacts

Variable	Variable Type	Statistical Test	Types of Hypothesis	Hypotheses		Results
				H ₀	H ₁	
Knowledge about Sustainability issues	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their knowledge of sustainability issues	Tenant organizations' WTP is positively related to their knowledge of sustainability issues	p-value for all the WTP variables are >0.05. Hence, H ₀ for these variables is not rejected ➤ K_Sus is not a significant factor of tenant organizations' WTP
Knowledge about Building sustainability rating systems	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their knowledge of building sustainability rating systems	Tenant organizations' WTP is positively related to their knowledge of building sustainability rating systems	p-value for all the WTP variables are >0.05. Hence, H ₀ for these variables is not rejected ➤ K_GM is not a significant factor of tenant organizations' WTP
Knowledge about Building impacts	Ordinal	Pearson r	Relationship	Tenant organizations' WTP is not related to their knowledge of building impacts	Tenant organizations' WTP is positively related to their knowledge of building impacts	p-value for all the WTP variables are >0.05. Hence, H ₀ for these variables is not rejected ➤ K_BldgImpact is not a significant factor of tenant organizations' WTP

Tenant Organizations' WTP for the VABs of Sustainable Buildings

6.2.3.2 Regression Analysis

After identifying the significant factors of the WTP of tenant organizations for the VABs and discussion of their impacts, this section continues to investigate how these factors jointly affect the tenant organizations' valuation of the VABs experienced through regression analysis. Appendix F contains the detailed statistical analysis results.

6.2.3.2.1 Overall WTP Model

The exogenous and endogenous variables are entered into a linear regression model using the Stepwise method with WTP_Total as the dependent variable. In the end, only two significant variables are retained in the model. They are the tenant organizations' satisfaction regarding the air quality (S_ComfAir) and whether the building is managed by building owner (BC_OwnMge). The R^2_{adj} of the model is 0.291.

Table 6-20: Regression Analysis of WTP_Total

Dependent Variable	Independent Variables Retained	Coefficients	p-value	Adjusted R ²
WTP_Total	S_ComfAir	4.595	0.019	0.291
	BC_OwnMge	-11.795	0.029	

The satisfaction of the tenant organizations regarding air quality of the indoor environment is found to be positively related to their total WTP for the VABs. Therefore, the tenant organizations' overall valuation of the VABs is significantly affected by how satisfied they are with the indoor air quality. It is noteworthy that among the four aspects of indoor environment, i.e. thermal comfort, air quality, lighting quality and acoustic quality, it is the indoor air quality that has the most extensive impact on the tenant organizations' valuation of the VABs.

In addition, the tenant organizations' total WTP is increased when the building is managed by the building owner. Therefore, when the building is managed by the building owner, it has a positive impact on the tenant organizations' valuation of the VABs. In other words, the value of VABs is significantly increased when the building is managed by the building owner. Assuming that the VABs reflect the sustainability performance of a building, the result shows that the sustainability

performance of a building is greatly increased when it is managed by the building owner.

6.2.3.2.2 *WTP_Productivity Model*

The tenant organizations' WTP for improved productivity is regressed over the exogenous and endogenous factors. The factors are entered into the model using the Stepwise method. Only two factors are retained in the model and they explain about 31.8% of the variances in the model. They are the satisfaction regarding the image of a socially responsible company (S_ImgSocResp) and whether the building is managed by the building owner (BC_OwnMge).

Table 6-21: Regression Analysis of WTP_Productivity

Dependent Variable	Independent Variables Retained	Coefficients	p-value	Adjusted R ²
WTP_Productivity	S_ImgSocResp	1.079	0.007	0.318
	BC_OwnMge	-2.473	0.017	

The result shows that there is a link between the tenant organizations' WTP for improved productivity and their satisfaction regarding their organizational image as a socially responsible corporation. This is quite surprising as it reflects that the tenant organizations' level of awareness regarding corporate social responsibility is not as low as it was thought to be. In fact, they see such an organizational image as beneficial to enhancing their productivity. Perhaps by being socially responsible, it creates an organizational culture that promotes better interactive behaviour and innovations which in turn contributes to their overall productivity.

In addition, similar to the tenant organizations' total WTP for the VABs, their WTP for improved productivity is also positively impacted when the building which they are operating from is being managed by the building owner. Hence, the tenant organizations which are operating in buildings managed by building owners are experiencing higher satisfaction level regarding their productivity.

6.2.3.2.3 *WTP_Image Model*

The next WTP behaviour of the tenant organizations to be examined is their WTP for enhanced image. It is linearly regressed over the independent variables using the

Stepwise method. Three variables are retained in the model, explaining about 46.7% of the variances. Table 6-22 below shows the independent variables that are found to be significant and are retained in the model.

Table 6-22: Regression Analysis of WTP_Image

Dependent Variable	Independent Variables Retained	Coefficients	p-value	Adjusted R ²
WTP_Image	S_Comfort	1.156	0.030	0.467
	BC_RoofGar	3.007	0.012	
	BC_OwnMge	-3.597	0.014	

One of the variables is the overall satisfaction of the tenant organization regarding the indoor comfort of their staff (S_Comfort). When their staffs are more satisfied with the thermal comfort, air quality, lighting quality and acoustic quality of their working environment, it increases the tenant organizations' WTP for the VAB of enhanced image. Hence, ensuring the comfort of staff is seen as having a significant positive impact on organizational image.

Another significant factor of the tenant organizations' WTP for enhanced image is the existence of roof gardens (BC_RoofGar). It is found that the existence of roof gardens in the buildings has a positive effect on the tenant organizations' WTP for enhanced image. The tenant organizations may see buildings with roof gardens projecting a healthier image. In addition, roof gardens may have a calming and relaxing effect on the occupants. Therefore, it increases the tenant organizations' WTP for enhanced image by providing a healthier and comfortable indoor environment for their staff. This is similar to a finding reported in (Heerwagen, 2006) where "good landscaping aesthetics and large shade trees add an average of 7% to the rental rates of office buildings".

Lastly, similar to the tenant organizations' WTP for improved productivity, the WTP of the tenant organizations for enhanced image is greater in buildings which are managed by the building owners themselves. Again, this shows a relation between the sustainability performance of a building and how it is being managed during its occupancy stage.

6.2.3.2.4 *WTP_Staff Model*

The fourth regression analysis is conducted on the tenant organizations' WTP for improved ability to attract and retain workers. Again, the variable whether the building is managed by building owner is retained in this model. The satisfaction of the tenant organizations regarding the air quality is another significant variable retained in the model. The R^2_{adj} of the model is 0.305.

Table 6-23: Regression Analysis of WTP_Staff

Dependent Variable	Independent Variables Retained	Coefficients	p-value	Adjusted R ²
WTP_Staff	BC_OwnMge	-2.968	0.012	0.305
	S_ComfAir	0.969	0.033	

The results show that the tenant organizations' valuation of the VAB of improved ability to attract and retain staff is affected positively by the indoor air quality (S_ComfAir). They believe that a good indoor air quality helps to attract and retain staff in an organization. This may be due to the increasing awareness of the "Sick Building Syndrome" of employees and the increasing importance of a healthy working environment emphasized by the employees.

Again, the variable whether the building is managed by the building owner (BC_OwnMge) is found to be a significant factor of tenant organizations' valuation of the VAB of improved ability to attract and retain staff. Similarly, this may be due to the impact of the way the building is managed on its overall sustainability performance and hence affecting the tenant organizations' WTP for the VAB of improved ability to attract and retain staff.

6.2.3.2.5 *WTP_Health Model*

Similar to the previous WTP models, the independent variables are entered into a linear regression model and analyzed using the Stepwise method. Only the variable, the tenant organizations' satisfaction regarding the air quality, is retained in the model with a R^2_{adj} of 0.153.

Table 6-24: Regression Analysis of WTP_Health

Dependent Variable	Independent Variables Retained	Coefficients	p-value	Adjusted R ²
WTP_Health	S_ComfAir	1.113	0.013	0.153

The tenant organizations' valuation of the VAB of improved staff health is found to be positively affected by their satisfaction regarding the indoor air quality (S_ComfAir). The relationship between them is fairly obvious. The health of the occupants, particularly their physical health, is directly affected by the quality of the indoor air. If there is too much contaminant in the air or there is poor circulation, it definitely has detrimental impacts on the health of the occupants.

6.2.3.2.6 WTP_Comfort Model

Lastly, the tenant organizations' WTP for improved comfort of staff is analyzed. Their satisfaction with the thermal comfort (S_ComfThermal) and whether the building is managed by the building owner (B_OwnMge) are found to be significant variables accounting for about 23.7% of the variances in the model.

Table 6-25: Regression Analysis of WTP_Comfort

Dependent Variable	Independent Variables Retained	Coefficients	p-value	Adjusted R ²
WTP_Comfort	S_ComfThermal	0.785	0.040	0.237
	B_OwnerMge	-2.302	0.032	

Although the indoor air quality has a considerable impact on the tenant organizations' WTP for improved ability to attract and retain staff and for improved health of staff, it is the level of thermal comfort (S_ComfThermal) that affects their overall WTP for improved comfort of staff.

In addition, it is found that when the building is managed by the building owners, it has a positive impact on the tenant organizations' WTP for improved comfort of staff.

6.2.4 **Testing for Reliability and Validity**

As discussed earlier on, the elicitation of the tenant organizations' WTP for the VABs experienced may be subjected to the issues of reliability and validity. Reliability issue stems from random error process, while the validity issue arises

due to systematic error process (Mitchell & Carson, 1989). This section shall test the reliability and validity of the WTP estimates obtained.

6.2.4.1 Reliability Testing

According to Mitchell & Carson (1989), “the more random the respondents’ WTP amounts, the greater the chance that a study’s mean WTP amount could be very different from the true WTP amount for the good”. Hence, reliability test is required to check that the elicited WTP amounts are not simply just random responses.

A reliability test can be performed by regressing the WTP amount over a set of independent variables to obtain the R^2 . R^2 measures the explanatory power of the entire model. Hence, the larger the R^2 , the greater is the explanatory power of the model as the random portion of the WTP response is lower (Bateman et al., 2002; Mitchell & Carson, 1989). There is no minimum value is specified for an acceptable R^2 in the literature and in practice (Bateman et al., 2002). However, Mitchell & Carson (1989) commented that “the reliability of a CV study which fails to show an R^2 of at least 0.15, using only a few key variables, is open to question”.

Based on above, the WTP models developed in the earlier section can be deemed as reliable. The adjusted R^2 ranges from 0.153 for the WTP model of improved staff health to 0.467 for the WTP model of enhanced organizational image with the number of key variables ranging from one to three. Hence, the reliability of the WTP models is sound.

6.2.4.2 Validity Testing

According to Mitchell & Carson (1989), validity refers to “the extent that an instrument measures the concept under investigation”. To check the validity of a CV study, the most obvious way is to assess whether the elicited values are equal to the actual values if a real market existed. However, this can never be established for this is the precise reason for the use of the CV method as the actual values cannot be observed in actual markets.

However, validity may be conceptualized in other ways to establish itself. Content validity is the simplest way of looking at the elicited values. It involves “the issue of whether the measure adequately covers the construct’s domain” (Mitchell &

Carson, 1989). It assessed the validity of the results obtained by looking at whether right questions have been asked and the way they are being asked. In Section 5.2.3.3, expert opinions are sought regarding whether adequate and sufficient explanatory variables are captured by the survey questionnaire. Generally, the experts interviewed agreed that appropriate and adequate variables have been included in this study.

Another type of validity is construct validity where it involves “the degree to which the measure relates to other measures as predicted by theory” (Mitchell & Carson, 1989). The validity of the results is established when the other measures relate to the obtained values in a way as predicted by theory. Construct validity may be determined by checking that the independent variables have the expected signs in the model (Bateman et al., 2002). In this study, all the significant independent variables in the WTP models developed in the previous section using regression analysis have the expected signs.

6.3 Case Study

In addition to the survey, an overseas case study is conducted to provide some comparisons between the WTP behavior of tenant organizations locally and overseas. The case study is to provide further investigation of the universal traits of tenant organizations' WTP behavior towards VABs. Through using an overseas study, similarities between the tenant organizations from the two different countries could be identified, in spite of the economic, cultural, social and regulatory differences.

The Beijing case study is mainly chosen for two reasons. Firstly, the office building in the Beijing case study uses a different building sustainability rating system (i.e. LEED) from the Singapore buildings in the survey. This allows investigation of the WTP behaviors of tenant organizations which operates in office buildings of different building sustainability rating systems. Secondly, the office building in the case study is one of the few buildings which have adopted a sustainability approach in its design and construction. Hence, the WTP behavior, exhibited by these tenant

organizations which chose operate in a sustainable office building, is likely to provide a more robust comparison.

In this section, some background information about the case study is firstly given. Then the research approach adopted to investigate the tenant organizations' WTP for the intangible VABs is presented. Lastly, the results and findings are reported and discussed.

6.3.1 Background of Case Study

The case study is a Grade A office building located in the Central Business District of Beijing, China which is completed in 2007. It is the first commercial project in China to be registered for the LEED rating system and obtained a Gold award in April 2008. It shall be referred to as the Building herein. Table 6-26 describes some background information about the building and Appendix G describes some of the main sustainability features implemented at the Building to meet the LEED criteria.

Table 6-26: Background Information about the Building

Total Site Area	13,922 m ²
Commissioned Green Area	4,500 m ²
Commissioned Road Area	4,120 m ²
Total Construction Area	150,375.72 m ² (Above ground: 116,797.58 m ² Below ground: 33,578.72 m ²)
Floor Area Ratio	5.59
Green Rate	21.8%
Efficiency Rate	Tower One: 74% Tower Two: 76%
Building Height	Roof Height: 99.1 m Highest Point: 119.5m
Number of Floors	Tower One: 25 (99.1 m) Tower Two: 20 (81.7 m) Underground: 4
Parking Spaces	On the ground: 24 Semi-underground: 22 Underground: 669 Total: 715

6.3.2 Research Approach

The purpose of the case study is to investigate the tenant organizations' WTP for the intangible VABs that they have experienced from operating at the building. It was conducted from Oct 2008 to Dec 2008.

The same WTP questionnaire developed in Chapter Five and applied in the survey conducted in Singapore is used. However, some modifications were made so that the questions asked are relevant to the local context (See Appendix D). This includes changing the Green Mark to LEED since LEED is the building sustainability rating system used at the Building.

Additional questions are also formulated to investigate the tenant organizations' specific motives on choosing the Building for their operations and also to compare their WTP attitude between the VABs and conventional benefits. Conventional benefits of buildings include the property services provided, location and lower operational costs.

Lastly, a major difference is the WTP elicitation question posed to the respondents. Instead of assuming that the VABs have not been included in the current rental fee as in the survey, the case study assumes that they have been into consideration and the tenant organizations are to express their WTP for the benefits by allocating their current rental fee according to the value they place upon the benefits. The purpose for the difference is to investigate the impact of the different assumption, i.e. whether the current rent has taken into consideration the VABs.

6.3.3 Results and Discussions

6.3.3.1 Response

Participation from all 17 tenants who are operating at the Building at the point of the survey was sought. 13 responded and participated in the survey. However, in order to capture as accurately as possible the benefits that are actually experienced by the tenant organizations, only completed questionnaires that were answered by personnel who are familiar with the overall operations of the businesses and space requirements of the organization are included. These personnel are usually the directors, general managers, office managers or administrative managers. Therefore, only 8 of the 13 completed questionnaires are used in the analysis.

6.3.3.2 Results

6.3.3.2.1 Profile of Respondents

Table 6-27 summarizes the profile of the eight respondents. Most of them are MNC companies with their headquarters based in the US or Europe and have a staff size of below ten operating at the Building, except for a real estate company which has a staff size of 200. In addition, most of the staff at these tenant organizations spend more than half of their working hours at the Building.

Table 6-27: Profile of Respondents

Organi- zation	Business Type	Company Type	Country of Origin	Age	Staff Size	Amount of Time Staff Spend in Office (% of working hours)
A	Manufacturing	Private	USA	41	6	100%
B	Real Estate	Private	USA	10	200	>50 %, <80%
C	Mining	Private	Canada	5	12	>50 %, <80%
D	Real Estate	Private	USA	13	6	>80%, <100%
E	Mining	Private	England	1	10	>80%, <100%
F	Real Estate	Private	USA	1	10	>80%, <100%
G	Finance	Private	China	18	6	<10%
H	Legal	Private	Germany	1	5	100%

6.3.3.2.2 Motivation of the Choice of the Building for Operation

The respondents were asked about their purpose of moving into the Building. Most of them moved into the Building due to expansion of their organizations, i.e. they moved out of their previous workplace and moved into the Building with a larger staff size. Some other purposes for moving into the Building include setting up a new office in Beijing, setting up new organizational functions and relocation with the same staff size.

Figure 6-10: Purpose for moving into the Building

In addition, the respondents were asked for their reasons of their choice of the Building. A majority of them chose the Building because it is located in the Central Business District. Nevertheless, some of them were also motivated by “green” reasons. For example, one respondent stated his organization’s reason for choosing the Building is because it has obtained the LEED award and two respondents said that the Building as a sustainable building would enhance their organizational image. Also, two respondents are expecting that their staff would experience greater comfort.

Figure 6-11: Reasons for choosing the Building

6.3.3.2.3 Satisfaction of Tenant Organizations

The tenant organizations were asked to rate on a scale of 1 (Somewhat Satisfied) to 5 (Extremely Satisfied) on their satisfaction level about the benefits they have experienced from operating at the Building. They may indicate a zero if they have not experienced any of the benefits. Overall, their average scores for each benefit experienced ranged from 1.71 for satisfaction of improved ability to attract and retain staff to 2.38 for satisfaction of an enhanced image.

Figure 6-12: Average Satisfaction Score of Respondents at the Building

Table 6-28 below shows further details on the respondents' satisfaction of each benefit. In addition to rating their overall satisfaction of each benefit, the respondents were also asked to rate their satisfaction regarding a specific aspect of each benefit on the same rating scale. Using their average score for their overall satisfaction of a benefit as a benchmark, the specific aspect that has been rated higher than the average score is deemed to be a contributing factor to the their overall satisfaction of that benefit.

Table 6-28: Average Satisfaction Score of Respondents (Details)

Satisfaction of Tenant Organizations	Average Score
Productivity	2.00
Decrease in absenteeism of staff	1.62
Improved interactive behavior and communication	1.63
Improved product quality and timeliness of output	2.13
Increased innovation	1.50
Image	2.38
Improved image as a socially responsible company	2.38
Improved image resulting in new and/or more business opportunities	2.38
Ability to Attract and Retain Staff	1.71
Reduced turnover rates of staff	1.25
Ease of attracting high-calibre staff	2.13
Health of Staff	1.86
Improved physical health due to decrease in 'Sick Building' related illnesses	1.32
Improved psychological health of staff due to a more positive working environment	2.00
Comfort of Staff	1.88
Improved satisfaction level of staff with regards to thermal comfort	2.13
Improved satisfaction level of staff with regards to lighting quality	2.38
Improved satisfaction level of staff with regards to acoustic quality	2.00
Improved satisfaction level of staff with regards to air quality	2.00

On average, the respondents gave a score of 2.00 for their overall satisfaction of the improvements in their productivity. Based on this average score, the main reason for the respondents' satisfaction of improved productivity seems to be the improvements in the product quality and timeliness of output due to operating at the Building, which the respondents had given an average satisfaction score of 2.13.

As for the tenant organizations' satisfaction with their enhanced organizational image, it is due to both being seen as a socially responsible company and a result of new and/or more business opportunities.

As for the benefit of improved ability to attract and retain staff, the likely contributing factor is the ease of attracting high-calibre staff by operating at the Building. The tenant organizations gave an average score of 2.13 which is higher than their average score of 1.71 for their overall satisfaction of the improvements in the ability to attract and retain staff.

Based on the tenant organizations' average overall satisfaction score of 1.86 for the benefit of improved health of staff, the contributing factor to their satisfaction is the improvements in the psychological health of their staff which an average score of 2.00 was given. On the other hand, improved physical health of staff seems to bring little impact on the tenant organizations' overall satisfaction level.

Lastly, the tenant organizations rated an average score of 1.88 regarding their overall satisfaction of the comfort level experienced by the staff. However, when asked to rate their satisfaction regarding the thermal, lighting, acoustic and air quality, they gave a score higher than their overall satisfaction. This shows that generally, the thermal comfort, lighting quality, acoustic quality and air quality of the Building have contributed towards the tenant organizations' satisfaction with the improved comfort of their staff. The lower overall satisfaction could be due to other reasons not captured by the questionnaire.

6.3.3.2.4 Perception of Tenant Organizations

Figure 6-13 summarizes the perception of the tenant organizations regarding the building impact, the LEED system and sustainable buildings. Generally, the tenant organizations perceived how the building impacts on the organization and the attainment of a LEED award as important. They indicated an average score from 3.43 to 3.87 which is between "Neutral" to "Important" on the rating scale. As for how they perceive the sustainable buildings, they agreed most that sustainable buildings enhances an organization's image with an average score of 4.00. Reduction of health costs as a benefit of sustainable buildings is the least agreeable by them.

Rating Scale for Perception of building impacts and Green Mark rating system:
1-Unimportant at all, 2-Important, 3-Undecided, 4-Important, 5-Very Important
Rating Scale for Perception of benefits produced by sustainable buildings:
1-Strongly Disagree, 2-Disagree, 3-Undecided, 4-Agree, 5-Strongly Disagree

Figure 6-13: Perception of Tenant Organizations at the Building

6.3.3.2.5 Knowledge of Tenant Organizations

The knowledge of the tenant organizations regarding the building impact, LEED rating system and sustainability issues are tested by asking them true/false questions. Figure 6-14 shows the average scores out of 100 obtained by the tenant organizations. It shows that the tenant organizations have the least understanding about the LEED rating system and have the most knowledge about the impacts of a building has on its occupants.

Figure 6-14: Average Score for Knowledge of Tenant Organizations at the Building

6.3.3.2.6 *WTP of Tenant Organizations*

Figure 6-15 shows the respondents' average WTP for the VABs and for some of the conventional benefits. The WTP of the tenant organizations is the highest for the benefit of an enhanced organizational image. This is even higher than their WTP for the location of the Building.

On average, each of the VABs has a WTP amount of 11.4% of the tenant organizations' current monthly rent, whereas the average WTP amount of each conventional benefit is 10.4% of the tenant organizations' current monthly rent.

Figure 6-15: Respondents' average WTP for the VABs at the Building

6.3.3.3 Discussions

From the results, some interesting observations regarding the tenant organizations' WTP behavior for the intangible VABs are made.

- **Tenant Organizations value Intangible Value-Added Benefits more highly than Conventional Benefits**

As reported in the previous section, it is interesting to note that the tenant organizations valued the intangible VABs more highly than the conventional benefits. On average, the tenant organizations' WTP for each VAB is 11.4% of their current monthly rent which is higher than their WTP for the conventional benefits at an average of 10.4%.

Conventional benefits include lower operational costs, strategic location of building, prestigious image of building and good property services provided. These are traditionally thought to attract tenants and command higher rental fees. However, the results of the study of the Building show that although tenant organizations may be attracted to such conventional benefits, these benefits may not command a higher WTP amount from the tenant organizations than the intangible VABs.

For example, the tenant organizations' main reason for the choice of the Building as their place of operations is that it is located in the CBD (See Figure 6-11) and they indicated a WTP of about 13.4% more on top of their current monthly rent for a strategic location. This is lower than the tenant organizations' average WTP of 19.5% for an enhanced organizational image.

- **Tenant Organizations' WTP for the Value-added Benefits and their Satisfaction & Perception**

Among the five intangible VABs, the benefit of an enhanced organizational image has the highest WTP amount. The tenant organizations' satisfaction of an enhanced organizational image is also the highest among the five VABs. In addition, the tenant organizations perceive an enhanced organizational image to be the most likely benefit of sustainable buildings.

Further examining the tenant organizations' WTP, satisfaction and perception of the other four benefits found that there is a likely correlation between them. Table 6-29 compares the tenant organizations' WTP, satisfaction and perception of the five VABs. The benefits are ranked in decreasing order in terms of the tenant organizations' WTP for them, satisfaction level and perception.

It can be seen that the tenant organizations' WTP for the benefit of enhanced organizational image and their satisfaction of it is the highest. They also perceive the benefit as the most likely benefit of sustainable buildings. On the other hand, the VAB of improved ability to attract and retain staff has not only the lowest WTP amount and satisfaction level but it is also perceived by the tenant organizations as the least likely benefit of sustainable buildings. For the other three VABs i.e. increased productivity, improved staff health and comfort, they are similarly ranked that order in terms of the tenant organizations' WTP, satisfaction and perception.

Table 6-29: Comparison of Tenant Organizations' WTP, Satisfaction and Perception at the Building

WTP amount			Satisfaction Level			Perception		
Rank	Benefits	% of rental fee	Rank	Benefits	Average Score	Rank	Benefits	Average Score
1	Enhanced organizational image	19.5	1	Enhanced organizational image	2.4	1	Enhanced organizational image	4.0
2	Increase in productivity	11.0	2	Increase in productivity	2.0	2	Increase in productivity	3.6
3	Improved health of staff	9.4	2	Improved health of staff	1.9	2	Improved health of staff	3.6
4	Improved comfort of staff	8.8	4	Improved comfort of staff	1.9	4	Improved comfort of staff	3.5
5	Improved ability to attract & retain staff	8.5	5	Improved ability to attract & retain staff	1.7	5	Improved ability to attract & retain staff	3.4

• Comparisons with the Survey Results

One of the greatest differences between the results of the Singapore survey and the case study is the WTP amount of the VABs. In the survey where it is assumed that the VABs have not been taken into consideration in the rental fee, the WTP of the

tenant organizations for the VABs range from 3.56% to 4.12% of their monthly rental fee. However, in the case study where it is assumed that the VABs have already been accounted for in the rental fee, the monetary value placed upon on the VABs range from 8.5% to 19.5%. There are two possible reasons for this. Firstly, the tenant organizations at the Building truly experience greater benefits. Secondly, the difference may be due to the way the elicitation question is formulated. It is similar to the discrepancy often reported between WTA and WTP. When asked to pay on top of their current rental fee, the tenant organizations are more reluctant to indicate a higher WTP amount.

Nonetheless, despite of whether it was assumed that the VABs are taken into consideration in the current rental fee, similar WTP behavior may be observed between the tenant organizations in the case study and survey.

Firstly, the benefit of an enhanced organizational image has the highest WTP amount from both the tenant organizations in the case study and survey. Although the tenant organizations are located in different countries and different building sustainability rating systems are adopted at the buildings they are operating in, an enhanced organizational image is what they value the most among the five intangible VABs.

Furthermore, in both the case study and survey, the tenant organizations' satisfaction of the benefits is found to be correlated to their WTP for them. In the survey, the Pearson r correlation tests show a positively relationship between the tenant organizations' WTP and satisfaction. In the case study, from Table 6-29, it can be seen that some correlation exists between the tenant organizations' WTP and satisfaction.

In addition, the table shows a possible correlation between the tenant organizations' WTP and their perception of the sustainable buildings and its benefits. However, in the survey, the tenant organizations' perception of sustainable buildings is not found to be a significant factor of their WTP. Instead, it is their perception of the specific benefits that a building can bring to their organizations that is found to have some relation with their satisfaction of their image, staff health and comfort which in turn

affects their WTP for the benefits of enhanced image, improved staff health and comfort.

6.4 Chapter Summary

This chapter begins by designing and implementing a survey on the tenant organizations of the office buildings in Singapore to elicit their WTP for the VABs and to measure the six groups of variables identified in the conceptual model developed in the previous chapter.

Hypothesis testing using various statistical techniques such as ANOVA and Pearson r correlation tests are carried out to identify the key variables of the tenant organizations' WTP for the VABs. The WTP amounts obtained are also regressed over the exogenous and endogenous variables.

Figure 6-16 and Figure 6-17 show two views of the results of the investigation - by the WTP variables and by the exogenous and endogenous factors respectively.

Figure 6-16: Significant Factors of Tenant Organizations' WTP for the VABs (WTP variables view)

Figure 6-17: Significant & Insignificant Factors of Tenant Organizations' WTP for VABs (Exogenous and Endogenous variables view)

Chapter Seven

7 Findings and Recommendations for Encouraging the Demand for Sustainable Office Buildings

7.1 Chapter Introduction

The investigation results are further explored to answer the last research question.

The investigation into the tenant organizations' WTP for the VABs provides insights into how the demand for sustainable buildings may be stimulated. As mentioned in Chapter One, understanding the tenant organizations' WTP behavior helps to stimulate the demand for sustainable buildings in two ways. Firstly, appropriate strategies and tools can be developed to promote sustainable buildings more effectively based on the preferences of the demand stakeholders. Secondly, as the WTP of the demand stakeholders reflect the sustainability performance of the buildings in a way, the sustainability performance of the buildings may be enhanced through understanding the demand stakeholders' WTP behavior. Better sustainability performance is envisaged to bring greater benefits to the demand stakeholders and hence encouraging the demand for sustainable buildings.

This chapter shall answer the last research question of what insights do the investigation of the tenant organizations' WTP for the VABs provide towards encouraging the demand for sustainable buildings. The chapter is organized into two parts. The first part identifies the barriers to the tenant organizations' demand for sustainable buildings. The findings of the investigation of the tenant organizations' WTP for the VABs are discussed in the light of these barriers and solutions to overcome the barriers are proposed. The second part of the chapter shall identify the problems faced by supply stakeholders in their sustainability efforts. New insights on the problems, gained from the findings of the tenant organizations' WTP investigation, are discussed and possible solutions to the problems are proposed.

7.2 Overcoming Barriers to Demand for Sustainable Buildings

7.2.1 Low Awareness of Sustainability Benefits

7.2.1.1 Problem

Although there are reports of increasing awareness of the sustainability benefits, the awareness of the majority demand stakeholders remains relatively low. There is generally a lack of awareness regarding the benefits of sustainable design. This low awareness has been cited as the main reason for the low demand for sustainable buildings (Building & Construction Interchange Asia., 2008; Chan et al., 2009;

McGraw-Hill Construction. & Siemens Building Technologies Inc., 2007; Melbourne Business School., 2006; Yudelson, 2009)

7.2.1.2 *Insights from the Investigation of Tenant Organizations’ WTP behavior*

7.2.1.2.1 *Older Tenant Organizations have Lower WTP for the VABs*

The investigation of the tenant organizations’ WTP for the VABs reveals a negative relationship between the age of a tenant organization and its overall WTP for the VABs, i.e. the older tenant organizations tend to have a lower WTP for the VABs (See Figure 7-1). In particular, their WTP for improved staff health and comfort are lower.

Figure 7-1: Tenant Organizations’ Age and their WTP for the VABs

The older tenant organizations’ lower WTP for improved health and comfort of staff may be explained by their lower awareness of the building sustainability benefits. As reported by Lutzkendorf & Lorenz (2005) and Melbourne Business School (2006), building occupants do not recognize the benefits of a high quality indoor environment, particularly on their health and comfort.

7.2.1.2.2 An Enhanced Organizational Image remains the Main Motivation of Tenant Organizations' Demand for Sustainable Buildings

In addition to a low awareness of sustainability benefits among the older tenant organizations, the investigation of the tenant organizations' WTP behavior reveals that among the five VABs, the tenant organizations are more conscious of one of them, i.e. an enhanced organizational image.

The tenant organizations' WTP for the enhanced organizational image is the highest in both the survey and case study carried out. In the survey, the tenant organizations' average WTP for an enhanced organizational image is 4.12% of their monthly rental fee. The next highest WTP amount is the benefit of improved ability to attract and retain staff which is about 6% lower at 3.88% of the monthly rental fee. In the case study, the tenant organizations' WTP for the enhanced organizational image is 19.5% of their monthly rental fee and the next highest WTP is 11.5% of the monthly rent for the benefit of increased productivity.

One of the reasons for the tenant organizations' higher WTP for an enhanced organizational image could be due to the changing demand of the consumers, in particular those from the European markets. According to McGraw-Hill Construction & Siemens Building Technologies Inc (2007), 70% of the European consumers do take into consideration a company's level of social responsibility when making a purchase. Operating in a certified sustainable building is one of the obvious ways to demonstrate an organization's commitment to sustainability causes.

Another reason for the higher WTP by the tenant organizations for an enhanced organizational image could be explained by the tangible factors affecting it. As seen from Figure 7-2, the tenant organizations' WTP for an enhanced organizational image is related to many building characteristic factors, such as the existence of roof gardens, which are physical. The emphasis on the building characteristics is probably due to the changing determinant of a property's worth to building characteristics (Lutzkendorf & Lorenz, 2005). On the other hand, the tenant organizations' WTP for other benefits is mainly related to satisfaction factors which

are less tangible. Therefore, it is easier for the tenant organizations to attach a monetary value for enhancing their organizational image.

Figure 7-2: Building Characteristics and Tenant Organizations' WTP for Enhanced Image

7.2.1.3 Proposed Solution

Conducting campaigns and educating the demand stakeholders have been proposed in past studies as a solution to raise the awareness of demand stakeholders regarding sustainability benefits (Melbourne Business School., 2006; Xenergy, 2000).

Such campaigns and education programs may be refined to target at specific groups of stakeholders. As the investigation of the tenant organizations' WTP behavior has shown, the older organizations, in particular those that have been established for more than ten years, have a lower WTP for the VABs. In addition, these older organizations have a lower WTP for improved health and comfort of staff. Hence, such campaigns and education programs targeted at this group of demand stakeholders may need to emphasize on the health and comfort benefits brought about by a high quality indoor environment which is often present in sustainable buildings.

Furthermore, in generally, the awareness of the demand stakeholders regarding sustainability benefits should move beyond just projecting a good organizational

image. Hence, the campaigns and education programs should emphasize on the other benefits such as improved productivity, improved ability to attract and retain staff and improved health and comfort of staff.

7.2.2 Lack of Appropriate Tools for Decision-Making

7.2.2.1 Problem

Besides the problem of a low awareness regarding sustainability benefits, there is a lack of appropriate tools for demand stakeholders to make decisions on whether they should demand for sustainable buildings (Melbourne Business School., 2006).

Currently, building sustainability rating systems are likely to be the only indication to the demand stakeholders about the sustainability performance of a building from the labeling. Such labeling has the advantage of being simple to use and understand. However, their simplicity may also hinder the effective communication of the actual benefits to the building occupants. The proliferation of different building sustainability rating systems and tools in market may also add to the confusion of the building occupants (Green Building Council of Australia., 2008).

7.2.2.2 Insights from Investigation of Tenant Organizations' WTP behavior

7.2.2.2.1 Diverse Information Needs of Tenant Organizations

The diverse information needs of the tenant organizations may be seen from the range of factors affecting their WTP for each VAB. Although the tenant organizations' WTP for each VAB are related to one another, they are not exactly affected by the same set of factors, i.e. how the tenant organizations attach economic value to each VAB is slightly different (See Figure 7-3).

t-test
ANOVA
Pearson r

Survey

Regression

Case study

WTP_Total	WTP_Productivity	WTP_Image	WTP_Staff	WTP_Health	WTP_Comfort
OC_Age S_Staff S_Health S_Comfort	BC_OwnMge S_Productivity S_Image S_Staff S_Health S_Comfort	BC_OwnMge BC_RoofGar BC_AirConAdj BC_GFA S_Productivity S_Staff S_Comfort	BC_OwnMge S_Staff S_Comfort	OC_Age BC_OwnMge S_Staff S_Comfort	OC_Age BC_OwnMge S_Staff S_Comfort
BC_OwnMge S_ComfAir	BC_OwnMge S_ImgSocResp	BC_OwnMge BC_RoofGar S_Comfort	BC_OwnMge S_ComfAir	S_ComfAir	BC_OwnMge S_ComfThermal
S_Productivity S_Image S_Staff S_Health S_Comfort	S_Productivity S_Image S_Staff S_Health S_Comfort	S_Productivity S_Image S_Staff S_Health S_Comfort	S_Productivity S_Image S_Staff S_Health S_Comfort	S_Productivity S_Image S_Staff S_Health S_Comfort	S_Productivity S_Image S_Staff S_Health S_Comfort

Figure 7-3: Various Significant Factors of Tenant Organizations’ WTP for each VAB

Generally, the tenant organizations’ WTP for the VABs exhibit some similarities. They are affected by how the building is being managed during the operational stage and by a certain aspect of the indoor environment. For example, in addition to how the building is being managed during the operational stage, the tenant organizations’ WTP for VABs of improved ability to attract and retain staff and of improved comfort are influenced by the air quality and the thermal comfort of the indoor environment respectively.

The tenant organizations have similar behavior toward the VAB of an enhanced organizational image. Their WTP is also affected by how the building is being managed during the operational stage. However, instead of a particular aspect of the indoor environment, it is the overall indoor comfort in terms of thermal, air, lighting and acoustics that influence their WTP for an enhanced organizational image. Furthermore, they also see the existence of roof gardens as a contributor toward enhancing their organizational image.

On the other hand, the tenant organizations’ WTP for improved health of staff is particularly affected by the indoor air quality, i.e. the tenant organizations place an

economic value to the benefit of improved health of staff according to their satisfaction with the quality of the indoor air.

Lastly, the tenant organizations' WTP for the VAB of improved productivity is quite different from that of other VABs. Although how the building is being managed during the operational stage is also a significant factor, their WTP for improved productivity is affected by their organizational image as a socially responsible corporation. At first glance, it is puzzling to see a relation between the productivity of an organization and its level of corporate social responsibility. However, upon further examination, a socially responsible organization may bring about a positive organizational culture that promotes better interactive behavior among the staff which helps to improve their productivity. Furthermore, to be socially responsible, an organization has to balance its economic objectives with its social ones, often through innovations which may in turn bring about improvements in its overall productivity.

Therefore, it can be seen that the tenant organizations' WTP for each VAB are affected by different factors. In other words, the tenant organizations have a diverse information need when deciding on their WTP for the VABs.

7.2.2.2.2 Information about Indoor Air Quality and Thermal Comfort is Important

Besides how the building is managed during the operational stage, indoor air quality and thermal comfort are significant factors. As discussed, the indoor environment quality is a key contributor to the tenant organizations' WTP for the intangible VABs of sustainable buildings.

From the Pearson r correlation tests carried between the tenant organizations' WTP for each VAB and their satisfaction regarding the four aspects of the indoor environment, it is found that generally, the overall WTP for the VABs by the tenant organizations is positive correlated with their satisfaction regarding their indoor environment. In particular, the correlation tests show that indoor air quality and thermal comfort affects the tenant organizations' WTP for improved staff health and comfort (See Section 6.2.3.1.4).

Figure 7-4: Indoor Environment Quality and Tenant Organizations' WTP for the VABs

Based on the regression analysis of the survey results, it further confirms that the indoor air quality and thermal comfort are the key factors that motivate the tenant organizations to pay for the VABs of improved ability to attract and retain staff, improved health and comfort of staff. The importance of thermal comfort is also confirmed in the study conducted by Paul & Taylor (2008) where it is concluded that thermal comfort influences the overall satisfaction with the workplace environment.

Therefore, indoor environment quality, especially the indoor air quality and thermal comfort, are pertinent to the realization of the intangible VABs and are important information to the tenant organizations.

7.2.2.2.3 Inadequacy of the Building Sustainability Rating System as a Tool for Communicating Sustainability Benefits to Tenant Organizations

The findings from the investigation of the tenant organizations' WTP behavior towards the VABs confirm the problem about the inadequacy of the building sustainability rating system as a tool for communicating sustainability benefits to the demand stakeholders. Although the building sustainability rating systems have been developed with the objective of stimulating the demand for sustainable

buildings (Cole, 2005; Lee & Burnett, 2006; World Green Building Council., 2007), the investigation of the tenant organizations' WTP for the VABs suggests that this objective has not been achieved. As shown by the findings from the investigation via the variables view in Figure 7-5, the building sustainability rating system is found to be an insignificant factor of the tenant organizations' WTP for the VABs.

Figure 7-5: Building Sustainability Rating System and Tenant Organizations' WTP for the VABs

From the survey, the result shows that the average WTP of tenant organizations operating in Green Mark buildings is not significantly different from those operating in the non-Green Mark buildings. Tenant organizations operating in buildings with different level of Green Mark award also do not have significant different average WTP for the VABs. In addition, in the regression analysis, the attainment of the Green Mark award and the level of Green Mark awarded are not found to be significant factors of the tenant organizations' WTP for the intangible VABs. Hence, the statistical results show that whether the building has obtained the Green Mark award or what level of Green Mark award has been achieved by the

building do not affect how the tenant organization attach economic values to the intangible VABs.

One of the reasons that the Green Mark award has no influence on the tenant organizations' WTP for the VABs is that the tenant organizations see no relation between the Green Mark award and the sustainability performance of the buildings. In other words, the Green Mark award is not a tool that the tenant organizations would rely on for information regarding the sustainability performance of the buildings. As reported in Section 6.2.2.2.3, when asked about the importance of a Green Mark award and the level of Green Mark awarded when considering a place for operation for their businesses, the tenant organizations indicated an average score that is between "Unimportant" and "Undecided" on the rating scale.

The response of the tenant organizations could be attributed to the inadequacy of the Green Mark rating system for communicating the sustainability benefits of the buildings to the tenant organizations. Firstly, the labeling of the sustainability performance of buildings by the Green Mark rating system may not be helpful to the tenant organizations in understanding the actual sustainability performance of the buildings. For example, the tenant organizations' WTP for the VABs is generally affected by how the building is being managed during its operational stage and by the indoor environment, especially the air quality and thermal comfort. However, the Green Mark rating system which labels the building in terms of Certified, Gold, Gold Plus and Platinum may not inform the tenant organizations much about the air quality or thermal comfort of the indoor environment.

Furthermore, as discussed, the tenant organizations exhibit different WTP behavior toward different VABs. For example, their WTP for improved ability to attract and retain staff and improved health of staff are affected by how the building is being managed and the indoor environment. On the other hand, in addition to the two factors, physical building characteristics such as the building size and existence of roof gardens play a role in the tenant organizations' WTP for enhanced organizational image. Therefore, to summarize the diversity of the information needs of the tenant organizations in just one label may not be too helpful to the tenant organizations in understanding the sustainability performance of a building.

Hence, there is no correlation between the tenant organizations' WTP for the VABs and the Green Mark award.

7.2.2.3 Proposed Solution

The building sustainability rating systems which indicate the sustainability performance of buildings by labeling prove to be not quite effective in communicating the benefits of the building to the demand stakeholders so far. It has failed to convince the demand stakeholders of the sustainability benefits of a building. To summarize the sustainability benefits in just one label may be too crude to stimulate the demand for sustainable buildings.

In recent years, some countries have looked to labeling the building according to a specific aspect of its performance. For example, the UK has made disclosure of building energy consumption mandatory to inform building occupants of the specific energy performance of a building. In Singapore, besides the Green Mark rating system, the National Environment Agency has also implemented the Energy Smart Labeling which informs building occupants about the energy performance of a building. Such disclosure of energy consumption or energy labeling should include reference values so that building occupants can compare and evaluate building energy efficiency (Rey et al., 2007). Hence, such specific tools may be more useful to building occupants.

However, such tools are limited to mainly to communicating about the tangible benefits of sustainable buildings. Hence, specific tools should be developed to inform building occupants about the intangible benefits. Such tools may focus on the air quality and thermal comfort which are two main factors that motivate the tenant organizations to pay for the VABs.

7.3 Enhancing Sustainability Performance of Buildings

7.3.1 High Initial Costs and High Technology

7.3.2.1 *Problem*

The perception of sustainable buildings involving high costs of has been described as one of the biggest barriers to sustainable buildings (Yudelso, 2009). It was reported that even experienced construction industry professionals have such perception. In a survey conducted by Building & Construction Interchange Asia (2008), 87% of the respondents from the construction industry in Singapore stated the high initial costs required for sustainable buildings as a deterrent to them from going for sustainable buildings. Therefore, the perception of high costs and the required use of high technology are discouraging supply stakeholders from implementing building sustainability measures (Chan et al., 2009; Green Building Council of Australia., 2008; Melbourne Business School., 2006; Yudelso, 2009).

7.3.2.2 *Insights from Investigation of Tenant Organizations' WTP behavior*

7.3.2.2.1 *Use of Sustainable Technologies is not as crucial as How the Building is Being Managed during the Operational Stage*

As discussed, although the tenant organizations' WTP for each VAB are not affected by exactly the same set of factors, they share a common one which is how the building is being managed during the operational stage. The t-tests carried out reinforce that it is indeed a significant factor to the tenant organizations' WTP for each of the VABs.

Among the list of building characteristics examined, including common building sustainability measures, only how the building is being managed during the operational stage is found to be a significant factor to the tenant organizations' WTP for each VAB. On the other hand, roof gardens and air conditioning systems that allow adjustments are the only two building sustainability measures that are found to have some impact on the tenant organizations' WTP and it is only on one of the VABs, i.e. the enhanced organizational image. The remaining building sustainability measures are found to have no impact on the tenant organizations' WTP behavior at all (See Figure 7-6 and Figure 7-7).

Figure 7-6: How the Building is being Managed during its Operational Stage and the Tenant Organizations' WTP for VABs

Figure 7-7: Building Characteristics and Tenant Organizations' WTP for VABs

The investigation reveals that tenant organizations operating in buildings that are managed by the building owners have a higher WTP for each of the five VABs than those managed by outsourced facilities management (FM) companies. This may be due to better management of the building owners than FM companies which results in a better sustainability performance, leading to greater VABs. The better management may be due to building owners having a higher commitment than FM companies for ensuring the performance of the buildings. Another reason could be the later involvement of the FM companies in the life of the building, as compared to the building owners who are likely to be involved in the early stage. Being involved earlier allows for the consideration of how the building will be managed during the operational stage to be considered at the design stage and thereby maximizing the building performance. Furthermore, getting the future building maintenance professionals involved during commission is also critical (Yudelso, 2009).

Therefore, the use of what kind of sustainable building technologies is not as important as how they are being managed during the operational stage of the building for ensuring the sustainability performance of buildings. As pointed out by Morris (2007), sustainable features that require specialized maintenance or sophisticated operation are often overridden by the building maintenance team. For example, building maintenance staff may override energy management controls because they find them too complex to use.

7.3.2.3 Proposed Solution

To achieve sustainable buildings, it may not necessarily involve high costs and high technology. According to Steven Winter Associates (2004), there is no correlation between the point value of a LEED credit and its cost. The same individual LEED credit could be obtained by a range of different strategies. Davis Langdon (2007b) further found that many projects are meeting LEED criteria within their budgets and in the same cost range as non-LEED projects. The investigation of the tenant organizations reveals that how the building is being managed is a more important factor than the use of technologies.

To change the perception of the supply stakeholders, more emphasis could be placed on achieving building sustainability during the operational stage of the buildings, i.e. sustainability efforts should be extended beyond just the design stage and just implementing highly advanced building technologies. Currently, most of the tools and guidebooks available focus on sustainable design. More resources should be created for sustainable facilities management. Regular re-certification by the building sustainability rating systems is also a good way of ensuring the sustainability performance of the building during its operational stage and shifting the focus of the industry to the operational stage of building.

In addition, sustainable design can be achieved at low costs through innovations by integrating the multi-disciplinary professionals, in particular the FM management team who is responsible for the operational stage of a building should be brought in as early as possible during the design stage. As pointed out by Morris (2007), engaging the building maintenance team during the design process can lead to better designs and a better understanding by the team regarding the functions of the sustainable features.

7.3.2 Over Reliance on Building Sustainability Rating Systems for achieving Sustainable Buildings

7.3.2.4 Problem

Other than the perception of high costs and high technology required, the low knowledge about sustainable buildings is also a deterrent to the supply stakeholders (Melbourne Business School., 2006). The general designers and constructors may have heard of sustainable buildings but may not have the knowledge and expertise to commit to building sustainability initiatives.

Hence, many have turned to the criteria specified in building sustainability rating systems as a design guide towards achieving sustainable performance despite such rating systems' intention is to evaluate the sustainable performance of buildings.

7.3.2.5 Insights from Investigation of Tenant Organizations' WTP behavior**7.3.2.5.1 Inadequacy of Building Sustainability Rating Systems as a Tool for achieving Building Sustainability**

In recent years, many countries have developed their own building sustainability systems. Regardless whether they are voluntary such as the LEED or are initiated by the government such as the Green Mark, they generally aim to promote sustainable buildings by labeling them with a “greenness” level (Kibert, 2005b; Macalusa, 2006) and hence creating awareness of sustainability issues among the building industry players. Although such sustainability rating systems are not created with the main purpose of providing design guidelines towards achieving sustainable buildings, they are often used as such nowadays (Kaatz et al., 2005; McCreadie, 2004; Raman, 2005).

The criteria stated in the rating systems are often used by the supply stakeholders, i.e. architects, engineers, building contractors, developers as the targets or standards of sustainable buildings. Hence, during the design stage, the supply stakeholders often look to these criteria as the design guidelines for achieving sustainable buildings. However, the issue that follows from this is whether the expected building sustainability benefits are actually realized. As highlighted by Environmental Building News (2005) and Raman (2005) sustainability benefits may be achieved theoretically but in practice, it may not be so.

In this research, the investigation of the tenant organizations' WTP for the VABs finds that the Green Mark award is not a significant factor of their WTP for the VABs. As mentioned, the t-test result shows that the WTP of the tenant organizations operating in Green Mark buildings is not significantly different from those operating in non Green Mark buildings. There is also no correlation between the level of Green Mark award and the WTP of the tenant organizations. Therefore, the tenant organizations operating in Green Mark awarded buildings have not experienced greater VABs than those operating in Non-Green Mark awarded buildings.

Further t-tests and regression analysis reveal instead that whether the building is managed by owners is a significant factor. Tenant organizations operating in buildings which are managed by owners themselves indicate a higher WTP for each of the VAB comparing with those operating in buildings which are not managed by owners themselves. Therefore, the results seem to suggest that the expected impact of Green Mark rating system may not have extended from design stage into the operational stage.

Figure 7-8: Building Sustainability Rating System and Tenant Organizations' WTP for VABs

Not only the findings from this research show the insignificant impact of building sustainable rating systems on realizing the expected intangible VABs, other studies have also shown the lack of effectiveness of building sustainable rating systems towards producing the tangible benefits.

One tangible benefit that is often examined is the energy consumption of the building. In Turner & Frankel (2008), 121 LEED certified buildings are studied and it shows that the average energy use intensity of these buildings is 24% less than the

national average of all the commercial building stock reported in the Commercial Building Energy Consumption Survey. However, in another similar study by Newsham et al (2009), it is found that although the 100 LEED certified commercial and institutional buildings examined consumed 18-39% less energy per floor area than their conventional counterparts, 28-35% of them actually consumed more energy than their conventional counterparts. In addition, there is no correlation between the actual energy consumption of these buildings and the certification level or the number of energy credits achieved by the building at design stage.

In Singapore, a study conducted by the researcher in 2008, about three years after the establishment of the Green Mark rating system, found that there is no significant difference in the energy and water consumption between Green Mark and Non-Green Mark office buildings. The energy and water consumption of 12 Green Mark office buildings and 14 non-Green Mark office buildings from Jul 2007 to Jun 2008 was studied. Based on age, floor area, building functions and the amount of air-conditioned space, the non-Green Mark buildings are reasonably comparable to that of the Green Mark buildings. The water consumption of the Green Mark buildings and non-Green Mark buildings are compared by normalizing the average amount of water consumed for the 12 months over the GFA, Number of Occupants and Number of Operation Hours. On average, based on per m² of the GFA and per operation hour, Green Mark buildings are consuming about 26% and 16% less water than the non-Green Mark buildings respectively. However, based on the number of occupants, each occupant in Green Mark buildings consume about 32% more water per month than an occupant in non-Green Mark buildings on average. As for the energy consumption, Green Mark buildings are in fact consuming between 11% to 86% more than non-Green Mark buildings based on the per m² of the GFA, per operation hour and per building occupant. More details regarding the study can be found in Appendix H.

Therefore, the building sustainability rating systems should be used with caution when they are used as a tool towards achieving sustainable buildings.

7.3.2.6 Proposed Solution

To improve its effectiveness, the building sustainability rating system needs to be constantly refined (Turner & Frankel, 2008). Hence, it is important to understand the effects of the sustainability criteria on the building sustainability performance (Olgyay & Herdt, 2004). Currently, although the building sustainability rating systems are widely used, there is little information about how the buildings, which have met the sustainability criteria in the rating systems, actually perform ("Looking Back and Moving Forward," 2008).

To investigate the impact of the sustainability criteria on the building sustainability performance, huge amount of data regarding the building sustainability performance would be required for monitoring and analyzing purposes. Todd & Fowler (2007) listed some of the practical considerations of measuring the performance of sustainable buildings:

- 1) The use of modeled performance for actual one
- 2) The availability of data
- 3) The feasibility or effort required to gather the data
- 4) The quality and consistency of the data
- 5) How to isolate the effects of individual buildings
- 6) What benchmarks to use for comparison

Nonetheless, Fowler et al (2005) suggested the following two sets of metrics for measuring the performance of a building which are useful:

- 1) Building and Site Characteristics
 - a. Building Specifications
 - b. Occupancy
 - c. First Costs
- 2) Building Costs and Performance Metrics
 - a. Water
 - b. Energy
 - c. Maintenance & Operations
 - d. Waste generation

- e. Purchasing
- f. Occupant Health & Productivity
- g. Transportation

In addition to improving the building sustainability rating system, the knowledge of the stakeholders regarding sustainable buildings should be enhanced. The investigation of the tenant organizations' WTP for the VABs has shown the inadequacy of the building sustainability rating systems as a tool on its own to achieve building sustainability and hence, the stakeholders relying on the rating system as a sustainable design guideline should do so with discretion. As highlighted by Kaatz et al (2006), these rating systems should not be viewed as instruments solely for producing sustainable buildings. Rather, they "offer the means potentially to enhance the quality of decision-making in the building process by incorporating the philosophy of sustainable development". Vakili-Ardebili & Boussabaine (2007) and Wedding & Crawford-Brown (2007) also agree that the building sustainability rating systems can be used to facilitate and encourage multi-stakeholder involvement at all the stages of the life of a building.

7.4 Chapter Summary

This chapter answers the last research question of how the investigation of the tenant organizations' WTP for the intangible VABs have helped to provide insights into encouraging the demand for sustainable buildings.

The barriers to the demand for sustainable buildings and towards enhancing sustainability performance are firstly identified. The investigation results are then discussed in the light of these barriers. Possible solutions are proposed. Figure 7-9 provides an overview of the barriers, investigation findings and proposed solution.

Figure 7-9: Overview of Problems Identified, Findings from the Investigation and Proposed Solutions

Chapter Eight

8 Conclusion

8.1 Summary of Research Answers

This research has investigated the tenant organizations' willingness to pay (WTP) for the value-added sustainability benefits (VABs). It is predominantly a qualitative study. Qualitative research is useful for investigating the human nature to provide insights into the nature of the social world (Morgan & Smircich, 1980). Hence, the investigation of the tenant organizations' WTP behavior has provided insights into how they attach economic values to the VABs and in turn helps to understand their demand towards sustainable buildings. There is also a quantitative aspect to this study as it uses statistical methods to identify the significant factors of the tenant organizations' WTP for the VABs.

Four research questions (RQ) are formulated to guide the research process towards achieving the research aim. The research answers found are summarized as follows.

8.1.1 RQ1: What are the VABs of sustainable buildings?

Five VABs relevant to the tenant organizations of office buildings are identified. They are:

- 1) Improved overall productivity
- 2) Enhanced organizational image
- 3) Improved ability to attract and retain staff
- 4) Improved physical and psychological health of staff
- 5) Improved comfort of staff

Figure 8-1 summarizes the process of identifying the VABs. These VABs are identified systematically from the common sustainability criteria adopted in the various building sustainability rating systems which are now widely used as a tool for achieving sustainability in buildings. These sustainability criteria are expected to produce an array of economic, environmental and social impacts which in turn results in the five VABs experienced by the tenant organizations in office buildings.

Figure 8-1: Value-Added Benefits of Sustainable Building

8.1.2 RQ2: How can the WTP of the tenant organizations for the intangible value-added benefits be captured and analyzed?

The preferences of the tenant organizations and the satisfaction derived from the VABs are likely to show up in the form of a WTP for these VABs. The WTP of the tenant organizations for the VABs is thus a reflection of the monetary value that they place upon the VABs. In order to have an understanding of how the tenant organizations’ WTP for the tenant organizations may be captured, the concept of economic valuation of which the notion of WTP falls under is reviewed.

Past research works where economic valuation techniques were applied to the field of building sustainability are reviewed. A conceptual model is developed with six groups of variables being identified as possible factors of the tenant organizations' WTP for the VABs. They include three groups of exogenous factors, i.e. Organization Characteristics, Current Premises and Building Characteristics, and three groups of endogenous factors which are the tenant organizations' Satisfaction of the benefits experienced, their Perception and Knowledge of sustainability issues, building sustainability rating systems and building impacts. Figure 8-2 summarizes the WTP variables and the six groups of factors and their hypothesized relationships. There are two types of hypothesized relationships. "Group Difference" hypothesizes a significant difference in the mean WTP of different clusters of tenant organizations grouped according to the values of a variable. "Relationship" hypothesizes a significant correlation between the WTP variable and the factor.

The conceptual model is then applied in practice to capture the tenant organizations' WTP for the VABs. A questionnaire instrument is developed based on the principles of contingent valuation method to elicit the WTP of the tenant organization and to capture the explanatory factors. Ten experts from the field of building sustainability and contingent valuation method were interviewed to assist in the development of the questionnaire. To analyze the model variables, different statistical techniques are employed according to the type of hypothesized relationships and the variable type of the factors as shown in the Figure 8-2.

Figure 8-2: Model Variables and the adopted Statistical Techniques

8.1.3 RQ 3: What are the factors affecting the tenant organizations’ WTP for the intangible value-added benefits?

The developed questionnaire is applied in a survey conducted in Singapore and a case study in Beijing to investigate the tenant organizations’ WTP for the VABs. Figure 8-3 and Figure 8-4 show the identified significant factors in two views, one according to the WTP variables and the other shows the significant and insignificant factors.

From Figure 8-3, it can be seen that the tenant organizations’ WTP for each VAB are not exactly affected by the same set of factors. Nonetheless, they exhibit some similarities. How the building is being managed during the operational stage is a common significant factor to all the WTP variables. In addition, the tenant organizations’ WTP for each benefit is affected by the thermal comfort, lighting quality, acoustic quality or air quality of the indoor environment. On the other hand, from Figure 8-4, it can be seen that some factors such as the building sustainability rating system have no relation with the tenant organizations’ WTP for the VABs.

Figure 8-3: Significant Factors of Tenant Organizations’ WTP for VABs by WTP variables view

Figure 8-4: Significant Factors of Tenant Organizations' WTP for VABs by the Exogenous and Endogenous Factors view

8.1.4 RQ 4: What insights do investigating the WTP of the tenant organizations provide towards encouraging the demand for sustainable buildings?

The investigation of the tenant organizations' WTP for the VABs has identified the significant factors and helped towards understanding the tenant organizations' WTP behavior and their demand for sustainable buildings. This understanding in turn provided insights into the current barriers for the demand stakeholders' commitment to sustainable buildings and for achieving building sustainability. The problems, insights from the investigation of tenant organizations' WTP behavior and proposed solutions are summarized in Figure 8-5.

Figure 8-5: Overview of Problems, Investigation Findings and Proposed solutions

8.2 Contributions of Research

The contributions of this research may be discussed in two aspects, i.e. contributions to the academic knowledge and contributions to the building industry.

8.2.1 Contributions to Academic Knowledge

Building sustainability is a relatively new field in the existing knowledge of buildings. This research contributes to the limited existing literature of building sustainability in the following ways:

- By highlighting the complexity surrounding the pursuit of sustainability in buildings through the discussions on the definitions of sustainable buildings
- By developing an approach towards identifying the benefits of sustainable buildings methodologically
- By consolidating the existing literature regarding the application of economic techniques on the benefits of sustainable buildings and providing an up-to-date overview of the studies conducted
- By proposing and demonstrating the application of the concept of economic valuation to the field of building sustainability
- By developing a WTP model for eliciting the tenant organizations' WTP for VABs and identifying the significant factors

8.2.2 Contributions to the Building Industry

This research has demonstrated that tenant organizations do appreciate the intangible VABs and are willing to pay for them. This signals to the supply stakeholders that it makes economic sense to design and construct sustainable buildings.

In addition, through the investigation of the tenant organizations' WTP behavior, new insights into the barriers for the demand for sustainable buildings and for achieving building sustainability are identified. These provided useful directions for the building industry to continue its sustainability efforts on how the demand for sustainable buildings may be stimulated and how the supply of sustainable buildings may be improved.

8.3 Limitations of Research

This research has significant contributions to the existing body of literature on building sustainability and to the building industry in assisting them for the market transformation of sustainable buildings. However, some limitations are present in this study.

As in any mail surveys, the respondents are usually the ones who are interested in the topic of the survey. This is also the case in this study. 62% of the respondents are Green Mark building occupants. Hence, some degree of sampling error may be present in this study.

In addition, the WTP values obtained may be contingent upon the time of the survey. Market forces play an important role in the property and rental market. The survey was conducted just before the global financial crisis in September 2008 where the market conditions were still sound.

Nevertheless, the limitations do not detract the research aim of investigating the tenant organization' WTP for the intangible VABs. Significant factors of their WTP are identified and have provided insights into the current barriers to the demand for sustainable buildings.

8.4 Recommendations for Future Research

This research has demonstrated the possible use of economic valuation technique to elicit the demand stakeholders' WTP for the intangible VABs and provided an understanding of the factors which affect how the demand stakeholders place monetary value on the VABs. Further research may focus on two areas, i.e. the application of economic valuation technique to quantify the intangible VABs and how the elicited WTP may be used for promoting building sustainability initiatives.

This research has shown the possibility of using economic valuation technique to quantify the intangible VABs. Thus, further works may continue to explore the different economic valuation techniques for quantifying the intangible VABs.

Another area for further research is the use of WTP for promoting building sustainability initiatives. As highlighted by Melbourne Business School (2006), it is crucial to document the WTP of the demand stakeholders for the acceleration of market transformation of sustainable buildings. Strong evidence and reliability of information on the demand stakeholders' WTP for sustainable buildings would establish a strong business case for the supply of sustainable buildings and encourage more players in the sustainable building market. It can be used to assist other tools such as the Cost-Benefit Analysis and Life Cycle Cost Analysis (Levett-Therivel Sustainability Consultants., 2004; Ness et al., 2007). It may also play an instrumental role in the financial model for "greening" existing buildings. Retrofitting existing buildings that were constructed without sustainability considerations to meet the sustainability criteria is always fraught with financial barriers. The inclusion of the WTP of demand stakeholders in such financial model for "greening" existing buildings could provide a possible solution.

The WTP of the building stakeholders may also be used as a measure for the sustainability performance of buildings. Many indices have been developed in past studies which attempt to measure the different facets of sustainability performance of buildings. The problem of such indices is usually the difficulty of bringing the tangible and intangible; the economic, environmental and social aspects of sustainability building performance altogether on a common platform. The WTP benefit measure in monetary terms could be a possible solution of bringing the different dimensions of sustainability performance together and providing effective common-language communication to the diverse stakeholders.

Lastly, the above suggested uses of WTP could be complemented with regulatory measures to promote building sustainability. Regulatory measures could adopt a carrot or stick approach and are more effective in "rewarding" the stakeholders who adopt sustainability or in "punishing" the stakeholders who do not.

In conclusion, this research has investigated the tenant organizations' WTP for the intangible VABs based on the concept of economic valuation and provided a foundation for further works on the application of economic valuation in the field of building sustainability.

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Appendix A
WTP Survey Questionnaire to Tenant Organizations

***Appendix A: Survey Questionnaire for Eliciting
Tenant Organizations' WTP for the
VABs***

Survey on Tenant Organizations' Willingness To Pay for the Intangible Value-added Benefits of Sustainable Buildings

Dear Sir/ Mdm,

This survey is part of a doctoral research on assessing the benefits enjoyed by building occupants of both 'sustainable' and 'non-sustainable' buildings. The aims of this survey are twofold:

1. To elicit a monetary value placed on these benefits by building users
2. To identify and investigate the factors affecting this value

Please rest assured that the information obtained will be solely used for research purpose towards achieving the goals of building sustainability. Individual responses will be kept strictly confidential and the findings will be reported collectively. A report on the survey results will be provided at the end of the study.

There are four sections in this questionnaire

- A) About your organization
- B) About your current premises
- C) About the value-added benefits that your organization has experienced from the current premises
- D) About your organization's perception and knowledge of sustainable buildings, the Green Mark assessment system and the impact of building on its occupants

This questionnaire should be filled up by personnel in your organization who oversees the **overall operation** of your organization and is familiar with the **property requirements** of your organization. The questionnaire is expected to take no more than **30min** to complete.

Your kind participation is important for the success of this study and is very much appreciated. Please kindly complete the questionnaire and return it by **XXX** using the self-address envelope enclosed.

For more information, please do not hesitate to contact me or my supervisor, A/P Robert Tiong:

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(A) General Information

1) Respondent

Name:

Designation:

Email:

Contact No:

2) Organization

Name:

Address:

(B) About Your Organization

1. What type of business is your organization involved in?

- ☐ Construction ☐ Finance ☐ Legal ☐ Others,
☐ Education ☐ Information ☐ Manufacturing Please specify
 Technology

2. What is your company type?

- ☐ Private ☐ Public ☐ Quasi-
 government ☐ Others,
 Please specify

3. Is your organization a multi-national corporation?

- ☐ No ☐ Yes, please specify the city in which the headquarter is
 located

4. How long has your organization been established?

- ☐ Less than 1 year
☐ More than 1 year but less than 5 years
☐ More than 5 years but less than 10 years
☐ More than 10 years but less than 15 years
☐ More than 15 years

5. How many staffs are working at the address which you've stated in (A) General Information?

- ☐ Less than 10
☐ More than 10 but less than 30
☐ More than 30 but less than 50
☐ More than 50. Please specify:

6. How much time do your staff approximately spend in the office?

- ☐ Less than 10% of their working hours
☐ More than 10% but less than 30% of their working hours
☐ More than 30% but less than 50% of their working hours
☐ More than 50% but less than 80% of their working hours
☐ More than 80% but less than 100% of their working hours
☐ 100% of their working hours

(C) About Your Current Premises

1. How long has your organization been operating in the current premises?

- ☐ Less than 1 year
☐ More than 1 year but less than 5 years
☐ More than 5 years but less than 10 years
☐ More than 10 years but less than 15 years
☐ More than 15 years

2. What is the total floor area occupied by your organization?

m² or ft²

3. Is your premises air-conditioned?

- ☐ No ☐ Yes

4. i) What is the length of your current lease? years

ii) When does your current lease expire? Year

5. How much is your current rental fee per month? S\$ per month

6. What is your lease type?

- ☐ Gross: The tenant pays a flat rental amount and the landlord pays for all property charges regularly incurred by the ownership
- ☐ Net: Requires the tenant to pay, in addition to the fixed rent, some or all of the property expenses which normally would be paid by the landlord. These include expenses such as real estate taxes, insurance, maintenance, repairs, utilities and other items
- ☐ Others, Please specify:

(D) About the Benefits your organization has enjoyed from operating in the current premises

1. Based on the following scale, how would you rate your organization’s satisfaction of the benefits that your organization has experienced from operating in the current premises?

No such benefits experienced	Benefits Experienced				
	Somewhat Satisfied	Quite Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
0	1	2	3	4	5

	0	1	2	3	4	5
1. Increase in Overall Productivity						
(i) Decrease in absenteeism of staff	☐	☐	☐	☐	☐	☐
(ii) Improved interactive behaviors & communication which results in better information flow & collaborative work	☐	☐	☐	☐	☐	☐
(iii) Improved product quality and timeliness of output	☐	☐	☐	☐	☐	☐
(iv) Increased innovation	☐	☐	☐	☐	☐	☐
• Overall Satisfaction	☐	☐	☐	☐	☐	☐
2. Enhanced Organizational Image						
(i) Improved image as a socially responsible company	☐	☐	☐	☐	☐	☐
(ii) Improved image resulting in new and/or more business opportunities	☐	☐	☐	☐	☐	☐
• Overall Satisfaction	☐	☐	☐	☐	☐	☐
3. Improved Ability to Attract and Retain staff						
(i) Reduced turnover rates of staff	☐	☐	☐	☐	☐	☐
(ii) Ease of attracting high-calibre staff	☐	☐	☐	☐	☐	☐
• Overall Satisfaction	☐	☐	☐	☐	☐	☐
4. Improved Physical and Psychological Health of Staff						
(i) Improved physical health of staff due to decrease in ‘Sick Building’ related illnesses	☐	☐	☐	☐	☐	☐
(ii) Improved psychological health of staff due to a more positive working environment, such as a sense of pride in the values conveyed by your organization	☐	☐	☐	☐	☐	☐
• Overall Satisfaction	☐	☐	☐	☐	☐	☐

Appendix A
WTP Survey Questionnaire to Tenant Organizations

	0	1	2	3	4	5
5. Improved Comfort and Satisfaction of Staff						
(i) Improved satisfaction level of staff with regards to thermal comfort	☐	☐	☐	☐	☐	☐
(ii) Improved satisfaction level of staff with regards to lighting quality	☐	☐	☐	☐	☐	☐
(iii) Improved satisfaction level of staff with regards to acoustic quality	☐	☐	☐	☐	☐	☐
(iv) Improved satisfaction level of staff with regards to air quality	☐	☐	☐	☐	☐	☐
• Overall Satisfaction	☐	☐	☐	☐	☐	☐

2. Assume that your current rental fee has not taken into consideration of the benefits stated in the previous question, how much *more* are you willing to pay on top of your current monthly rental fee in order to continue enjoying the same benefits at the same level of satisfaction?

Please state this additional amount that you are willing to pay as a percentage of your current monthly rental fee. Do remember you have a budget to stick to.

- % more on top of current rent for Increase in Overall Productivity
- % more on top of current rent for Improved Ability to Attract & Retain Staff
- % more on top of current rent for Enhanced Organizational Image
- % more on top of current rent for Improved Health of Staff
- % more on top of current rent for Improved Comfort of Staff

Total = % more on top of your current monthly rent for all the benefits experienced

(Please sum up all of the above percentages. The purpose of the summation is to highlight how much you have indicated that you are willing to pay more for the benefits in total. This is to assist you to check if you have indicated a realistic willingness to pay amount)

(E) About your organization’s Perception and Knowledge of Sustainable Buildings, the Green Mark Rating System and the Impact of Building on its Occupants

Please rate the importance of the following items or issues to your organization on a scale of 1 to 5, where

Unimportant at all	Unimportant	Undecided	Important	Very Important	Not Applicable because have not heard of it
1	2	3	4	5	N.A.

	1	2	3	4	5	NA
1. How important is the building premises towards the achievement of your organisation’s mission?	☐	☐	☐	☐	☐	
2. How important are the following to your organization when considering a place for operation of your businesses?						
(i) Whether the building is able to produce <u>any benefits</u> for your organization	☐	☐	☐	☐	☐	
(ii) Whether the building has obtained the <u>Green Mark certification</u>	☐	☐	☐	☐	☐	☐
(iii) What <u>level of certification</u> (i.e. Platinum, Gold Plus, Gold, Certified) has the building obtained	☐	☐	☐	☐	☐	☐

Appendix A
WTP Survey Questionnaire to Tenant Organizations

Please rate the extent of your agreement with the following claims on a scale of 1 to 5, where

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

	1	2	3	4	5
3. It is claimed that sustainable buildings bring about the following benefits to the organizations operating in them. How much do you agree?					
(i) Reduction in operational costs, such as electricity costs, water costs, etc	☐	☐	☐	☐	☐
(ii) Reduction in remodeling costs, such as renovation, relocation of equipment,etc	☐	☐	☐	☐	☐
(iii) Reduction in health costs, such as medical claims by staff, etc	☐	☐	☐	☐	☐
(iv) Reduction in insurance costs, such as property insurance, etc	☐	☐	☐	☐	☐
(v) Increase in overall productivity					
(vi) Enhanced organizational image	☐	☐	☐	☐	☐
(vii) Improved ability to attract and retain staff	☐	☐	☐	☐	☐
(viii) Improved physical and psychological health of staff	☐	☐	☐	☐	☐
(ix) Increase in comfort and satisfaction of staff	☐	☐	☐	☐	☐

Please state whether you think the following statements are true or false, where

True	False	Don't Know
T	F	DK

	T	F	DK
4. Do you think the following statements regarding sustainability are true or false?			
(i) Sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own need	☐	☐	☐
(ii) Sustainability is achieved as long as its negative impacts on the environment are addressed	☐	☐	☐
(iii) A building has three types of impacts, i.e. environmental, economic and social	☐	☐	☐
(iv) An energy-efficient building is a sustainable building	☐	☐	☐
5. Do you think the following statements regarding the Green Mark assessment system are true or false?			
(i) The Green Mark assessment system initiated by the Building and Construction Authority, is a green building rating system	☐	☐	☐
(ii) The Green Mark assessment system is applicable to new buildings only	☐	☐	☐
(iii) One of the criteria of the Green Mark assessment system aims to improve the indoor environment quality of a building	☐	☐	☐
6. Do you think the following statements regarding the impact of a building on its occupants are true or false?			
(i) Natural lighting and access to external views are distractions to the building occupants	☐	☐	☐
(ii) The ability to have personal control over temperature, noise, air movement and lighting is likely to improve the productivity of a worker	☐	☐	☐
(iii) The floor layout affects remodeling costs	☐	☐	☐

End of Survey. Thank you!

Appendix B
Questionnaire to Experts

Appendix B: Questionnaire for Interviewing Experts

**Assessing the Content Validity of a Questionnaire for Eliciting
Organizations' Willingness To Pay for the Intangible Sustainability
Benefits of Office Buildings**

Dear Sir/ Mdm,

I would like to seek your expert opinion on the content validity of a questionnaire which is designed for the purpose of my doctoral research on investigating the organizations' willingness to pay (WTP) for the intangible value-added benefits of sustainable buildings in Singapore. This questionnaire is developed based on the principles of the contingent valuation method to elicit the WTP of organizations and the explanatory factors.

I would like to seek your opinions in three aspects:

- 1) Does the questionnaire allow respondents to answer meaningfully?
I.e. whether the information provided in the questionnaire is sufficient and reasonable for respondents to make informed decisions on their WTP for the benefits enjoyed
- 2) Does the questionnaire encourage respondents to answer honestly?
I.e. whether the design of the questionnaire encourages respondents to reveal their intended WTP for the benefits enjoyed
- 3) Does the questionnaire ask appropriate and sufficient explanatory variables to explain the attitude and behavior of the respondents on their stated WTP?

Please follow the instructions in red and also refer to the questionnaire attached. It is expected that the whole content validity assessment takes about **50 min** to complete. Kindly return the completed assessment to leey0057@ntu.edu.sg by **XXX**.

Your kind participation is important for the success of this study and is very much appreciated. Please leave your contact details if you would like to receive a report of the survey findings. For more information, please do not hesitate to contact me or my supervisor, A/P Robert Tiong:

Ms. Irene Lee
PhD Candidate
School of Civil & Environmental Engineering
Nanyang Technological University
Tel: 6790 6037
Email: leey0057@ntu.edu.sg

Dr. Robert Tiong
Associate Professor
School of Civil & Environmental Engineering
Nanyang Technological University
Email: clktiong@ntu.edu.sg

Please provide some information about yourself:

General Information

1. About Yourself

Name:

Designation:

Organization:

2. How familiar are you with Contingent Valuation studies?

☐	☐	☐	☐
0	1	2	3
Unfamiliar	Fairly familiar	Familiar	Very familiar

3. How familiar are you with Building Sustainability issues?

☐	☐	☐	☐
0	1	2	3
Unfamiliar	Fairly familiar	Familiar	Very familiar

In the following questions, please indicate to what extent you agree with the statements on a scale of 1 to 5, where

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Please read the COVER PAGE on Page 1 of the questionnaire and answer the following questions

About the Cover Page

On the cover page, besides explaining the purpose of the survey, the respondents are assured that their participation and responses will be kept confidential. The respondents are also instructed to send their completed questionnaires to the researcher directly.

With regards to the issue "Does the questionnaire encourage respondents to answer honestly?", how much do you agree with the following statements?

1. The assurance on the confidentiality of the respondents' participation encourages the respondents to reveal their intended WTP for the benefits enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
2. By returning the completed questionnaire directly to the researcher encourages the respondents to reveal their intended WTP for the benefits enjoye	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
3. Comments on this section:	

Please read the SECTION B on Page 2 of the questionnaire and answer the following questions:

About Section B

The purpose of Section B is to investigate organizations' characteristics as a factor to the attitude and behavior of the organizations on their stated WTP.

With regards to the issue "Does the questionnaire ask appropriate and sufficient variables to explain the attitude and behavior of the respondents on their stated WTP?", how much do you agree with the following statements?

1. The questions in Section A are appropriate for capturing the characteristics of organizations	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
--	---

Appendix B
Questionnaire to Experts

2. The characteristics of organizations is an appropriate factor for analyzing the attitude and behavior of organizations towards their WTP for the benefits enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
3. Comments on this section:	

Please read the SECTION C on Page 3 of the questionnaire and answer the following questions:

About Section C

The purpose of Section B is to investigate the current premises which the organizations are operating from as a factor to their attitude and behavior towards their stated WTP.

With regards to the issue "Does the questionnaire ask appropriate and sufficient variables to explain the attitudes and behaviors of the respondents on their stated WTP?", how much do you agree with the following statements?

1. The questions in Section C are appropriate for capturing the conditions of the current premises	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
2. The current premises which the organizations are operating from is an appropriate factor for analyzing their attitude and behavior towards their WTP for the benefits enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
Comments on this section:	

Please read the SECTION D on Page 4 of the questionnaire and answer the following questions:

About Section D

In Q1 of Section D, the value-added benefits that may be enjoyed by organizations operating in sustainable buildings are described. The purpose of the descriptions is to allow for a meaningful elicitation of organizations' WTP for them later on.

With regards to the issue "Does the questionnaire allow respondents to answer meaningfully?", how much do you agree with the following statements?

1. The description of the Value Added benefits is clear to the respondents such that they are able to identify whether such benefits have been experienced	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
2. The assumptions are clear to respondents such that they are able to answer the elicitation question seriously and thoughtfully	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
3. The assumptions are plausible and reasonable to respondents such that they are able to answer the elicitation question seriously and thoughtfully	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
4. The consequence of non-payment for the benefits, i.e. being not able to enjoy the same benefits at the same level, is clear to respondents such that they are able to answer the elicitation question seriously and thoughtfully	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
5. The elicitation question is clear to respondents such that they are able to answer it seriously and thoughtfully	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
6. Expressing the amount of WTP as a percentage of the organizations' current rental fee is reasonable	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
7. Expressing the amount of WTP as a percentage of the organizations' current rental fee is more likely to yield a valid estimate of their WTP as compared to expressing the WTP amount in absolute numbers	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
8. The reminder "Do remember you have a budget to stick to" is helpful to respondents to state a realistic WTP	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
9. The summation of the stated percentages is helpful to respondents to state a realistic WTP	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
Comments on this section:	

Please read the SECTION E on Page 5 of the questionnaire and answer the following questions:

About Section E

The purpose of Section E is to investigate the organizations’ perception and knowledge of the following as factors for the stated WTPs:

- a. Impact of building on building occupants (Questions 1, 2i, 7)
- b. Green Mark scheme (Questions 2ii, 2iii, 6)
- c. Sustainable buildings (Questions 4, 5)

With regards to the issue "Does the questionnaire ask appropriate and sufficient variables to explain the attitudes and behaviors of the respondents on their stated WTP?", how much do you agree with the following statements?

1. Question 1 and 2(i) are appropriate for capturing the organizations’ perception of the impact of building on its occupants	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
2. Question 2(ii) and 2(iii) are appropriate for capturing the organizations’ perception of the effectiveness of Green Mark towards contributing to the indoor environment quality	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
3. Question 3 is appropriate for capturing the organizations’ level of corporate social responsibility	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
4. Question 4 is appropriate for capturing the organizations’ perception of sustainable buildings	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
5. Question 5 are appropriate for capturing the organizations’ knowledge of sustainable buildings	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
6. Question 6 are appropriate for capturing the organizations’ knowledge of Green Mark	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
7. Question 7 are appropriate for capturing the organizations’ knowledge of the impact of building on its occupants	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐

Appendix B
Questionnaire to Experts

8. The perception of organizations on sustainable buildings is an appropriate factor for analyzing their attitudes and behaviors towards their WTP for the benefit enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
9. The perception of organizations on Green Mark is an appropriate factor for analyzing their attitudes behaviors towards their WTP for the benefit enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
10. The perception of organizations on the impact of building on building occupants is an appropriate factor for analyzing their attitudes and behaviors towards their WTP for the benefits enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
11. The knowledge of organizations on sustainable buildings is an appropriate factor for analyzing their attitudes and behaviors towards their WTP for the benefit enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
12. The knowledge of organizations on Green Mark is an appropriate factor for analyzing their attitudes behaviors towards their WTP for the benefit enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
13. The knowledge of organizations on the impact of building on building occupants is an appropriate factor for analyzing their attitudes and behaviors towards their WTP for the benefits enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
14. Comments on this section:	

Please answer the following questions on the overall assessment of the questionnaire:

Overall Assessment

Issue 1: Does the questionnaire allow respondents to answer meaningfully?

The overall aim of this research work is to investigate the WTP of the organizations operating in office buildings for the intangible sustainability benefits. Thus, the purpose of the questionnaire is to elicit their WTP for the benefits. It is believed that organization’s WTP is affected by the usefulness of the benefits and the usefulness of the benefits is in turn, dependent upon the organizations’ preferences and the performance of the buildings.

Appendix B
Questionnaire to Experts

With regard to the above issue, how much do you agree with the following statements?

1. The stated WTP in the questionnaire reflects the usefulness of the benefits enjoyed by organizations from operating in their current premises	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
2. The stated WTP in the questionnaire reflects the preferences of the organizations on the sustainability benefits	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
3. The stated WTP in the questionnaire reflects the performance of the buildings	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
4. The stated WTP in the questionnaire reflects the monetary value of the benefits of the buildings	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
5. Comments on this section:	

Issue 2: Does the questionnaire encourage respondents to answer honestly?

When eliciting the amount organizations are WTP for the benefits they have experienced, not all organizations will disclose their true intended WTP. One of the reasons may be the fear of an increase in the rental fees should they indicate a WTP more on top of their current rental fees.

With regard to the above issue, how much do you agree with the following statement?

1. The questionnaire is carried out for research purposes. Hence, there will be minimum strategic behavior of the respondents, i.e. behavior of not revealing their true intended WTP for the benefits enjoyed	1 2 3 4 5 ☐ ☐ ☐ ☐ ☐
2. Comments on this section:	

Appendix B
Questionnaire to Experts

Issue 3: Does the questionnaire ask appropriate and sufficient variables to explain the attitude and behavior of the respondents on their stated WTP?

The variables explored in the questionnaire include:

- a. Characteristics of organizations
- b. Current premises which the organizations are operating from
- c. Perception and knowledge of organizations on:
 - i. Sustainable buildings
 - ii. Green Mark
 - iii. Impact of building on occupants

With regard to the above issue, how much do you agree with the following statement?

1. The variables explored in the questionnaire are sufficient for analyzing the attitude and behavior of the organizations towards their WTP for the benefits enjoyed	1	2	3	4	5
	☐	☐	☐	☐	☐
2. Comments on this section:					

The End. Thank You.

Appendix C
Building Characteristics Survey to Building Owners

***Appendix C: Building Characteristics Survey
Questionnaire to Building Owners***

Survey on Green Building Features in Singapore

Dear Sir/Mdm,

This survey aims to obtain information about the key green building features commonly adopted by the office buildings in Singapore.

This questionnaire is expected to take no more than **10 min** to complete. Upon completion, please kindly save the file and email to leey0057@ntu.edu.sg by **XXX**.

Please rest assured that all information obtained will be kept in the strictest confidence. Your kind participation is very much appreciated. For further clarifications, please do not hesitate to contact me or my supervisor. Thank you.

Ms Irene Lee
PhD Candidate
Email: leey0057@ntu.edu.sg
Mobile: 81184643

Dr Robert Tiong
Associate Professor
Email: clktiong@ntu.edu.sg

(I) General Information		
Name of Respondent:		
Name of Building:		
Would you like to receive the results of this survey? Yes ☐ No ☐		

(II) Building Information		
Gross Floor Area (m ²):		
Year when building was first occupied:		
Year of last major renovation:		
Building is managed by in-house FM team: Yes ☐ No ☐		

Please indicate whether the following green building features are being implemented at your building. (Yes - Y; No - N)

(III) Energy Efficiency	Y	N
Building envelope is designed to minimise heat gain	☐	☐
Energy efficient air-conditioned equipment, such as chillers, cooling towers, air handling units, fan coil units, etc	☐	☐
Building is carefully oriented to minimise heat gain	☐	☐
Sun shading devices are attached to building envelope to minimise heat gain	☐	☐
Building is designed to achieve good natural ventilation	☐	☐
Use of energy efficient lightings	☐	☐
Energy efficient design and control of ventilation systems in carparks	☐	☐
Energy efficient design and control of ventilation systems in common areas	☐	☐
Use of energy efficient lifts and escalators	☐	☐
Use of renewable energy sources in building	☐	☐

Appendix C
Building Characteristics Survey to Building Owners

Other energy efficient practices and features, please specify:		
(IV) Water Efficiency	Y	N
Use of water efficient fittings which are certified under the Water Efficiency Labeling Scheme	☐	☐
Use of water sub-metering and leak detection system	☐	☐
Utilization of rainwater or recycled water for landscape irrigation	☐	☐
Reduction of water consumption for cooling purpose	☐	☐
Use of grey water recycling system	☐	☐
Recycling of AHU condensate	☐	☐
Use of siphonic rainwater discharge system at roof	☐	☐
Provision of system to recycle surface runoff from the vertical green wall and sky garden	☐	☐
Other water efficient practices and features, please specify:		
(V) Environmental Protection	Y	N
Use of environmental friendly products that are certified under the Singapore Green Labeling Scheme	☐	☐
Use of products with at least 30% recycled content	☐	☐
Use of greenery and restoration of existing trees to reduce heat island effects	☐	☐
Provision of green roof and roof top garden	☐	☐
Provision of vertical greening	☐	☐
Implementation of environmental friendly programs, e.g. monitoring and setting targets to minimise energy use, water use and construction waste	☐	☐
Provision of building users' guide including details of the environmental friendly facilities and features within the building	☐	☐
Public transport such as MRT stations or bus stops are within 500m from building	☐	☐
Provision of adequate bicycle parking lots	☐	☐
Use of refrigerants with ozone depleting potential (ODP) of zero or with global warming potential (GWP) of less than 100	☐	☐
Use of refrigerant leak detection system at critical areas of plant rooms containing chillers and other equipments with refrigerants	☐	☐
Use of non-chemical water treatment for cooling tower	☐	☐
Other environmental protection practice and features, please specify:		
(VI) Indoor Environmental Quality	Y	N
Air-conditioning systems are designed to allow for cooling load variations due to fluctuations in ambient air temperature to ensure consistent indoor conditions	☐	☐
Use of ultraviolet light-C band emitters in all AHUs to improve indoor air quality	☐	☐
Occupied spaces in the buildings are designed with the recommended ambient sound levels stated in SS CP13	☐	☐

Appendix C
Building Characteristics Survey to Building Owners

Use of low volatile organic compounds paints certified under the Singapore Green Labelling Scheme for at least 90% of the internal wall areas	☐	☐
Use of adhesives certified under the Singapore Green Labelling Scheme in all composite wood products used for the development	☐	☐
Use of high frequency ballasts in at least 90% of the applicable areas that are served by fluorescent luminaries	☐	☐
Other practice and features for ensuring indoor environmental quality, please specify:		
(VII) Other Green Features		
	Y	N
Use of self cleaning façade system	☐	☐
Provision of double refuse chutes for separating recyclable from non-recyclable waste	☐	☐
Provision of at least 5 number of compost bins to recycle organic waste	☐	☐
Use of titanium dioxide solutions to remove odour in toilets	☐	☐
Use of pneumatic waste collection system	☐	☐
Other green building practices and features, please specify:		

End of Survey. Thank You.

Appendix D
WTP Survey Questionnaire to Tenant Organizations (Case Study)

***Appendix D: Survey Questionnaire for Eliciting
Tenant Organizations' WTP for the
VABs (Case Study)***

Appendix D

WTP Survey Questionnaire to Tenant Organizations (Case Study)

Please fill in the grey fields or check the boxes. Upon completion, please kindly email the completed questionnaire to Irene Lee at leey0057@ntu.edu.sg. Thank you.

(A) General Information

1. **Name of Organisation**

2. **Name of Respondent**

3. **Designation of Respondent**

4. **Email of Respondent**

(B) About Your Organization

1. **What type of business is your organization involved in?**

☐ Education	☐ Finance	☐ Information Technology
☐ Real Estate	☐ Legal	☐ Others, please specify:
☐ Construction	☐ Manufacturing	

2. **What is your company type?**

☐ Private	☐ Others, please specify:
☐ Public	
☐ Quasi-government	

3. **Is your organization a multi-national corporation?**

☐ No
☐ Yes, please specify the city in which the headquarters is located:

4. **How long has your organization been established?**
Number of years:

5. **What is the mission of your organization?**

6. **How many of your staff are working at the Building?**
Number of Staff:

Appendix D

WTP Survey Questionnaire to Tenant Organizations (Case Study)

- 7. How much time does the majority of your staff approximately spend in the office?**
- ☐ Less than 10% of their working hours
 - ☐ More than 10% but less than 30% of their working hours
 - ☐ More than 30% but less than 50% of their working hours
 - ☐ More than 50% but less than 80% of their working hours
 - ☐ More than 80% but less than 100% of their working hours
 - ☐ 100% of their working hours
- 8. Which of the following best describes your purpose for moving into the Building?**
- ☐ Relocation of organization, i.e. moving out from another building into the Building with about the same size of workforce
 - ☐ Streamline of organization, i.e. moving out from another building into the Building with a reduced workforce
 - ☐ Expansion of organization, i.e. moving out from another building into the Building with an increased workforce
 - ☐ Setting up new organizational functions, i.e. not moving out from another building and setting up new office in the Building
 - ☐ Setting up a new office in Beijing, i.e. had no office in Beijing before
 - ☐ Others, please specify:
- 9. What is your reason for moving into the Building? (You may choose more than one)**
- ☐ It is a LEED Gold awarded building
 - ☐ Its location is convenient
 - ☐ It is located in the CBD
 - ☐ It will enhance my organization's image as it is a green building
 - ☐ It will enhance my organization's image as it is a Grade A high-end office building
 - ☐ It will improve my organization's ability to attract and retain staff
 - ☐ It will improve the comfort and satisfaction of my staff
 - ☐ It will improve the physical and psychological health of my staff
 - ☐ It will improve the productivity of my staff
 - ☐ It will reduce my operational (variable) costs
 - ☐ Others, please specify:

(C) About the Benefits your organization has enjoyed from operating in the current premises

1. Based on the following scale, how satisfied are you with the benefits that your organization has experienced from operating in the current premises?

No such benefits experienced	Benefits Experienced				
	Somewhat Satisfied	Quite Satisfied	Satisfied	Very Satisfied	Extremely Satisfied
0	1	2	3	4	5

	0	1	2	3	4	5
a. Increase in Overall Productivity						
(i) Decrease in absenteeism of staff	☐	☐	☐	☐	☐	☐
(ii) Improved interactive behaviours & communication which results in better information flow & collaborative work	☐	☐	☐	☐	☐	☐
(iii) Improved product quality and timeliness of output	☐	☐	☐	☐	☐	☐
(iv) Increased innovation	☐	☐	☐	☐	☐	☐
Overall Satisfaction	☐	☐	☐	☐	☐	☐
b. Enhanced Organisational Image						
(i) Improved image as a socially responsible company	☐	☐	☐	☐	☐	☐
(ii) Improved image resulting in new and/or more business opportunities	☐	☐	☐	☐	☐	☐
Overall Satisfaction	☐	☐	☐	☐	☐	☐
c. Improved Ability to Attract and Retain staff						
(i) Reduced turnover rates of staff	☐	☐	☐	☐	☐	☐
(ii) Ease of attracting high-calibre staff	☐	☐	☐	☐	☐	☐
Overall Satisfaction	☐	☐	☐	☐	☐	☐
d. Improved Physical and Psychological Health of Staff						
(i) Improved physical health of staff due to decrease in 'Sick Building' related illnesses	☐	☐	☐	☐	☐	☐
(ii) Improved psychological health of staff due to a more positive working environment, such as a sense of pride in the values conveyed by your organization	☐	☐	☐	☐	☐	☐
Overall Satisfaction	☐	☐	☐	☐	☐	☐
e. Improved Comfort and Satisfaction of Staff						
(i) Improved satisfaction level of staff regarding thermal comfort	☐	☐	☐	☐	☐	☐
(ii) Improved satisfaction level of staff regarding lighting quality	☐	☐	☐	☐	☐	☐
(iii) Improved satisfaction level of staff regarding acoustic quality	☐	☐	☐	☐	☐	☐
(iv) Improved satisfaction level of staff regarding air quality	☐	☐	☐	☐	☐	☐
(v) Improved satisfaction level of staff regarding the access to external views	☐	☐	☐	☐	☐	☐
Overall Satisfaction	☐	☐	☐	☐	☐	☐

Appendix D

WTP Survey Questionnaire to Tenant Organizations (Case Study)

2. How would you allocate your rental fee according to the following, i.e. what benefits do you think you are paying for and how much? (Total should add up to 100%)

Increase in overall productivity -----	%
Enhanced organizational image -----	%
Improved ability to attract and retain staff -----	%
Improved physical and psychological health of staff -----	%
Improved comfort and satisfaction of staff -----	%
Low operational costs -----	%
Strategic location -----	%
Prestige image -----	%
Property services provided, such as cleaning, maintenance, etc --	%
Others, please specify: -----	%
Others, please specify: -----	%
Others, please specify: -----	%

Total =	<u>100%</u>
---------	-------------

Appendix D
WTP Survey Questionnaire to Tenant Organizations (Case Study)

(D) About your organisation’s Perception and Knowledge of Sustainable Buildings, the LEED rating system and the Impact of Building on its Occupants

1. Please rate the importance of the following items or issues to your organisation on a scale of 1 to 5, where

Unimportant at all	Unimportant	Undecided	Important	Very Important	Not Applicable because have not heard of it
1	2	3	4	5	N.A.

	1	2	3	4	5	NA
a. How important is the building premises towards the achievement of your organisation’s mission?	☐	☐	☐	☐	☐	
b. How important are the following to your organization when considering a place for operation of your businesses?						
(i) Whether the building is able to produce <u>any benefits</u> for your organization	☐	☐	☐	☐	☐	
(ii) Whether the building has obtained the <u>any Green Building certification</u>	☐	☐	☐	☐	☐	☐
(iii) What <u>level of certification</u> (i.e. Platinum, Gold Plus, Gold, Certified) has the building obtained	☐	☐	☐	☐	☐	☐

2. Please rate the extent of your agreement with the following claims on a scale of 1 to 5, where

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

	1	2	3	4	5
a. It is claimed that sustainable buildings bring about the following benefits to the organizations operating in them. How much do you agree?					
(i) Reduction in operational costs, such as electricity costs, water costs, etc	☐	☐	☐	☐	☐
(ii) Reduction in remodeling costs, such as renovation, relocation of equipment, etc	☐	☐	☐	☐	☐
(iii) Reduction in health costs, such as medical claims by staff, etc	☐	☐	☐	☐	☐
(iv) Reduction in insurance costs, such as property insurance, etc	☐	☐	☐	☐	☐
(v) Increase in overall productivity	☐	☐	☐	☐	☐
(vi) Enhanced organizational image	☐	☐	☐	☐	☐
(vii) Improved ability to attract and retain staff	☐	☐	☐	☐	☐
(viii) Improved physical and psychological health of staff	☐	☐	☐	☐	☐
(ix) Increase in comfort and satisfaction of staff	☐	☐	☐	☐	☐

Appendix D
WTP Survey Questionnaire to Tenant Organizations (Case Study)

3. Please state whether the following statements are true or false, where

True	False	Don't Know
T	F	DK

	T	F	DK
a. Do you think the following statements regarding sustainability are true or false?			
(i) Sustainable development meets the needs of the present generation without compromising the ability of future generations to meet their own need	☐	☐	☐
(ii) Sustainability is achieved as long as its negative impacts on the environment are addressed	☐	☐	☐
(iii) A building has three types of impacts, i.e. environmental, economic and social	☐	☐	☐
(iv) An energy-efficient building is a sustainable building	☐	☐	☐
b. Do you think the following statements regarding the US' Leadership in Energy and Environmental Design (LEED) Green Building Rating System are true or false?			
(i) The highest award is Gold	☐	☐	☐
(ii) LEED is applicable to new buildings only	☐	☐	☐
(iii) One of the criteria of LEED aims to improve the indoor environment quality of a building	☐	☐	☐
c. Do you think the following statements regarding the impact of a building on its occupants are true or false?			
(i) Natural lighting and access to external views are distractions to the building occupants	☐	☐	☐
(ii) The ability to have personal control over temperature, noise, air movement and lighting is likely to improve the productivity of a worker	☐	☐	☐
(iii) The floor layout affects remodeling costs	☐	☐	☐

End of Survey. Thank you!

Kindly email the completed questionnaire to leey0057@ntu.edu.sg